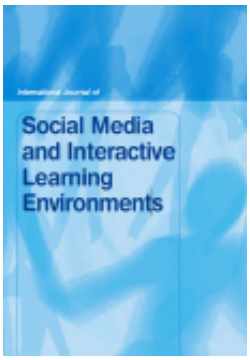

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Time and tide wait for no student: what adolescents spend time online and social networks affect their academic performance

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Time and tide wait for no student: what adolescents spend time online and social networks affect their academic performance

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Abstract: The current generation of students grow up in the age of technology. They are exposed to a plethora of devices that allow them to stay connected at all times. The impact and adverse consequences of the overuse of social media on school performance are well documented in the literature. Drawing from the recently available data from the study on social and emotional skills, this paper explored the relationships between the time spent on the internet and online activities and academic performance among students. The data from OECD's survey on social and emotional skills that involves a sample of 60,498 students from ten cities across nine countries is used in the study. The results revealed that mathematics, language, and arts grades were positively related to reading activities. However, internet and online activities were negatively associated with performance grades. This study suggested that teachers and parents guide the students to manage time efficiently and to minimise distractions brought about by online and social networks.

Keywords: social and emotional skills; 21st century skills; social media; screen time; achievement; internet; online games; online chat; social network.

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1 Introduction

Students spend a considerable amount of time learning and doing their tasks and assignments in class and after-school homework. They must also have leisure activities and time for exercise, adjusting between work and play. Teachers expect their students to equip with computers and communication technology skills and competent with information literacy to perform them competitively in the 21st century workforce. They are also concerned with the adverse effects of overuse. Studies show that some students are excessively consumed with online activities with their mobile and handheld devices in today's interconnected world. Too much screen time can harm health and academic achievement. Meaningful and moderate engagement with technology and time management is crucial for every student in using the available time efficiently and balancing a healthy life.

Time utilisation and time management have always been a secret catalyst for students' academic success and fulfilling life experience. Reasonably arranging schedules, rationally balancing study-leisure conflicts, and effectively carrying out time plan, all serve as a great advantage for students to excel. Linking the elementary level and tertiary level education, secondary education has always been considered as a crucial transitional learning phase. From classroom learning to cultivating hobbies and interests, from academic excellence to all-around development of personalities, how time is used efficiently and whether time management is appropriate, to a certain extent, determines the continual progress of a student. At the same time, time management in the interconnected era derives series of questions about student time management. Based on this background, it is vital for educational researchers, practitioners, and policymakers to

re-examine students' time management capabilities and how it is associated with other key determinants of students' academic achievement.

2 Review of the literature

When children grow up from childhood to adolescence, the amount of time spent with their parents and siblings reduces, and the amount of time on their (schoolwork) increases. They also spend more time with their friends and schoolmates (Berk, 2019). Technological development in recent decades has increased young people engaging with the internet and mobile devices to connect with each other. Digital devices, mobile, and social media have become an indispensable part of everyday life for people of all ages worldwide. According to the ITU (2020) report, at the end of 2019, half of the world population was using the internet, and many of them are from the young generation. UNICEF (2017) described that children and adolescents under 18 years account for an estimated one in three internet users around the world. Capitalising on the affordances of technology, teachers use instructional technology to enhance the teaching and learning process and engage the students. Over time, the boundary between educational use and personal use of technology becomes blurred. Playing online games, chatting online, participating in social networks, and browning the internet are daily activities for adolescents. However, excessive use of electronic devices can become problematic.

On the issue of child development and educating children in the 21st century, Joshi and Shukla (2019, p.159) suggested,

> "As children begin going to school, parents feel that safety concerns necessitate they have mobile phones. It is best not to buy the child a phone till the age of 12–13, and you could consider getting a basic one for communication rather than a smartphone. Children quickly fall into the habit of holding the phone or staring at a screen, involved in passive activities. It is better to encourage children to use a digital device when needed rather than being engaged with it on an ongoing basis. When children are a little older, using technology is relevant and useful for them; however, they should be careful so that it does not eat into their time being with friends, playing, or being active in other ways. The distracting nature of the devices may affect academic work or homework, leading to the performance below potential."

Over the last decades, research investigating the problematic use of the internet and social media has been prevalent in the literature. Bányai et al. (2017) conducted a study with a large-scale nationally representative sample involving approximately 6,000 adolescents to examine Hungary's internet and social media use. The study identified the at-risk groups and reported the association between low self-esteem and high level of depression symptoms with elevated social media usage. The authors highlighted the problematic social media use and suggested how at-risk groups can be assisted with school-based prevention and intervention programs. In a systematic review on the meta-analysis of screen time and childhood obesity, Fang et al. (2019) examined 16 studies conducted in 12 countries. They found that students who use mobile devices more than two hours per day increased the risk of overweight and obesity. The authors concluded that spending too much time online could be a risk factor for adolescents and suggested intervention strategies.

Researchers have studied the excessive use of mobile devices and social networks in various contexts. Domoff et al. (2019) reviewed the literature and reported that harmful physical health correlates with excessive mobile use during childhood and adolescence. Some of the effects include sleep irregularity, lack of exercise, and obesity. Some studies reported ocular health, musculoskeletal pain, and headaches associated with the excessive use of mobile devices. Salmela-Aro et al. (2017) indicated that there had been increased concerns with the well-being and social and emotional states of students and potential problems associated with the online presence. They conducted a longitudinal study in Finnish adolescents to examine the link between excessive internet use and school engagement, school burnout, and depressive symptoms. The study concluded that excessive internet use could cause school burnout and subsequently develop depressive symptoms. Lissak (2018) also conducted a similar literature review regarding the adverse physiological and psychological effects of screen time on adolescents. The study found that excessive internet and online presence are associated with poor sleep, poor stress regulation, and physical health consequences, including vision impairment.

When Kim et al. (2017) explored the associations between internet use time and school performance among Korean adolescents, they found that more extended internet use for the general-purpose was negatively associated with school performance. Similarly, the study by Cao et al. (2018) involved over 500 students in a university in China and found the excessive use of social networking sites is related to poor academic performance. In Brazil, Felisoni and Godoi (2018) experimented to determine the relationship between students' average time using their smartphones per day and academic achievement. They found the negative relationship between usage and academic results at the extent of each 100 minutes spent using the device on average per day corresponds to a reduction in a student's position at the school's ranking of 6.3 points. Despite its recognised role of time management in achieving academic success, Wolters and Brady (2020) advocated to examine time management as a significant self-regulatory process through which students actively manage when and for how long they engage in the activities deemed necessary for reaching their academic goals.

Adolescents believe that being constantly connected on social media is the norm, and their friends reinforce the action. They also have the impression that if they are not on social media like their peers, they are missing out on opportunities. This fear of missing out (FoMO) refers to social media users' preoccupation with lost opportunities when offline or unable or unwilling to connect and communicate with others (Alutaybi et al., 2020). Alt and Boniel-Nissim's (2019) study found a positive link between FoMO and surface learning. It must be noted that not all social media use creates adverse side effects. There are many positive effects if adequately used. There was evidence that social media allows making friends regardless of distance, provides faster communications within the group, and eases loneliness. The literature on the effects of excessive use of the internet and social media is linked to the physical and psychological well-being of the adolescent. Little is known about the effects of the internet and social network overuse on students' academic achievement. Thus far, this study focused on illustrating further on the impact of above mentioned determinants on students' achievement.

3 Purpose

The purpose of this research was to examine the effects of time spent on the internet and online activities on academic performance in mathematics, language, and arts among students in participating countries. To achieve this purpose the following questions were addressed:

1 What is the magnitude and direction of association between reading time and academic performance?

2 What is the magnitude and direction of association between time playing online games and academic performance?

3 What is the magnitude and direction of association between time chatting online and academic performance?

4 What is the magnitude and direction of association between time participating in social networks and academic performance?

5 What is the magnitude and direction of association between time browsing internet for fun and academic performance?

6 What is the magnitude and direction of association between time browsing internet for information and academic performance?

Based on theory and research above, the following hypotheses were formulated to assess the relationships between reading books and engaging in online activities with academic performance among adolescent students in eight countries.

H1 The amount of time spent reading has a positive impact on academic performance.

H2 The amount of time spent playing online games has a negative impact on academic performance.

H3 The amount of time spent chatting online has a negative impact on academic performance.

H4 The amount of time spent participating in social networks has a negative impact on academic performance.

H5 The amount of time spent browsing the internet for fun has a negative impact on academic performance.

H6 The amount of time spent browsing the internet for information has a negative impact on academic performance.

4 Methods

4.1 Data source

The primary data source for this study is from the student questionnaire administered in the Survey of Social and Emotional Skills (SSES) by the Organization for Economic Cooperation and Development (OECD) in 2019. The OECD believes that in the fast-

changing world and dynamic economic context, 21st-century skills are necessary to enable the countries to operate competitively. The SSES measures social and emotional skills, also known as non-cognitive factors, or soft skills, which every student should have to succeed in their future. This data contains over 60,000 records of students from ten cities across nine countries. There are 29,863 males, and 30,635 are females, ages ranging from 10–16 years. The sample is divided into two cohorts, younger and older. The average age at the survey administration is 10.7 to 10.9 and classified as a younger cohort, and an average age of 15.6 to 16 is defined as an older cohort (OECD, 2021). The cities and countries involved in the study are Ottawa (Canada), Houston (United States), Bogota and Manizales (Columbia), Helsinki (Finland), Moscow (Russia), Istanbul (Turkey), Daegu (South Korea), Sintra (Portugal), and Suzhou (China). For this study, the data from Canada is excluded since no achievement grades are available.

When collecting large-scale data, it is necessary to ensure that the sample is as inclusive as possible within the target populations. For this reason, stratified sampling techniques are used to gather equal numbers of students. Stratification is a process that improves the efficiency of the sample design (OECD, 2021).

5 Statistical analysis

5.1 Descriptive statistics

Part of the questionnaire includes items that ask the students how they spent their time in daily activities. From the set of 11 time-related questions, six items of interest are selected for the analysis. The students were asked how much time they spent on daily school-related and non-school-related activities. Students choose from no time to more than 4 hours in each activity. Table 2 shows the percentage of students for each activity. The 6-item internet use and online activity had good internal consistency with Cronbach alpha coefficient of 0.686, which is acceptable according to DeVellis and Thorpe (2021). McDonald's omega was tested and found to be 0.727.

Table 2 Time spent on activities per day

	No time	*< 60 min*	*1-4 hours*	*>4 hours*
Reading a book/newspaper/magazine	32.4	48.2	15.2	4.2
Playing online games	33.2	30.9	23.8	12.1
Chatting online	28.1	36.3	22.1	13.4
Participate in social networks	32.8	30.7	23.3	13.2
Browse internet for fun	14.2	35.2	33.5	17.1
Browse internet for information	26.8	49.5	17.6	6.0

5.2 Correlation analysis

To assess the strength and direction of the linear relationship between mathematics, language, and arts achievement and the explanatory variables of interest, a bivariate Pearson's product-moment correlation coefficient (r) was computed. Preliminary analyses were performed to make sure no violation of the assumption of normality, linearity and homoscedasticity. To see the magnitude of relationships between variables,

Cohen's *d* was calculated to determine the effect size. For Cohen's (1988) d, 0.2 = small effect, 0.5 = medium effect and 0.8 = large.

5.3 Independent-samples t-test

An independent-samples t-test was conducted to determine whether there is a statistically significant difference in the mean scores for males and females, and younger and older cohorts in terms of their mathematics, language and arts grades. To provide an indication of the magnitude of the differences between the groups, eta squared was used. As proposed by Cohen (1988), the interpretation of eta squared values are as follows: 0.01 = small effect, 0.06 = moderate effect and 0.14 = large effect.

6 Results

When asked about the duration of time spent on the internet and online activities, close to 28% indicated that they have no time for such activities. A high 38.4% stated that they spent less than one hour on these activities. Only 22.5% of the students indicated that they spent 1 to 4 hours each day on these activities. 11% stated that they spent more than 4 hours a day on reading, the internet, and online activities.

6.1 Association between academic performance and online and internet activities

Table 3 reports the association between mathematics, language, and arts grades and the time spent on the internet and social networking activities. The strongest associations between the mathematics grade and reading a book/newspaper and magazine were detected. The correlation coefficient $r = 0.66$ is significant at $p < 0.01$. The percentage of variance $r^2 = 0.44$ shows that the reading effect accounts for 44% of the mathematics grades. The effect size Cohen's *d* is 0.132 and considered a small effect. As expected, the remaining items on internet use and online activities were negatively and significantly associated with the mathematics grade. The highest negative effect in participating in social networks, $r = –0.164$, is significant at $p < 0.01$, and Cohen's *d* is 0.333 and considered a small effect.

Playing online games is negatively and significantly associated with mathematics achievement. The correlation coefficient $r = 0.073$ is significant at $p < 0.01$. The effect size Cohen's *d* is 0.146 and considered a small effect. Similarly, chatting online, participating in social networks, browsing the internet for fun, and browsing for information is negatively and significantly associated with mathematics grades at varying magnitudes. All of them have large effect sizes. The details of the correlation matrix are shown in Table 3.

Table 3 Association between academic performance and online and internet activities – N = 55,570

	Read a book	*Play game*	*Chat online*	*Social networking*	*Internet for fun*	*Internet for info*
Mathematics grade	$r = 0.66$**	$r = -0.073$**	$r = -0.163$**	$r = -0.164$**	$r = -0.120$**	$r = -0.063$**
	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$
	$d = 0.132$	$d = 0.146$	$d = 0.330$	$d = 0.333$	$d = 0.242$	d = 0.126
Language grade	$r = 0.082$**	$r = -0.107$**	$r = -0.137$**	$r = -0.124$**	$r = 0.096$**	$r = 0.038$**
	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$
	$d = 0.016$	$d = 0.215$	$d = 0.277$	$d = 0.250$	$d = 0.193$	$d = 0.076$
Arts grade	$r = 0.053$**	$r = -0.111$**	$r = -0.115$**	$r = -0.089$**	$r = -0.066$**	$r = -0.032$**
	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$
	$d = -0.106$	$d = 0.223$	$d = 0.232$	$d = 0.179$	$d = 0.132$	$d = 0.064$

Note: **p < 0.01.

H1 'The amount of time reading has positive impact on academic performance' was supported. The time spent reading a book, magazine and newspaper are positively and significantly associated with academic performance in all three subjects. A positive and significantly highest association was found in language grade ($r^2 = 0.0067$, $p < 0.000$), and 0.67% of the variance is attributed to language grade. Overall, 4% of the variance in academic performance is explained by reading a book, magazine, and newspaper.

H2 'The amount of time playing online games has negative impact on academic performance' was supported. The time spent on playing online games is negatively and significantly associated with academic performance in all three subjects. A negative and significantly highest association was found in the arts grade and playing online games ($r^2 = 0.0123$, $p < 0.000$), and 1.23% of the variance is attributed to the arts grade. In total, 8.4% of the variance accounts for academic performance by the time spent playing online games.

H3 'The amount of time chatting online has negative impact on academic performance' was supported. The time spent on chatting online is negatively and significantly associated with academic performance in all three subjects. The negative and significantly highest association was found in the mathematics grade and chatting online ($r^2 = 0.0265$, $p < 0.000$), and 2.65% of the variance is attributed to the arts grade.

H4 'The amount of time participating in social networks has negative impact on academic performance' was supported. The time spent participating in social networks is negatively and significantly associated with academic performance in all three subjects. The negative and significantly highest association was found in the mathematics grade and social networking ($r^2 = 0.0268$, $p < 0.000$), and 2.68% of the variance is attributed to the mathematics grade.

H5 'The amount of time browsing the internet for fun has negative impact on academic performance' was supported. The time spent browsing the internet for fun is negatively and significantly associated with academic performance in all three subjects. The negative and significantly highest association was found in the mathematics grade and browsing the internet for fun ($r^2 = 0.0144$, $p < 0.000$), and 1.44% of the variance is attributed to the mathematics grade.

H6 'The amount of time browsing the internet for information has negative impact on academic performance ' was supported. The time spent browsing the internet for information is negatively and significantly associated with academic performance in all three subjects. The negative and significantly highest association was found in the mathematics grade and browsing the internet for information ($r^2 = 0.0039$, $p < 0.000$), and 0.39% of the variance is attributed to the mathematics grade.

Tables 4, 5, and 6 report the descriptive data to compare all participants' academic performance in three subject areas, mathematics, language, and art, by gender and cohort. As shown in Table 4, female students significantly perform well in mathematics ($p < 0.000$). The older cohort of students did better on mathematics ($p < 0.000$). In language, again, female students performed better than male students. The difference is significant at the $p < 0.000$ level. However, there were no significant differences in

language achievement among the two cohorts, although the older cohort scored higher than, the younger cohort (see Table 5). Table 6 depicts the difference in arts grades by gender and cohort. In arts grades, the female group scored higher than the male group, and it is statistically significant at $p < 0.000$ level. The younger cohort achieved higher in arts grades. The difference is statistically significant ($p < 0.001$). This analysis found that female students tend to perform better in mathematics, language, and arts. The younger cohort of students achieved higher grades in all three subject areas.

6.2 Gender and cohort differences in academic performance

An independent-samples t-test was conducted to compare mathematics, language, and arts grades for males and females and younger and older cohorts. As shown in Table 4, mathematics grades for females (M = 34.70, SD = 11.07) and males (M = 33.96, SD = 11.39; t (49475.16) = 7.30, $p < 0.000$, two-tailed) are significantly different. However, the magnitude of the differences in the means (mean difference = 0.74, 95% CI: 0.54 to 0.93) was very small ($\eta^2 = 0.001$).

Mathematics grades for younger cohort (M = 36.66, SD = 10.62) and older cohort (M = 32.21, SD = 11.36; t (49,843.32) = 45.11, $p < 0.000$, two-tailed) are also significantly different. The magnitude of the differences in the means (mean difference = 4.46, 95% CI: 4.26 to 4.65) was small ($\eta^2 = 0.039$).

Table 4 Descriptive statistics and mean differences for mathematics grades of all participants by gender and cohort

Group	*N*	*Mean*	*SD*	*Standard error*	*t*
Female	25,109	34.70	11.07	0.0699	7.30**
Male	24,504	33.96	11.39	0.0727	
Younger	23,705	36.66	10.62	0.0690	45.11**
Older	26,196	32.21	11.36	0.0700	

Note: **p < 0.01.

Table 5 depicts the descriptive statistics and comparison of means for language grades by gender and cohort. It was found that language grades for females (M = 36.96, SD = 9.93) and males (M = 34.24, SD = 10.66; t (48929.89) = 29.27, $p < 0.000$, two-tailed) are significantly different. The magnitude of the differences in the means (mean difference = 2.71, 95% CI: 2.53 to 2.89) was small ($\eta^2 = 0.017$).

Table 5 Descriptive statistics and mean differences for language grades of all participants by gender and cohort

Group	*N*	*Mean*	*SD*	*Standard error*	*t*
Female	25,051	36.96	9.93	0.0627	29.27**
Male	24,364	34.24	10.66	0.0683	
Younger	23,582	37.47	10.22	0.0666	38.77**
Older	26,116	33.91	10.24	0.0633	

Note: **p < 0.01.

The language grades for younger cohort (M = 37.47, SD = 10.22) and older cohort (M = 33.91, SD = 10.24; t (49696) = 38.77, $p < 0.000$, two-tailed) are also significantly different. The magnitude of the differences in the means (mean difference = 3.57, 95% CI: 3.39 to 3.75) was small ($\eta^2 = 0.029$).

Table 6 shows the descriptive statistics and comparison of means for arts grades by gender and cohort. Arts grades for females (M = 41.58, SD = 9.18) and males (M = 38.12, SD = 10.76; t (44157.58) = 36.84, $p < 0.000$, two-tailed). The magnitude of the differences in the means (mean difference = 3.46, 95% CI: 3.27 to 3.64) was small ($\eta^2 = 0.028$).

It was found that the arts grades for younger cohort (M = 40.98, SD = 10.36) and older cohort (M = 38.74, SD = 9.81; t (45340.14) = 23.69, $p < 0.000$, two-tailed) are significantly different. But, the magnitude of the differences in the means (mean difference = 2.24, 95% CI: 2.05 to 2.42) was small ($\eta^2 = 0.012$).

Table 6 Descriptive statistics and mean differences for arts grades of all participants by gender and cohort

Group	*N*	*Mean*	*SD*	*Standard error*	*t*
Female	22,841	41.58	9.18	0.0607	36.84**
Male	22,583	38.12	10.76	0.0716	
Younger	22,460	40.98	10.36	0.0691	23.69**
Older	23,241	38.74	9.81	0.0643	

Note: **p < 0.01.

7 Discussion

The study reports the relationships between the time spent engaging in online activities and internet use and the academic performance in mathematics, language, and arts among 10 to 16 years old students in nine cities across eight countries. The questionnaire items were extracted from the main SSES carried out by the OECD. It was found that achievement scores for mathematics, language, and arts subjects are positively associated with reading a book, newspaper, and magazine. The achievement grades are negatively associated with internet and online activities, including playing online games, chatting online, participating in social networks, browsing the internet regardless of whether for fun or information. The significance of the study lies in its large-scale sample data gathered from different countries, representing a large cohort of the student population for the first time.

The study also found significant differences but a small effect size between gender, cohort, and academic performance. It was found that female students scored significantly higher in mathematics, language, and arts than male students, although the effect size was small. It was also found that the younger cohort of students scored higher in mathematics, language, and arts subjects than the older cohort. The difference was significant, but the effect size was small.

A study conducted by Cao et al. (2018) involved 505 social networking sites users and reported that the excessive use of social networking sites causes a cognitive-emotional preoccupation. According to them, cognitive-behavioural control in using

social networking sites weakens this relationship to overcome the adverse outcomes, and negative consequences dimmish the academic performance. Azizi et al. (2019) explored the relationship between social networking addiction and academic performance involving 360 students using Bergen social media addition scale. They found that social media addiction is significantly higher among male students. They also found a negative and significant relationship between students' social media use and their academic performance. The results of this study are consistent with those earlier findings. Moreover, the authors suggested that counselling need to be provided to those affected students to reduce their dependency on social media.

7.1 Implications

The study has implications for teachers in using technology in the classrooms, guiding the students on productive use of mobile devices, and limiting the excessive time spent on gaming and chat activities. While teachers can instruct the students about the good practices in using internet and online activities, parents can also play a role in making sure that their childrens do not fall into harmful and inappropriate content and contact (Symons et al., 2020; Hammer et al., 2021). Some parents monitor how their children spend on the internet and smartphones and control their use. Customisable applications and software are available so that the parents can limit the time children spend online and track and filter inappropriate websites. Teachers and parents should emphasise with the importance of time management and how students can organise and divide their time between specific activities.

7.2 Limitations

In interpreting the findings from the present study, several factors should be taken into account. The subjects for this study were from selected countries with different socio-economic status and cultures. The analysis did not delineate younger and older cohorts regarding the time spend on the internet and social media use, and there may be differences in behaviours among them.

7.3 Conclusions

This study has contributed to our knowledge and understanding of adolescents' use of internet online activities and their effects on academic performance. This study opens up a host of possibilities for exploring many areas of internet use by adolescents, how it affects social, emotional skills, and strategies to balance their time online for school-related tasks and non-school-related activities. Further investigations can use more robust statistical tools and investigate the effects at the student level and school and country level. Modelling and regression analyses may provide more insights into predicting the outcomes from the different nature of online engagement.

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