

The Effects of Social Media Use on School Learning: Evidence From PISA 2018

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Abstract

It is shown that younger users are more active on social media (Colleen McClain, Emily A. Vogels, Andrew Perrin, 2021). The frequent use of social media is changing the manner in which a new generation of students communicate, learn, and think. As a result, the discussion on the impact of social media on learning achievement has taken on a new urgency. In this paper, we have employed data from OECD's Programme for International Student Assessment (PISA) 2018 database to investigate the effect of using social media for school learning on academic performance. In order to eliminate selection bias and assess the causal effect of using social media on learning, this research used propensity score matching (PSM) as an approach. By running the analyses in each participating country, we were able to see whether the effect of social media use on school learning manifests itself differently in various social, cultural, and political contexts. According to the results measured based on test scores in the PISA assessment, more frequent use of social media as a tool of learning related to schoolwork is detrimental to academic performance in most countries. However, the results regarding the impact of social media on academic performance were highly varied, with some showing a positive relationship and others showing a negative relationship. Although it is beyond the scope of this paper to discuss the causes behind the negative correlation between social media use and academic achievement in most cases, conclusions and limitations are cautiously presented.

Keywords: PISA, Propensity Score Matching, Social Media, School Learning

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Introduction

Most Internet users regularly access well-known social media sites such as Facebook, Snapchat, and Instagram; younger users (aged 18-29) are even more active on social media (Brooke Auxier & Anderson, 2021). In addition, global reports show that the average daily time spent on social media is more than two hours (*Global Social Media Stats*, n.d.). These results come as no surprise to academics and educators familiar with today's teens and college students' social media use habits. In recent years, the use of social media has expanded beyond social software and entertainment tools for college students. Social media has even become an important part of the daily learning of college students, participating in both classroom and extracurricular learning. In line with the number of recent research articles examining the relationship between social media and education, it is clear that scholars are increasingly interested in how social media is changing teaching, learning, and students' lives (Gikas & Grant, 2013; Selwyn & Stirling, 2016). As a result, the discussion on the impact of social media on education has taken on a new urgency. This study, using large-scale international assessment data, aimed to investigate the impact of social media use on academic performance among students in various countries.

Literature Review

Social media use and academic performance

The impact of social media use on academic performance has been a topic of much discussion and research in recent years. The results of these studies have been mixed, with some indicating a negative relationship between social media use and academic performance, while others suggest that social media use can actually have a positive impact. One study by Skiera et al. (2017) found that Facebook activities during class were negatively related to academic performance. The researchers suggest that this may be because Facebook activities during class distract students from paying attention to the lecture and taking notes. Another study by (Habes et al., 2018) found that a large number of university students use social media, with a focus on Facebook, which can negatively impact their academic results. The authors suggest that students need to approach their use of social media with ultimate responsibility to ensure that it does not have a negative impact on their academic performance.

On the other hand, it was found that communication with peers through social media can help students socialize, find new friends, and discuss issues related to their studies, which can ultimately have a positive impact on their academic performance (M. Talaue et al., 2018).

In addition, many studies have identified individual and contextual factors that may moderate the relationship between social media use and academic performance (Al-Azawei, 2019; Hitchcock & Young, 2016; Piki, n.d.; van den Beemt et al., 2020), but there is a need for more research to examine the interplay between these factors and how they may influence the relationship.

Existing theories

-Theory of Social Comparison

The social comparison theory, proposed by psychologist Leon Festinger (1954), suggests that individuals engage in social comparisons with others in order to evaluate their own abilities and opinions. This can be especially relevant in the context of social media, where people are constantly exposed to highly curated and idealized versions of others' lives and achievements. High school students, who are at a critical stage in their development, are particularly vulnerable to the negative effects of such comparisons.

Studies have found that social media use is associated with increased feelings of social comparison and decreased self-esteem, especially among high school students (Mann & Blumberg, 2022). For instance, students who spend more time on social media may compare themselves to their peers who seem to have more friends, better grades, and more interesting lives, leading to feelings of inadequacy and decreased academic motivation.

-Theory of Multitasking

Social media use has been a topic of interest in recent years, particularly with regard to its impact on student's academic performance. The theory of multitasking suggests that students who engage in simultaneous use of social media while studying are likely to experience a decrease in their ability to focus on a single task, leading to a reduction in their academic performance. This phenomenon, commonly referred to as multitasking, has been found to have a negative effect on student's cognitive ability, academic performance, and overall self-efficacy. When students engage in social media use while studying, they are likely to experience a decrease in their ability to focus on a single task. This can lead to lower academic performance, as seen in studies that have found a negative correlation between social media use for non-academic purposes (such as video gaming) and academic performance as measured by cumulative grade point average (Lau, 2017). Additionally, research has shown that social media usage and multitasking are associated with students' self-efficacy and academic performance (Mohammed et al., 2021). This theory highlights the importance of understanding the impact of social media use on students' academic performance, and the need for responsible and mindful usage of these technologies.

-Theory of Information Overload

The Theory of Information Overload posits that the excessive use of mobile social networking sites can result in individuals feeling overwhelmed by the amount of information they are exposed to, leading to negative impacts on their well-being. Research has found that perceptions of information overload are a significant predictor of depressive symptoms and can negatively affect an individual's well-being over time (Matthes et al., 2020). This theory is further supported by the Cognitive Overload Theory, which states that the human mind has a limited capacity for processing new knowledge and that excessive cognitive load or a flood of complicated information can exceed this capacity (de Jong, 2010; Isaksen & Oslo, 2014). Information overload can take on three forms: too much information, not enough time, and poor quality information (Agnew & Szykman, 2010).

The impact of social media use on students can be related to the theory of information overload. Mobile social networking sites (SNS) or social media are frequently considered a

source of perceived information overload, leading to negative effects on well-being. This theory suggests that constant exposure to vast amounts of information through SNS can lead to cognitive overload, as students struggle to process the large volume of information they are exposed to.

-Theory of Social Support

The theory of social support posits that individuals receive emotional, informational, and instrumental support from their social network, which can influence their well-being and psychological adjustment (Lakey & Cohen, 2015). This theory has been applied to explain the effects of social media use on students' academic performance and well-being. Emotional support, for example, can help students feel connected to others and cope with stress and anxiety, which can positively impact their academic performance. Informational support can help students access resources, knowledge, and information related to their academic and personal lives, which can also enhance their academic performance. Instrumental support refers to tangible help or resources, such as providing students with access to technology or academic materials. Social media can provide students with opportunities to connect with others and receive social support, which can contribute to their academic and personal well-being. Research has shown that students who receive more social support, including through social media, tend to have better academic performance and well-being outcomes.

The Buffer Social Support theory, proposed by Alloway and Bebbington (1987), suggests that social support acts as a buffer against stress, protecting individuals from its negative effects and promoting well-being. In the context of student social media use, this theory suggests that social support received through social media can help mitigate stress and promote positive outcomes such as improved academic performance. This may include emotional support, encouragement, and guidance from peers, family, and teachers, which can help students cope with academic challenges and increase their motivation and engagement in their studies. Moreover, the use of social media to connect with others who share similar interests and experiences can also provide a sense of belonging and community, further boosting well-being and academic success.

Cultural Differences

The previous studies indicate that the impact of social media on education and academic performance can differ greatly depending on various cultural, social, and political factors. In countries like China, South Korea, and Taiwan, the use of social media in education is widely accepted and encouraged as a means to facilitate learning and collaboration (Athukorala, 2018; Tang et al., 2021). In these countries, there are specialized platforms and services that are specifically designed for educational purposes.

In countries like the United States and the United Kingdom, the use of social media in education is more controversial (Krutka et al., 2019; Taylor et al., 2012). While some educators and institutions embrace its potential to enhance student engagement and facilitate collaboration, others are concerned about its potential to distract students and undermine academic integrity.

In developing countries, access to technology and the Internet remains a major barrier to the widespread adoption of social media in education. However, some initiatives have been undertaken to bring technology and internet access to schools and communities, so that

students and teachers can benefit from the educational potential of social media. In countries with strict censorship laws and limited internet freedom, the use of social media in education may be limited or banned altogether (Wu & Alaimo, 2018). In these countries, it is important for educators and policymakers to carefully consider the potential benefits and risks of social media use in the classroom and to balance academic freedom with the need for security and stability.

In conclusion, the relationship between social media use and academic performance is complex and can be influenced by a variety of individual and contextual factors. Some studies suggest a negative relationship between social media use and academic performance, while others indicate a positive impact. The theories of social comparison, multitasking, information overload, and social support help to explain the potential effects of social media use on students' academic performance and well-being. More research is needed to fully understand the relationship between social media use and academic performance, as well as the role of individual and contextual factors in moderating this relationship. It is important for students to approach their use of social media in a responsible and mindful manner to ensure that it does not have a negative impact on their academic performance.

Methodology

The primary aim of this study was to explore the relationship between social media use and academic performance among students as measured by the Programme for International Student Assessment (PISA) 2018. The research question specifically addressed in this study was:

"What is the impact of social media use on students' academic performance as measured by PISA 2018?"

In addition to examining the overall effect of social media use on academic performance, this study also sought to address a secondary research question:

"Does the impact of social media use on academic performance vary across nations and cultures?"

By exploring this question, the study aimed to gain a deeper understanding of the potential cultural and national differences in the relationship between social media use and academic performance. This multi-faceted approach to the research question allows for a more comprehensive examination of the topic and provides a nuanced understanding of the relationship between social media use and academic performance.

As the data used in this study was obtained from a non-experimental assessment, in order to answer these questions, propensity score analysis was used to establish a valid causal inference. Propensity score matching (PSM) is used to control for potential confounding factors and examine the causal effect of social media use on students' PISA scores.

Data

The present study utilizes data from the 2018 Program for International Student Assessment (PISA), a globally recognized evaluation of the academic abilities of 15-year-old students. A total of 79 countries and economies participated in PISA 2018. PISA 2018 assessed students'

knowledge and skills in mathematics, reading, and science, providing a comprehensive measure of their educational achievement. In addition, PISA collects a wealth of information on students and schools through its student and school questionnaires. The information gathered covers various aspects of students' home and family backgrounds, as well as the school environment, across all participating countries. One of the unique features of PISA 2018 is its provision of interesting variables related to Information and Communication Technology (ICT) at the student level.

While all countries and partners that participated in PISA 2018 provided assessment scores on mathematics, reading, and science achievement, only 31 OECD countries and 19 partners provided survey data on students' use of information and communication technologies (ICT), including social media. Therefore, our analysis is based on data from these countries and partners only. The administration of the ICT Familiarity Questionnaire was not universal among participating countries, which determined the selection of countries to be examined in the empirical analysis. The countries and economies are listed below in Table 1 with the participant number of students.

OECD	Participants No.	Partners	Participants No.
Australia	14273	Albania	6359
Austria	6802	Brazil	10690
Belgium	8475	Brunei Darussalam	6828
Chile	7621	Bulgaria	5294
Czech Republic	7019	Chinese Taipei	7243
Denmark	7657	Costa Rica	7221
Estonia	5316	Croatia	6609
Finland	5649	Dominican Republic	5674
France	6308	Georgia	5572
Greece	6403	Hong Kong (<u>China</u>)	6037
Hungary	5132	Kazakhstan	19507
Iceland	3296	Macao (<u>China</u>)	3775
Ireland	5577	Malta	3363
Israel	6623	Morocco	6814
Italy	11785	Russian Federation	7608
Japan	6109	Serbia	6609
Korea	6650	Singapore	6676
Latvia	5303	Thailand	8633
Lithuania	6885	Uruguay	5263
Luxembourg	5230		
Mexico	7299		
New Zealand	6173		
Poland	5625		
Slovak Republic	5965		
Slovenia	6401		
Spain	35943		
Sweden	5504		
Switzerland	5822		
Turkey	6890		
United Kingdom	13818		
United States	4838		

Table 1: OECD countries and partners participating ICT questionnaire.

Measurement

This study makes use of three distinct sets of variables in its analysis. The primary outcome variables are the scores of 15-year-old students in mathematics, reading, and science, as assessed by PISA 2018. These scores serve as an indicator of academic performance and are used to evaluate the impact of social media use on students' academic outcomes.

The treatment variable in this study is the frequency with which 15-year-old students use social media for communication with their peers regarding schoolwork. This variable is

measured through the IC010Q05NA item in the information and communication technologies (ICT) questionnaire of PISA 2018. The question specifically asks students about their use of social media platforms, such as Facebook and MySpace, for communication with other students about school-related matters.

In order to control for potential confounding factors, the study employs a group of ten covariates, which include demographic information and an ICT use index. These covariates are used in propensity score matching to balance the treatment and control groups and to ensure that the observed effect of social media use on academic performance is not biased by other variables.

By utilizing these three sets of variables, the study provides a comprehensive examination of the relationship between social media use and academic performance, while taking into account the potential impact of other relevant factors. The careful consideration and use of these variables are crucial in ensuring the validity and reliability of the study's findings. All the variables and their definitions are listed in the table below.

	Variable	Definition
Outcome Variable	<u>Science_w</u>	<i>Weighted Science Score</i>
	<u>Reading_w</u>	<i>Weighted Reading Score</i>
	<u>Maths_w</u>	<i>Weighted Math Score</i>
Treatment Variable	IC010Q05NA	<i>how often use social networks such as Facebook and MySpace for communication with other students about school-related matters</i>
Covariates	ST004D01T	<i>Student (Standardized) Gender</i>
	MISCED	<i>Mother's Education</i>
	FISCED	<i>Father's Education</i>
	IMMIG	<i>Index Immigration status</i>
	ESCS	<i>Economic, Social and Cultural Status</i>
	PERCOOP	<i>Perception of cooperation at school</i>
	ICTHOME	<i>ICT available at home</i>
	ICTSCH	<i>ICT available at school</i>
	INTICT	<i>Interest in ICT</i>
	COMPICT	<i>Perceived ICT competence</i>

Table 2: Variable category, name, and definition.

Propensity score matching is a statistical technique that allows researchers to estimate the causal effect of a treatment on an outcome by controlling for a range of confounding factors (Rosenbaum & Rubin, 1983). It involves estimating the probability that a subject will receive a particular treatment, based on their characteristics as measured by a set of covariates. By matching or weighting subjects based on their propensity scores, researchers can reduce selection bias and obtain more valid estimates of the treatment's causal effect. In this study, propensity score matching is used to control for potential confounders and examine the relationship between students' use of social media for communication about schoolwork and their performance on the mathematics, reading, and science assessments of PISA 2018.

Analysis

Based on the suggestions outlined in recent literature (Jiang & McComas, 2015; Agasisti et al., 2020; Hogrebe & Strietholt, 2016), the causal analysis in this study consisted of the following major steps:

(1) Selection of the covariates

The first step in the causal analysis in this study was the selection of covariates. This involved identifying the relevant variables that could potentially affect the outcome of interest and serve as confounding factors. The outcome variables and the treatment variables were selected from the PISA 2018 questionnaire based on the research questions of this study. The covariate variables were selected based on the literature and the researchers' own experience.

(2) Estimation of the propensity scores

In this study, propensity score matching (PSM) was used to create comparable treatment and control groups of students based on their propensity scores. The matching method employed was nearest neighbor matching with a caliper, which involves finding the nearest untreated subject to each treated subject and forming a pair, as long as the difference in their propensity scores is within a specified range known as the caliper. The caliper is typically set at a small value (e.g., 0.2 or 0.5 of the standard deviation of the propensity scores) to ensure that the treatment and control groups are well-matched on the covariates. In this study, the caliper was set at 2.5 to allow for a larger pool of matched subjects and increase the statistical power of the analysis. This method helps to control for potential confounders and reduce the influence of selection bias on the estimates of the treatment effect.

(3) Matching or weighting of treatment and control groups based on propensity scores

The next step in the causal analysis was to match or weigh the treatment and control groups based on their propensity scores. This was achieved through propensity score matching (PSM) using the nearest neighbor matching method with a caliper of 2.5. The aim of this step was to create comparable treatment and control groups of students based on their propensity scores, which helps control for potential confounders and reduce the influence of selection bias on the estimates of the treatment effect.

(4) Estimation of the treatment effect on the outcome variable

The final step in the causal analysis was the estimation of the treatment effect on the outcome variable. This involved comparing the outcomes of the treated and untreated groups after controlling for potential confounding factors through the matching or weighting process. The outcome of this analysis provides insight into the causal effect of the treatment on the outcome of interest.

Results

The study employed a meticulous approach to data analysis by conducting separate propensity score analyses for each country involved. This strategy allowed for a comprehensive evaluation of the data from each country and facilitated the identification of

country-specific patterns and trends. The detailed analysis of the data from the United States serves as an example, providing in-depth insights into the results obtained from this particular country. Following this, a summary of the results from all participating countries is presented, enabling a comparison of the findings across different countries. This multi-faceted approach to data analysis provides a comprehensive understanding of the results and sheds light on the nuances and complexities of the data. By examining the results at both the country-specific and global levels, the study offers a more robust understanding of the patterns and trends at play.

Results of the US

The regression outcome for the data from the United States (see Table 3) shows that the model has 11 independent variables (IC010Q05NA_T, ST004D01T, MISCED, FISCED, IMMIG, ESCS, ICTHOME, ICTSCH, PERCOOP, INTICT, COMPICT) and has a total of 3980 observations. The F-statistic for the model is 81.38 and the p-value is less than 0.0000, which means that the overall model is significant at the 5% level. The R-squared value is 0.1841, which indicates that 18.41% of the variation in the outcome variable is explained by the independent variables in the model. However, although the results of the regression operation showed a correlation between social media use and students' academic performance, no causal relationship could be drawn. Therefore, after the regression analysis of the variables, this study continued with the PSM analysis.

Table 4 shows the results of a propensity score matching (PSM) analysis. After running logistic regression with the nearest neighbor matching with caliper 2.5, the number of observations was assigned to "Treated" and "Untreated" based on each matching score. The "Common Support" column shows the number of observations in the overlapping region of the two groups, which is defined by the propensity score. This is the number of observations that can be compared between the two groups, as they have similar observed characteristics. In this case, there are 2,568 observations in the "Untreated" group and 1,412 observations in the "Treated" group that are part of the common support. The total number of observations in the study is 3,980.

After matching the treated and untreated groups based on each individual's propensity score, the difference in the average treatment effect (ATT) between the groups can be seen. Table 5 presents the difference in the mean values of three variables: Science_w, Reading_w, and Maths_w, between the treated and untreated groups both before and after matching. The t-statistic provides information on the statistical significance of the difference in means between the groups. It can be seen that after matching, the difference between the means of the treated and untreated groups has increased and is statistically significant for all three variables, as indicated by the t-values.

Source	SS	df	MS	Number of obs	=	3,980
Model	6053325.24	11	550302.295	F(11, 3968)	=	81.38
Residual	26831109.6	3,968	6761.87238	Prob > F	=	0.0000
				R-squared	=	0.1841
				Adj R-squared	=	0.1818
Total	32884434.8	3,979	8264.49732	Root MSE	=	82.231

Science_w	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
IC010Q05NA_T	-13.99878	2.830384	-4.95	0.000	-19.54792	-8.449635
ST004D01T	5.64468	2.662433	2.12	0.034	.4248142	10.86455
MISCED	-6.670316	1.38199	-4.83	0.000	-9.379793	-3.960838
FISCED	.5750589	1.238196	0.46	0.642	-1.852501	3.002619
IMMIG	5.052847	2.525259	2.00	0.045	.1019203	10.00377
ESCS	46.01657	2.290007	20.09	0.000	41.52686	50.50627
ICTHOME	-6.555831	.7644094	-8.58	0.000	-8.054503	-5.057159
ICTSCH	-4.252677	.6844399	-6.21	0.000	-5.594564	-2.91079
PERCOOP	1.179425	1.408755	0.84	0.403	-1.582528	3.941377
INTICT	6.167916	1.618173	3.81	0.000	2.995387	9.340445
COMPICT	6.273487	1.673673	3.75	0.000	2.992148	9.554825
_cons	606.8115	11.99632	50.58	0.000	583.292	630.331

Table 3: Regression outcome of the US data.

psmatch2: Treatment assignment	psmatch2: Common support On suppor	Total
Untreated	2,568	2,568
Treated	1,412	1,412
Total	3,980	3,980

Table 4: The outcome of PSM.

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
Science_w	Unmatched	504.769245	510.079227	-5.3099825	3.01106261	-1.76
	ATT	504.769245	520.106762	-15.3375177	4.32714495	-3.54
Reading_w	Unmatched	511.481747	513.83122	-2.34947268	3.33721547	-0.70
	ATT	511.481747	529.513957	-18.0322093	4.72687916	-3.81
Maths_w	Unmatched	481.961657	482.915976	-.954318753	2.76246607	-0.35
	ATT	481.961657	493.468144	-11.506487	3.97282207	-2.90

Table 5: The outcome of Average Treatment Effect on Treated (ATT).

Results of All the Countries and Partners

As with the US data, we also analyzed data from 49 other countries. The outcome altogether showed that the use of social media for learning outside of class is significantly related to students' academic performance in 39 out of the 50 OECD countries and economies that provided data on information and communication technologies (ICT) use. Of these 39 countries, 20 showed a positive causal relationship, meaning that the use of social media was positively associated with improved academic performance. These countries include Belgium, Czech Republic, Estonia, Hungary, Luxembourg, Mexico, Poland, Slovak Republic, Slovenia, Turkey, Albania, Brazil, Brunei Darussalam, Bulgaria, Croatia, Kazakhstan, Russian Federation, Serbia, and Singapore. In contrast, the remaining 19 countries showed a negative causal relationship, with the use of social media being negatively associated with academic performance. These countries include Australia, Chile, Denmark,

Finland, Greece, Ireland, Israel, Italy, Japan, Korea, Latvia, New Zealand, Spain, Sweden, the UK, the US, Costa Rica, Hong Kong, and Uruguay.

It is important to note that these results were found after conducting separate PSM analyses for each of the 50 OECD countries and economies, highlighting the variability in the relationship between social media use and academic performance across different countries and education systems. These results provide insight into the potential impact of social media use on students' academic performance and can inform future research and policy efforts in the field of education technology and media use in schools. It is also worth exploring the reasons behind the positive and negative causal relationships observed in different countries and economies to further understand the role of social media in student learning.

Conclusions

Our study aimed to investigate the impact of social media use on academic performance among students. Using the data from PISA 2018, we analyzed the relationship between social media use for learning and academic performance using a propensity score matching (PSM) approach. Using Propensity Score Matching as a research method, we intended to explore the causal relationship between social media use and students' academic performance. In our results, outcome data from the majority of participating countries and partners show that social media use has a significant effect on students' performance in math, science, and reading. Certainly, the effects are inconsistent across countries in different subjects, and even vary significantly. However, it is worth noting that for students in some countries, social media use in learning has a positive impact on achievement, while for students in other countries, it has a negative impact.

Our findings are consistent with other mixed result of previous studies. When discussing the impact of social media on student learning, contrasting results are obtained across countries, regions, and education systems. Our results showed that in 39 out of the 50 countries analyzed, there was a significant relationship between social media use for learning and academic performance. Of these 39 countries, 20 showed a positive relationship, while 19 showed a negative relationship. This highlights the variability in the relationship between social media use and academic performance across different countries and education systems. Despite these findings, it is important to continue exploring the reasons behind the positive and negative relationships observed in different countries. Since we analyzed each of the 50 countries and economies, further research can be conducted to explore whether different country characteristics significantly affect the impact of social media on students in that country.

This study is limited to the scope, within-country variation, and lack of explanation of causes. First, the study analyzed data from 50 countries and economies, but this sample is not representative of the entire world. The results obtained from the OECD's PISA data may not be applicable to countries outside of the organization, particularly African countries, which are not represented in the data. Second, the results of this study revealed differences in the impact of social media use on learning across countries, but it is important to note that the differences within a particular country can often be greater than the differences between countries. This means that the results obtained in this study may not be generalizable to specific countries. Third, while the study found a significant relationship between social media use and academic performance, it failed to examine the reasons behind these

differences. Further research is needed to explore the reasons why the impact of social media use on learning varies across countries.

In conclusion, it is important to acknowledge the limitations of the study when interpreting the results. The findings should be interpreted with caution, and future studies should aim to address the limitations of this research to build a more comprehensive understanding of the impact of social media on academic performance.

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