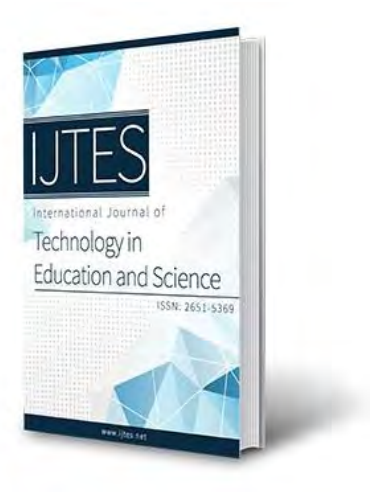

www.ijtes.net

Learning Environment and Online Assignment Behaviors as Predictors of the Academic Performance of Low Socioeconomic Status (SES) Junior High Students

Kendall D. Naceanceno
Middle Tennessee State University, United States

Usenime M. Akpanudo
Harding University, United States

To cite this article:

Naceanceno, K. D. & Akpanudo, U. M. (2023). Learning environment and online assignment behaviors as predictors of the academic performance of low socioeconomic status (SES) junior high students. *International Journal of Technology in Education and Science (IJTES), 7*(2), 253-273. https://doi.org/10.46328/ijtes.445

IJTES International Journal of Technology in Education and Science
2023, Vol. 7, No. 2, 253-273 https://doi.org/10.46328/ijtes.445

Learning Environment and Online Assignment Behaviors as Predictors of the Academic Performance of Low Socioeconomic Status (SES) Junior High Students

Kendall D. Naceanceno, Usenime M. Akpanudo

Article Info

Article History

Received:re
18 December 2022
Accepted:
23 April 2023

Keywords

Learning environment
Academic performance
Junior high
COVID-19
Online assignment behaviors

Abstract

The COVID-19 pandemic profoundly impacted the methods of instruction for K-12 and higher education institutions around the world. Schools and families were challenged to adapt to online-based modes of instruction with minimal preparation. This study examined the importance of the learning environment and commitment to assignments as predictors of the academic performance of junior high students during the COVID-19 pandemic. We obtained data from 328 seventh through ninth grade students enrolled in an urban school district in the Delta region of Arkansas. Students used the same online learning platform, Lincoln Learning Solutions, receiving instruction in virtual, mixed, or on-site learning environments. We examined the total time spent in each course, overall assignment completion, and average grades for science, mathematics, and ELA. Our results show that when we considered only the learning environment, students in the on-site environment consistently outperformed their peers in the virtual learning environment across all subjects and grade levels, except for mathematics at the eighth-grade level. However, when we also considered students' online assignment behaviors (time spent working on assignments, and number of assignments completed), there was a significant improvement in the prediction of academic performance for mathematics in the seventh and ninth grade, for science at the eighth-grade level, and for ELA at the ninth-grade level.

Introduction

The coronavirus (COVID-19) pandemic forced major changes in how schools across the United States deliver instruction. For instance, based on recommendations from the Centers for Disease Control and Prevention (CDC, 2020), many colleges and K-12 schools across the country, on short notice, adjusted from traditional brick-and-mortar only instructional settings to accommodate virtual learning environments. At the height of the pandemic, the virtual learning environment was considered an effective strategy for mitigating the risk of spreading COVID-19 in schools (Goldhaber et al., 2021). According to the United States Census Bureau (2020), over 90% of U.S. households with school-age children have participated in some form of virtual education during the late spring and early fall 2020 semesters. To aid schools in funding virtual education, the CARES Act (The Coronavirus Aid, Relief, and Economic Security Act) provided the U.S. Department of Education with over 30 billion dollars to

support both the technological capacity and access ("Funding Digital Learning," n.d.).

Many school districts, families, and educational organizations quickly adopted online-based learning systems to adjust to these changes in teaching and learning needs. Unfortunately, these transitions were rarely smooth as teachers and students struggled with reduced instructional interaction and technological challenges in online settings during the pandemic (Midcalf & Boatwright, 2020). These challenges hinder student success, particularly for minority and low socioeconomic status (SES) students. Past differences in levels of educational achievement between low and high SES students in the traditional learning environment have been well documented (Davis-Kean, 2005; Farkas & Beron, 2004; Henry et al., 2020; Paulus et al., 2021; Yeung & Pfeiffer, 2009). Similar differences also existed between students of minority ethnic backgrounds and their White peers (Thompson et al., 2012).

Ultimately, online learning during the pandemic exacerbated educational inequalities and differences in academic outcomes between low and high-SES students (Kuhfeld et al., 2020). Online instruction during the COVID-19 pandemic also added to the long list of factors that pose challenges to the ability of students of low SES background (who are often also of minority ethnic background) to complete online work. These factors include disruptive home environments (Brown & Low, 2008), lack of parental involvement (Benner et al., 2016), and lack of technological resources (Haderlein et al., 2021). During the pandemic, even though access to technology increased among all demographic groups, only two-thirds of families who made less than $25,000 per year reported having the necessary technology for online learning. In contrast, over 90% of households making more than $75,000 per year had access to technology for remote learning (Haderlein et al., 2021).

It will probably take several decades to fully uncover the consequences to the academic outcomes of low-SES minority students resulting from the adjustments made during COVID-19. However, online learning platforms will continue to shape instructional delivery post COVID-19. Educators must therefore begin to decipher some of the immediate implications of the adjustments made to instructional delivery during the COVID -19 pandemic.

Literature Review

Instruction during the COVID-19 Pandemic

In the spring of 2020, teachers across the country were tasked unexpectedly with instructing students in a manner described as *emergency remote teaching* to accommodate social distancing mandates associated with the COVID-19 pandemic (Boltz et al., 2021; Hodges et al., 2020). This method of online teaching serves as a temporary strategy to provide instruction to students in the time of a crisis (Hodges et al., 2020). Though emergency remote teaching is necessary to continue instruction during the COVID-19 pandemic, there is growing concern regarding its effectiveness on student learning and assessment (Engzell et al., 2021; Middleton, 2020; Wyse et al., 2020).

Although schools have utilized various methods to provide in-person and online instruction to students, there is a lack of consensus regarding the terminology for categorizing these learning environments (Moore et al., 2011). For instance, on-site, face-to-face, and brick-and-mortar are terms used to describe the more traditional learning

environments that involve teachers and students interacting in the same physical space. In contrast, online, e-learning, blended learning, distance, computer-assisted, and web-based are terms used to describe settings where technology delivers content and instruction to students who may or may not be in close physical proximity to the instructor (Singh & Thurman, 2019).

During the pandemic, K-12 schools employed various combinations of these instructional methods through distance and blended learning frameworks to mitigate the community spread of the COVID-19 virus. Allen and Seaman (2017) define distance learning as incorporating technology to deliver instruction to students in completely separate settings from their teachers. On the other hand, blended learning involves using technology for both online and in-person instruction (Halan, 2005). Before the widespread emergency use of these strategies during the COVID-19 pandemic, K-12 and higher educational institutions employed blended learning and distance learning methods with varying degrees of success (Means et al., 2013). In many cases, the instruction was delivered through video-based devices (Vargo et al., 2020) and course content managed online through learning management systems (LMS) (Boltz et al., 2021).

Institutions have taken advantage of LMS as they allow instructors to manage information related to their subjects, the course content, and student users (Kats, 2010). According to Bouchrika (2020), Moodle, Blackboard, Schoology, Google Classroom, and Canvas are widely used educational LMS programs. Despite their widespread use, the adoption of these systems for classroom instruction is not always without challenges. For instance, although many students readily adjusted to the use of online learning management systems during the pandemic (Raza et al., 2021), shifting to new modes of teaching can be difficult for students who have never engaged in online learning in the past. The pedagogical approaches used in traditional learning environments are not always suitable for online teaching (Pokhrel & Chhetri, 2021). For example, Leech et al. (2020) noted that although K-12 teachers felt they had the necessary resources for remote teaching during the pandemic, many struggled with understanding how best to use these resources to provide effective instruction for their online learners. Essentially, during the pandemic, the challenge of using online technology for educational purposes was about coupling the right technological resources to the appropriate pedagogical methods to meet students' needs in various learning environments.

Learning Environment and Academic Achievement

There is a compelling body of evidence to suggest that high school students in a blended learning environment will perform in a manner comparable to students in traditional learning environments (Alsalhi et al., 2019; Kazu & Demirkol, 2014; Tara & Bindu, 2016; Utami, 2018; Yapici & Akbayin, 2012). Others such as Harrell and Wendt (2019) found no difference in learning outcomes between high school students in blended and distance-only environments. Furthermore, Chen (2012) discovered even better academic outcomes among elementary school students in a blended learning environment when compared to students receiving distance-only instruction.

This parity between blended and traditional learning environments regarding students' academic outcomes does not seem to hold for online-only (virtual) learning environments. Evidence suggests that students enrolled in

virtual-only courses do not perform as well as students in traditional learning environments (Ahn & McEachin, 2017; Fitzpatrick et al., 2020; Harris-Packer & Ségol, 2015; Heinrich et al., 2019; Heissel, 2016; Miron & Urschel, 2012). Likewise, students enrolled in online-only high schools are less likely to graduate or pass a same-subject course the following year when compared to students in a traditional learning environment (Hart et al., 2019; Miron & Urschel, 2012). Learning in an online environment also appears to be more challenging for younger students. In secondary schools, 12th-grade students in an online course demonstrate higher passing rates across multiple subjects compared to younger students (Chang & Kim, 2021). For elementary-age students, virtual-only learning environments may actually obstruct learning. For instance, Tomasik et al. (2020) found that prior to COVID-19, learning progress in primary school students was relatively uniform, but individual progress became twice as slow after transitioning to an online setting. They noted that secondary student progress was not significantly affected. In essence, the extant literature suggests unique challenges to students' academic outcomes in online-only environments that are not typical of blended or traditional learning environments.

Interaction and Engagement in the Virtual Learning Environment

Numerous factors make learning much more challenging for the virtual learner and lead to disparities in academic performance between them and traditional learners. For example, Barbour and Reeves (2009) reported that time management and technology skills were crucial to online learners' success. Nevertheless, beyond the learning skill level of the student, the nature of interactions can have a major influence on the performance of learners in the virtual environment. Students in an online course perform the best when the content is both challenging and relatable. The evidence shows that students who participate in virtual learning benefit from interacting with their teachers and peers (Babinčáková & Bernard, 2020; Borup & Stevens, 2017; Borup, Walters, & Call-Cummings, 2020; Chen, 2012). Such interactions could include general communication, feedback on work completed, or group discussion sessions. Students want teachers to go beyond merely moderating course activities to incorporate these relevant and engaging content into their online learning experience (Borup & Stevens, 2017; Oliver et al., 2012; Oliver et al., 2009). Zheng et al. (2020) found that secondary school students' learning outcomes in an online course improve with higher-level knowledge assignments and project-based activities.

Without such activities, students can become disengaged and complete fewer course assignments. Heinrich et al. (2019) noted that the more course assignments high school students completed, the better their course outcomes. Likewise, Hung et al. (2012) found that in non-STEM courses, student engagement, as measured by multiple predictors, including student-content interactions, was a significant predictor of overall performance. Though interacting with the course content or completing the learning activities in an online course may not always represent meaningful learning experiences, they can enable students to accomplish course outcomes. For many learners in the virtual environment, there are significant limitations to the interactions they experience in an online environment compared to when they are in a face-to-face environment. Oliver et al. (2009) reported that students expect teachers to generate discussions, quickly grade assignments, and provide individualized attention. Similarly, Zeichner (2018) found that online students require personal feedback to fulfill the need for interaction, and feedback that is only content specific can reduce student motivation and satisfaction. Unfortunately, this type of support may be a challenge for teachers who have had no training providing online instruction, as is the case

for many educators during COVID-19.

Online Assignment Submission Behaviors

Many online courses are operated through learning management systems. Because LMSs gather learning analytics (Poon et al., 2017), data points that can be collected and used to influence teaching and learning (Lee et al., 2020), they can help predict student behavior, performance, and course completion (Mwalumbwe & Mtebe, 2017; Soffer & Cohen, 2019). Data points that involve students' interaction with assignments have been described as online assignment submission behaviors (Kokoç et al., 2021) and include several indicators such as the number of assignments completed, the time taken to complete an assignment, and time spent in the online course. Evidence has shown that there is a strong association between the amount of time secondary school students spend on the learning platform and their success in the online course (Heinrich et al., 2019; Liu & Cavanaugh, 2011; Liu & Cavanaugh, 2012; Pazzaglia et al., 2016; Zheng et al., 2020). A similar pattern exists when considering the number of times students log in to the learning management system and their achievement (Chang & Kim, 2021; Liu & Cavanaugh, 2011; Zheng et al., 2020). If these hours represent time spent viewing lessons and completing assignments, then the amount of time spent in the program may be positively related to their level of success in the course.

Summary

The COVID-19 pandemic has necessitated adjustments to instructional delivery at K-12 schools across the United States, including an increased reliance on web-based learning tools and learning management systems. However, despite the immense benefits of deploying LMS during the pandemic, there are also numerous challenges to their use. Beyond the time management and technology skills required of virtual learners, teachers must be alert to the need for extra support for students in this environment. At many schools, arrangements for instruction at the height of the pandemic required that teachers simultaneously instruct students in various settings ranging from on-site, virtual, and a blend of the two settings. The literature shows that teachers must incorporate high-level knowledge activities into the lessons to promote interaction and engagement with online learners. Delivering on this requirement during the COVID-19 era was exacerbated by the fact that virtual learners work autonomously and often receive less direct help than their peers in traditional face-to-face learning environments. It is pertinent to determine whether the unique set of circumstances during the COVID-19 pandemic had implications on students' performance in the different learning environments. A firm understanding of this phenomenon can inform educational leaders and policymakers regarding how best to prepare students and teachers for success should the need arise to switch to this meld of instructional environments once again.

Purpose of the Study

The purpose of this non-experimental study was to explore how well the learning environment and online assignment behaviors predicted the academic outcomes of junior high students during the COVID-19 pandemic. We investigated outcomes in three subject areas: science, mathematics, and English Language Arts (ELA).

Research Questions

We developed the following research questions to guide the study.

Research Question 1

Is there an association between learning environment (on-site, virtual, and mixed) and the academic performance of junior high students during the COVID-19 pandemic?

Research Question 2

To what extent do online submission behaviors (total time spent on assignments and the total number of assignments completed) improve the prediction of the association between the learning environment and the academic performance of junior high school students during the COVID-19 pandemic?

Methods

Sample

The data for this study were obtained as a convenience sample of scores for 328 junior high school students (seventh through ninth grades) at a school in the eastern (delta) region of Arkansas from the 2020 fall semester. A total of 101 samples were obtained for students in the seventh grade, 122 for eighth-grade students, and 105 for ninth-grade students. All students at this school qualify to receive free and reduced lunches. Table 1 provides a summary of additional demographic characteristics of the students from which sample data were obtained.

Table 1. Demographic Characteristics of Junior High School Students

Characteristic		*n* = 328	%
Sex			
	Male	168	51.2
	Female	160	48.8
Race			
	African American	324	98.8
	Hispanic	2	0.6
	White	2	0.6
Learning Environment			
	On-Site	72	22.0
	Virtual	141	43.0
	Mixed	115	35.0
Grade level			
	7th	101	30.8

Characteristic	*n* = 328	%
8th	122	37.2
9th	105	32.0
IEP		
7th	5	1.5
8th	12	3.7
9th	9	2.7

Instrumentation

Data for this study were collected using two resources relating to learning analytics which were described in the form of secondary data gathered from the learning management system (Buzz) and school records. The Buzz learning management system was used as the platform to deliver content to students using the Lincoln Learning Solutions curriculum. Lincoln Learning Solutions provides a standards-based, personalized instructional curriculum designed to support blended and distance learning strategies and holds corporate accreditations by AdvancED and school accreditation in Pennsylvania ("Lincoln Empowered FAQ," n.d.). The content is developed by the strategies of the Aurora Institute and Quality Matters and has been validated by the organization EdGate ("Lincoln Empowered FAQ," n.d.). The Lincoln Learning Solutions curriculum format provides a variety of instructional activities such as passages, videos, online worksheets, simulations, and projects. Students earn grades based on the non-comprehensive and comprehensive assessments in the program containing multiple-choice, open-ended, and matching questions. The LMS platform, Buzz, automatically gathers learning analytics which include assignment percentage score, assignment points, assignment letter grade, minutes per assignment, overall gradable course completion, overall activity completion, overall average grade, student pace, and total minutes spent in each course.

Procedure

After IRB approval, permission was obtained from the district administrators to export student learning outcomes from the Buzz LMS. The outcomes were exported based on available data from seventh, eighth, and ninth-grade students for science, mathematics, and English Language Arts (ELA) courses and included students' mean score per course, student letter grade per course, total time spent in each course, time spent on each assignment, gradable activity completion, and overall assignment completion. The learning outcomes were collected from the fall 2020 semester only and exported to a spreadsheet for analysis.

The student learning environment was determined by the school counselor and data gathered from the school's daily absence report. Included in the analysis were student demographic characteristics such as gender, race, IEP, and free and reduced lunch status. All files were compiled into a single, de-identified dataset for analysis. The variables of interest included student learning environment, grade level, subject, total minutes spent on all learning activities (total time spent in course), overall assignment completion (all learning activities), and overall grade average (0 - 100% scale). The student's overall grade average in each course was used as the indicator of academic

performance. The academic performance was compared between students enrolled in three different learning environments: on-site, virtual, and mixed. All students in each setting were provided with a Chromebook (one-to-one district) and completed the same coursework through the Lincoln Learning Solutions curriculum on the Buzz LMS.

On-site Learning Environment

The on-site learning environment was applied to students who opted to attend school in person for the entire semester. Because all assignments were completed through the LMS and students also received face-to-face teacher instruction, this method would be considered as blended learning. These students attended classes according to the regular bell schedule.

Virtual Learning Environment

The virtual learning environment was applied to students who opted to receive instruction at home for the entire semester. Students received instruction primarily through the content on the LMS. However, students had the opportunity to attend an optional zoom meeting once per week for each class. Assignments were completed at the students' own pace without a mandatory daily schedule. Teachers predominately communicated with students via email and the LMS. Because students were physically separated from their teachers the entire semester, this method would be considered as distance learning.

Mixed Learning Environment

The mixed learning environment referred to students who voluntarily selected either on-site or the virtual instructional method but then switched settings during the semester. Students had the option to switch between on-site and virtual instruction at three designated dates throughout the semester per district administration policy. These students engaged in both blended and distance learning methods.

Data Analysis

We used IBM SPSS version 26 to complete all data analysis and set an alpha level of .05 for testing the hypotheses related to each analysis. First, we fit hierarchical multiple regression models to the data for junior high students' academic outcomes to explore how well the learning environment alone served as a predictor for academic performance in science, mathematics, and ELA. At the second stage of each model, we examined the extent to which the total number of minutes students spent on the instructional platform and the total number of assignments they completed in each subject affected the prediction of academic performance.

Results

As a first step toward addressing the research questions, we conducted a descriptive analysis of the academic

performance of junior high school students during the COVID-19 pandemic in science, mathematics, and ELA by grade level. Data for two subject areas (science and mathematics; mathematics and ELA, respectively) were available for seventh and ninth-grade students. For eighth-grade students, data were available for all three subject areas (science, mathematics, and ELA). The descriptive summaries (see Table 2) revealed a pattern where on average, across all subject areas, students who received on-site instruction during this period outperformed those who received instruction in the other environments (mixed and virtual). Likewise, on average, the performance pattern in the mixed learning environment was higher or similar to those of students in the virtual learning environment. The descriptive summaries also showed that, on average, performance scores were lowest at the ninth-grade level (especially for mathematics) and highest at the seventh (science) and the eighth-grade level (ELA).

Table 2. Descriptive Statistics for Academic Performance

							95% Confidence Interval for Mean			
Grade	Subject		N	Mean	Std. Dev.	Std. Error	Lower Bound	Upper Bound	Min.	Max.
7	Science	On-Site	13	81.10	10.90	3.02	74.52	87.69	62.18	93.48
		Virtual	11	40.03	38.95	11.74	13.86	66.19	0.00	91.19
		Mixed	14	73.37	22.50	6.01	60.38	86.35	0.00	88.68
		Total	38	66.36	30.45	4.94	56.35	76.37	0.00	93.48
	Math	On-Site	24	62.95	19.39	3.96	54.76	71.14	23.10	89.23
		Virtual	43	36.10	29.92	4.56	26.89	45.31	0.00	86.03
		Mixed	28	53.85	23.93	4.52	44.57	63.12	2.24	86.07
		Total	95	48.12	28.08	2.88	42.39	53.84	0.00	89.23
8	Science	On-Site	16	77.01	7.98	1.99	72.76	81.26	64.65	94.12
		Virtual	47	56.99	30.63	4.47	48.00	65.98	0.00	97.50
		Mixed	53	69.43	19.08	2.62	64.17	74.69	0.00	97.47
		Total	116	65.44	24.56	2.28	60.92	69.95	0.00	97.50
	Math	On-Site	4	66.68	8.07	4.04	53.83	79.52	55.76	73.49
		Virtual	4	46.03	3.57	1.78	40.35	51.70	40.77	48.69
		Mixed	13	48.57	18.18	5.04	37.59	59.56	23.40	74.92
		Total	21	51.54	16.36	3.57	44.09	58.98	23.40	74.92
	ELA	On-Site	9	84.16	6.20	2.07	79.39	88.92	75.38	92.74
		Virtual	16	70.64	11.62	2.90	64.45	76.83	44.18	86.53
		Mixed	24	77.12	13.97	2.85	71.22	83.02	47.59	100.00
		Total	49	76.30	12.83	1.83	72.61	79.98	44.18	100.00
9	Math	On-Site	27	39.51	17.03	3.28	32.77	46.25	6.52	72.39
		Virtual	42	22.42	25.26	3.90	14.55	30.29	0.00	82.89

Grade	Subject		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Min.	Max.
		Mixed	29	21.26	18.89	3.51	14.08	28.45	0.00	58.36
		Total	98	26.79	22.65	2.29	22.25	31.33	0.00	82.89
	ELA	On-Site	27	39.41	14.67	2.82	33.61	45.21	9.98	72.89
		Virtual	45	21.83	21.06	3.14	15.51	28.16	0.00	85.35
		Mixed	28	27.73	21.82	4.12	19.27	36.19	0.00	67.95
		Total	100	28.23	20.89	2.09	24.09	32.37	0.00	85.35

In order to further explore these patterns, we conducted inferential analyses using hierarchical multiple regression. Before this analysis, we evaluated the data for outliers, influential cases, and multiple regression assumptions (linear relationships, normally distributed residuals, and homoscedasticity). Correlations between the predictor variables and outcome variables were reasonable. Although there were some moderately high correlations between the on-task behavior variables (total minutes on assignments and overall completion), we found no multicollinearity issues. The data met all other conditions for conducting regression analysis. Table 3 presents descriptive statistics and correlation coefficients for all variables in the regression models by grade level.

Table 3. Correlations between Academic Performance and Predictor Variables

Grade	Subject (*n*)	Variable	Mean	SD	1	2	3	4	5
7	Science (38)	Average Grade	66.36	30.45		0.35	0.18	0.50	0.37
		On-site Instruction	0.34	0.48			-0.55	0.28	0.22
		Mixed Instruction	0.37	0.49				0.18	-0.03
		Assignment Time	244.16	209.71					0.40
		Assignment Completion	31.45	21.81					
	Math (95)	Average Grade	48.12	28.08		0.31	0.13	0.45	0.63
		On-site Instruction	0.25	0.44			-0.38	0.27	0.27
		Mixed Instruction	0.29	0.46				0.20	0.17
		Assignment Time	387.82	310.24					0.49
		Assignment Completion	50.75	28.08					
8	Science (116)	Average Grade	65.44	24.56		0.19	0.15	0.39	0.50
		On-site Instruction	0.14	0.35			-0.37	0.13	0.22
		Mixed Instruction	0.46	0.50				0.05	0.06
		Assignment Time	267.40	267.81					0.55
		Assignment Completion	25.17	19.09					
	Math (21)	Average Grade	51.54	16.36		0.46	-0.24	0.11	0.34

Grade	Subject (*n*)	Variable	Mean	SD	1	2	3	4	5
		On-site Instruction	0.19	0.40			-0.62	-0.11	0.43
		Mixed Instruction	0.62	0.50				-0.03	-0.49
		Assignment Time	1812.00	1028.81					0.51
		Assignment Completion	35.38	12.06					
	ELA (53)	Average Grade	76.30	12.83		0.29	0.06	-0.30	-0.20
		On-site Instruction	0.18	0.39			-0.47	0.05	0.12
		Mixed Instruction	0.49	0.51				-0.04	-0.25
		Assignment Time	871.59	485.48					0.51
		Assignment Completion	64.81	25.95					
9	Math (98)	Average Grade	26.79	22.65		0.35	-0.16	0.76	0.71
		On-site Instruction	0.28	0.45			-0.40	0.33	0.10
		Mixed Instruction	0.30	0.46				-0.17	-0.30
		Assignment Time	937.18	954.94					0.65
		Assignment Completion	30.68	16.88					
	ELA (100)	Average Grade	28.23	20.89		0.33	-0.02	0.56	0.49
		On-site Instruction	0.27	0.45			-0.38	0.31	0.21
		Mixed Instruction	0.28	0.45				-0.09	-0.19
		Assignment Time	691.61	567.75					0.48
		Assignment Completion	54.70	21.12					

We followed the preliminary analyses with an examination of the data to address our research questions.

Research Question 1

Our first research question explored the association between learning environment (on-site, virtual, and mixed) and the academic performance of junior high school students during the COVID-19 pandemic. To address this question, we interpreted the first stage of the hierarchical linear regression models. The results of the first stage of these analyses (see Table 4) revealed that the learning environment alone was a significant predictor of science, mathematics, and ELA performance across all grade levels, except for mathematics at the eighth-grade level.

The initial models accounted for between 8 and 29 percent of the variations in students' academic performance. These analyses revealed that the on-site learning environment had a statistically significant positive effect on students' academic outcomes across all grade levels and subjects for the statistically significant prediction models. There was also a positive effect for the mixed learning environment in three (seventh-grade science and mathematics, and eighth-grade science) of the six statistically significant regression models.

Table 4. Hierarchical Multiple Regression Models for Predicting Academic Performance

										Change Statistics			
Gr.	Subject	Mod.	R	R Square	Adj. R Square	S.E.	R Square Change	AIC	BIC	F Change	df1	df2	F Change (*p* value)
7	Science	1	0.57	0.33	0.29	25.73	0.33	249.70	254.61	8.41	2	35	.001
		2	0.65	0.42	0.35	24.58	0.09	247.98	256.17	2.68	2	33	.084
	Math	1	0.41	0.17	0.15	25.90	0.17	621.25	628.92	9.25	2	92	.000
		2	0.66	0.44	0.41	21.49	0.27	587.68	600.45	21.83	2	90	.000
8	Science	1	0.30	0.09	0.08	23.62	0.09	736.56	744.82	5.69	2	113	.004
		2	0.55	0.30	0.28	20.89	0.21	710.05	723.82	16.70	2	111	.000
	Math	1	0.46	0.22	0.13	15.27	0.22	117.26	120.39	2.47	2	18	.113
		2	0.51	0.26	0.07	15.79	0.04	120.17	125.40	0.42	2	16	.663
	ELA	1	0.37	0.14	0.10	12.18	0.14	247.86	253.53	3.66	2	46	.034
		2	0.49	0.24	0.17	11.71	0.10	245.83	255.29	2.88	2	44	.067
9	Math	1	0.35	0.12	0.10	21.45	0.12	603.81	611.57	6.58	2	95	.002
		2	0.84	0.70	0.69	12.68	0.58	502.67	515.59	89.46	2	93	.000
	ELA	1	0.35	0.12	0.10	19.78	0.12	599.91	607.73	6.67	2	97	.002
		2	0.65	0.42	0.40	16.24	0.30	562.40	575.43	24.44	2	95	.000

Note: Gr. = Grade Level, Mod. = Model

Research Question 2

For our second research question, our goal was to understand if adding measures of online assignment behaviors in each subject area improved our understanding of students' academic outcomes after controlling for the learning environment. To accomplish this, we examined the second stage of each hierarchical regression model for statistical significance and model fit. After controlling for the learning environment, the results show that online assignment behaviors significantly improved the prediction of academic performance for mathematics at the seventh and ninth-grade levels, for science at the eighth-grade level, and ELA at the ninth-grade level.

The secondary models generated changes in R^2 that ranged between 4 and 58 percent, with the most considerable change occurring in the prediction of ninth-grade mathematics performance and the slightest change occurring in the model for mathematics performance at the eighth-grade level. We then used Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) statistics to select the best fitted models among those that were statistically significant (See Table 4). Models with the lowest AICs and BICs are typically more parsimonious and less likely to be overfitted (Lv & Liu, 2014). Next, we examined how each predictor contributed to the models that included online assignment behaviors after controlling for the learning environment (see Table 5).

Table 5. Regression Coefficients for Predicting Academic Performance

			Model 1					Model 2				
							B 95% CI					*B* 95% CI
Grade	Subject	Variable	*B*	Std. Error	Beta	*p*	[*LL, UL*]	*B*	Std. Error	Beta	*p*	[*LL, UL*]
7	Science	(Constant)	40.03	7.76		<.001	[24.28, 55.78]	46.79	8.15		<.001	[30.21, 63.37]
		On-Site	41.07	10.54	0.65	<.001	[19.67, 62.47]	30.04	11.33	0.47	.012	[6.99, 53.09]
		Mixed Instruction	33.34	10.37	0.54	.003	[12.29, 54.38]	25.23	10.86	0.41	.026	[3.14, 47.33]
		Assignment Time						0.03	0.02	0.23	.172	[-0.02, 0.08]
		Assignment Completion						0.25	0.20	0.18	.225	[-0.16, 0.67]
	Math	(Constant)	36.10	3.95		<.001	[28.26, 43.95]	44.06	3.53		<.001	[37.05, 51.06]
		On-Site	26.85	6.60	0.42	<.001	[13.74, 39.95]	10.42	6.09	0.16	.091	[-1.68, 22.52]
		Mixed Instruction	17.74	6.29	0.29	.005	[5.25, 30.23]	4.84	5.64	0.08	.393	[-6.37, 16.05]
		Assignment Time						0.01	0.01	0.16	.104	[-0.00, 0.03]
		Assignment Completion						0.49	0.09	0.49	<.001	[0.31, 0.68]
8	Science	(Constant)	56.99	3.45		<.001	[50.16, 66.12]	59.99	3.09		<.001	[53.86, 66.12]
		On-Site	20.02	6.84	0.28	.004	[6.48, 33.56]	10.90	6.26	0.15	.084	[-1.51, 23.30]
		Mixed Instruction	12.44	4.73	0.25	.010	[3.07, 21.82]	8.63	4.24	0.18	.044	[0.23, 17.03]
		Assignment Time						0.01	0.01	0.15	.110	[-0.00, 0.03]
		Assignment Completion						0.48	0.13	0.37	<.001	[0.23, 0.73]
	Math	(Constant)	46.03	7.64		<.001	[29.98, 62.07]	44.72	8.03		<.001	[27.71, 61.73]
		On-Site	20.65	10.80	0.51	.072	[-2.04, 43.34]	19.94	12.07	0.49	.118	[-5.64, 45.52]
		Mixed Instruction	2.55	8.73	0.08	.774	[-15.80, 20.89]	4.88	9.55	0.15	.617	[-15.37, 25.12]
		Assignment Time						0.00	0.00	0.08	.773	[-0.00, 0.01]
		Assignment Completion						0.22	0.43	0.16	.620	[0.70, 1.14]
	ELA	(Constant)	70.64	3.04		<.001	[64.80, 76.75]	70.78	2.97		<.001	[64.80, 76.75]
		On-Site	13.52	5.07	0.41	.011	[3.30, 23.73]	13.93	4.88	0.43	.007	[4.09, 23.77]
		Mixed Instruction	6.48	3.93	0.26	.106	[-1.43, 14.39]	6.05	3.90	0.24	.128	[-1.80, 13.90]
		Assignment Time						-0.01	0.00	-0.29	.063	[-0.02, 0.00]
		Assignment Completion						-0.02	0.08	-0.04	.798	[-0.18, 0.14]
9	Math	(Constant)	22.42	3.31		<.001	[15.85, 28.99]	21.57	2.05		<.001	[17.50, 25.65]
		On-Site	17.09	5.29	0.34	.001	[4.60, 18.08]	11.34	3.39	0.23	.001	[4.60, 18.08]
		Mixed Instruction	-1.16	5.18	-0.02	.824	[-11.44, 9.12]	7.05	3.25	0.14	.033	[0.59, 13.52]
		Assignment Time						0.01	0.00	0.41	<.001	[0.00, 0.01]
		Assignment Completion						0.63	0.11	0.47	<.001	[0.41, 0.84]
	ELA	(Constant)	21.83	2.95		<.001	[15.80, 27.69]	23.58	2.45		<.001	[18.71, 28.45]
		On-Site	17.58	4.82	0.38	<.001	[8.02, 27.14]	9.80	4.14	0.21	.020	[1.57, 18.02]
		Mixed Instruction	5.90	4.76	0.13	.218	[-3.55, 15.35]	7.16	3.96	0.16	.074	[-0.70, 15.02]
		Assignment Time						0.01	0.00	0.36	<.001	[0.01, 0.02]
		Assignment Completion						0.30	0.09	0.30	.001	[0.12, 0.48]

These analyses show that ninth-graders' overall online assignment behaviors (total minutes spent on assignments

and overall completion) was the most important predictor of academic performance even though two learning environment variables (on-site and mixed) remained an important predictor of their mathematics and ELA performance respectively. In contrast, the model for science performance was the only statistically significant model at the eighth-grade level, with the mixed learning environment and overall completion contributing significantly to the model. Finally, at the seventh-grade level, only the model for predicting mathematics performance was significant, and overall completion alone accounted for much of the variation in the model. None of the learning environment variables contributed in a significant way to the prediction of this outcome.

The evidence from these analyses suggests a strong relationship between the learning environment and the academic performance of junior high school students during the COVID -19 pandemic. This strong relationship was most evident in the on-site (and to a lesser extent, the mixed learning environment), where students on average had higher academic performance than those in the virtual learning environment. Even after considering variables related to online assignment behaviors, this strong relationship between learning environment and academic performance persisted. This influence was most evident at the ninth-grade level and to a lesser extent at the seventh and eighth-grade levels.

Discussion

The purpose of this study was to compare the academic outcomes in science, mathematics, and ELA of junior high school students receiving virtual, mixed, and on-site instruction during the COVID-19 pandemic. We also sought to explore the influence of online assignment behaviors in each class on their academic outcomes beyond the effect of the learning environment. Our findings suggest when the learning environment alone is considered, receiving on-site instruction during the COVID-19 pandemic revealed stronger associations with academic success across most subjects and grade levels compared to receiving instruction in other settings (virtual and mixed).

Our results are similar to other studies which have shown that students in distance learning environments do not perform as well as students who receive face-to-face instruction (Ahn & McEachin, 2017; Fitzpatrick et al., 2020; Heissel, 2016; Miron & Urschel, 2012). A possible reason for these differences could be that students in the virtual environment during COVID-19 were not provided with adequate learning resources and the teacher support necessary to be successful due to the rapid shift to online-based instruction. Our results are in contrast with Harrell and Wendt (2019) who found no difference in learning outcomes between high school students in blended and distance-only environments.

For students who participated in mixed instruction (on-site and virtual), we found a similar pattern at the seventh-grade level. At the eighth-grade level, however, being in the mixed learning environment only had a relevant association with science performance but not with mathematics performance. For ninth-grade students, academic performance for students in the mixed environment was not different from that of students in the virtual learning environment. Though the mixed setting may have been a unique method of instruction during the pandemic, these results indicate that the performance of younger students seem to benefit the most from receiving some on-site

instruction (the mixed setting). Similar age-different outcomes were found in other studies showing that online-only instruction has a stronger negative effect on the academic performance of younger students (Chang & Kim, 2021; Tomasik et al., 2020).

At the second level of our analysis, we considered the additional influence of two factors related to online assignment behaviors - total time spent in each course and the total number of assignments completed. The online assignment behaviors improved the prediction of academic performance for mathematics at the seventh and ninth-grade levels, for science at the eighth-grade level, and for ELA at the ninth-grade level. These findings are consistent with Heinrich et al. (2019) and Hung et al. (2012) who found that completion of course assignments positively influenced student learning outcomes. With regard to the total time spent on the learning platform, our results are consistent with several studies showing a strong association between the amount of time students spend in an online course and their achievement (Heinrich et al., 2019; Liu & Cavanaugh, 2011; Liu & Cavanaugh, 2012; Pazzaglia et al., 2016; Zheng et al., 2020).

Implications

This study revealed contrasting patterns of relationships in academic performance between students receiving instruction on-site, virtually, and in mixed environments settings during the first year of the COVID-19 pandemic. Many of these disparities remained even after we considered students' online assignment behaviors. These findings raise concerns regarding the effectiveness of fully online (virtual) instruction for secondary students during the pandemic or thereafter. Previous studies have identified gaps in learning outcomes between face-to-face and distance learners before the pandemic (Ahn & McEachin, 2017; Fitzpatrick et al., 2020; Harris-Packer & Ségol, 2015; Heinrich et al., 2019; Heissel, 2016; Miron & Urschel, 2012). These findings suggest that students who received instruction primarily in an online learning environment during the 2020-2021 school year may require intensive remediation to address learning loss.

As the COVID-19 pandemic lingers and schools continue to rely on virtual instruction as an alternative to on-site learning, educators must make the appropriate adjustments to ensure that students are as successful in the virtual environment as they are in on-site settings. Likewise, parents who choose online-only options during the pandemic must consider their child's ability to acquire the time management and technology skills which Barbour and Reeves (2009) reported as necessary to be successful in an online learning environment.

Limitations and Future Research

There are some limitations to our findings in this study. For instance, the data were from a non-randomized sample of student scores at one school in the delta region of Arkansas. Due to this, we had small sample sizes in some groups (e.g., eighth-grade students in the virtual learning environment). In the sample, there was an overrepresentation of students from low SES families and students of African American ethnicity. These demographic characteristics may not be representative of some settings across the United States. Furthermore, although all teachers at the school used the same learning platform for content delivery, there may have been

variations in pacing and use of supplemental activities from teacher to teacher. Students in the virtual environment were also responsible for the pacing of their instruction as opposed to teacher-directed instruction in the face-the-face environment. We did not account for these variations in the study.

Additionally, the mixed learning environment included students who experienced a wide range of time in and out of the on-site and virtual learning environments. Students in this mixed learning environment were permitted to switch between learning environments at three different points during the semester. Our study did not account for any period for which on-site students had to quarantine (two weeks minimum) during the semester. Another limitation to the study was our measure of time spent in the study.

Our measure does not necessarily capture the qualitative value of the time spent on the learning platform. Likewise, our measure of the total number of assignments completed does not consider the specific types of assignments completed—these limitations could threaten internal validity and affect the extent to which the findings can be generalized. We recommend further investigations that draw from larger samples and include strategies to address the limitations of the current study. It would also be helpful for future studies to consider known factors affecting academic success at the K-12 level such as SES, sex, and previous academic achievement to determine the magnitude of their influence during the COVID-19 pandemic.

References

Ahn, J., & McEachin, A. (2017). Student enrollment patterns and achievement in Ohio's online charter schools. *Educational Researcher*, *46*(1), 44–57. https://doi.org/10.3102/0013189X17692999

Allen, I. E., & Seaman, J. (2017). *Digital learning compass: Distance education enrollment report 2017* (Report No. ED580868). Babson Park, MA: Babson Survey Research Group. Retrieved from https://eric.ed.gov/?id=ED580868

Alsalhi, N. R., Eltahir, M. E., & Al-Qatawneh, S. S. (2019). The effect of blended learning on the achievement of ninth grade students in science and their attitudes towards its use. *Heliyon*, *5*(9). https://doi.org/10.1016/j.heliyon.2019.e02424

Babinčáková, M., & Bernard, P. (2020). Online experimentation during COVID-19 secondary school closures: Teaching methods and student perceptions. *Journal of Chemical Education*, *97*(9), 3295–3300. https://doi.org/10.1021/acs.jchemed.0c00748

Barbour, M. K., & Reeves, T. C. (2009). The reality of virtual schools: A review of the literature. *Computers & Education*, *52*(2), 402–416. https://doi.org/10.1016/j.compedu.2008.09.009

Benner, A., Boyle, A., & Sadler, S. (2016). Parental involvement and adolescents' educational success: The roles of prior achievement and socioeconomic status. *Journal of Youth & Adolescence*, *45*(6), 1053–1064.

Boltz, L. O., Yadav, A., Dillman, B., & Robertson, C. (2021). Transitioning to remote learning: Lessons from supporting K-12 teachers through a MOOC. *British Journal of Educational Technology, 52*(4), 1377-1393. https://doi.org/10.1111/bjet.13075

Borup, J., & Stevens, M. A. (2017). Using student voice to examine teacher practices at a cyber charter high school. *British Journal of Educational Technology*, *48*(5), 1119–1130.

https://doi.org/10.1111/bjet.12541

Borup, J., Walters, S., & Call-Cummings, M. (2020). Student perceptions of their interactions with peers at a cyber charter high school. *Online Learning*, *24*(2), 207–224. http://dx.doi.org/10.24059/olj.v24i2.2015

Bouchrika, I. (2020, March 25). List of learning management systems for schools and universities [Web log post]. Retrieved from: https://www.guide2research.com/research/list-of-learning-management-systems-for-schools-and-universities

Brown, E. D., & Low, C. M. (2008). Chaotic living conditions and sleep problems associated with children's responses to academic challenge. *Journal of Family Psychology*, *22*(6), 920–923.

Centers for Disease Control and Prevention. (2020, February 11). *Community, work, and school*. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/community/Schools-childcare/schools.html

Chang, H. M., & Kim, H. J. (2021). Predicting the pass probability of secondary school students taking online classes. *Computers & Education*, *164*. https://doi.org/10.1016/j.compedu.2020.104110

Chen, W. F. (2012). An investigation of varied types of blended learning environments on student achievement: An experimental study. *International Journal of Instructional Media*, *39*(3), 205–212.

Davis-Kean, P. E. (2005). The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. *Journal of Family Psychology*, *19*(2), 294-304–304.

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences of the United States of America, 118*(17). https://doi.org/10.1073/pnas.2022376118

Farkas, G., & Beron, K. (2004). The detailed age trajectory of oral vocabulary knowledge: Differences by class and race. *Social Science Research*, *33*(3), 464–497.

Fitzpatrick, B. R., Berends, M., Ferrare, J. J., & Waddington, R. J. (2020). Virtual illusion: Comparing student achievement and teacher and classroom characteristics in online and brick-and-mortar charter schools. *Educational Researcher*, *49*(3), 161–175. https://doi.org/10.3102/0013189X20909814

Funding Digital Learning. (n.d.). Office of Educational Technology. Retrieved January 16, 2021, from https://tech.ed.gov/funding/

Goldhaber, D., Imberman, S., Strunk, K., Hopkins, B., Brown, N., Harbatkin, E., & Kilbride, T. (2021). *To what extent does in-person schooling contribute to the spread of COVID-19? Evidence from Michigan and Washington* (Report No. 28455). Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/papers/w28455

Haderlein, S. K., Saavedra, A. R., Polikoff, M. S., Silver, D., Rapaport, A., & Garland. M. (2021). Disparities in educational access in the time of COVID: Evidence from a nationally representative panel of American families. *AERA Open*, *7*.

Halan, D. (2005). Blended learning. *Journal of Educational Technology*, *2*(1), 20–24. Retrieved from https://www.learntechlib.org/p/161294/

Harrell, K. B., & Wendt, J. L. (2019). The impact of blended learning on community of inquiry and perceived learning among high school learners enrolled in a public charter school. *Journal of Research on Technology in Education, 51*(3), 259-272. https://doi.org/10.1080/15391523.2019.1590167

Harris-Packer, J. D., & Ségol, G. (2015). An empirical evaluation of distance learning's effectiveness in the K–

12 setting. *American Journal of Distance Education*, *29*(1), 4–17. https://doi.org/10.1080/08923647.2015.990768

Hart, C. M. D., Berger, D., Jacob, B., Loeb, S., & Hill, M. (2019). Online learning, offline outcomes: Online course taking and high school student performance. *AERA Open*, *5*(1). https://doi.org/10.1177/2332858419832852

Heinrich, C. J., Darling-Aduana, J., Good, A., & Cheng, H. (Emily). (2019). A look inside online educational settings in high school: Promise and pitfalls for improving educational opportunities and outcomes. *American Educational Research Journal*, *56*(6), 2147–2188. https://doi.org/10.3102/0002831219838776

Heissel, J. (2016). The relative benefits of live versus online delivery: Evidence from virtual algebra I in North Carolina. *Economics of Education Review*, *53*, 99–115. https://doi.org/10.1016/j.econedurev.2016.05.001

Henry, D. A., Betancur Cortés, L., & Votruba-Drzal, E. (2020). Black–White achievement gaps differ by family socioeconomic status from early childhood through early adolescence. *Journal of Educational Psychology*, *112*(8), 1471–1489.

Hodges, C., Bond, A., Trust, T., Lockee, B., & Moore, S. (2020, March 27). The difference between emergency remote teaching and online learning. Retrieved August 28, 2021, from https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Hung, J., Hsu, Y., & Rice, K. (2012). Integrating data mining in program evaluation of K-12 online education. *Educational Technology & Society, 15*(3), 27-41. https://www.j-ets.net/home

Kats, Y. (2010). *Learning management system technologies and software solutions for online teaching: Tools and applications*. IGI Global. https://doi.org/10.4018/978-1-61520-853-1

Kazu, I. Y., & Demirkol, M. (2014). Effect of blended learning environment model on high school students' academic achievement. *Turkish Online Journal of Educational Technology - Tojet*, *13*(1), 78–87. http://www.tojet.net/

Kokoç, M., Akçapınar, G., & Hasnine, M. N. (2021). Unfolding students' online assignment submission behavioral patterns using temporal learning analytics. *Educational Technology & Society*, *24*(1), 223–235.

Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., & Liu, J. (2020). Projecting the potential impact of COVID-19 school closures on academic achievement. *Educational Researcher*, *49*(8), 549–565. https://doi.org/10.3102/0013189X20965918

Lee, L.-K., Cheung, S. K. S., & Kwok, L.-F. (2020). Learning analytics: Current trends and innovative practices. *Journal of Computers in Education*, *7*(1).

Leech, N. L., Gullett, S., Cummings, M. H., & Haug, C. A., (2020). Challenges of remote teaching for K-12 teachers during COVID-19. *Journal of Educational Leadership in Action, 7*(1). https://www.lindenwood.edu/academics/beyond-the-classroom/publications/journal-of-educational-leadership-in-action/

Lincoln Learning Solutions (n.d.). *Lincoln Empowered FAQ*. Retrieved March 11, 2021, from http://info.lincolnlearningsolutions.org/faq

Liu, F., & Cavanaugh, C. (2011). High enrollment course success factors in virtual school: Factors influencing student academic achievement. *International Journal on E-Learning*, *10*(4), 393–418. Retrieved from https://www.learntechlib.org/primary/p/33040/

Liu, F., & Cavanaugh, C. (2012). Factors influencing student academic performance in online high school algebra. *Open Learning: The Journal of Open, Distance and e-Learning, 27*(2), 149-167. https://doi.org/10.1080/02680513.2012.678613

Lv, J., & Liu, J. S. (2014). Model selection principles in misspecified models. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, *76*(1), 141–167. https://doi-org./10.1111/rssb.12023

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record, 115*(3), 1–47. https://www.tcrecord.org/

Midcalf, L., & Boatwright, P. (2020). Teacher and parent perspectives of the online learning environment due to COVID-19. *Delta Kappa Gamma Bulletin*, *87*(1), 24–34.

Middleton, K. V. (2020). The longer-term impact of COVID-19 on k-12 student learning and assessment. *Educational Measurement: Issues and Practice, 39*(3), 41–44. https://doi.org/10.1111/emip.12368

Miron, G. & Urschel, J.L. (2012). *Understanding and improving full-time virtual schools: A study of student characteristics, school finance, and school performance in schools operated by K12 Inc.* Boulder, CO: National Education Policy Center. Retrieved from http://nepc.colorado.edu/publication/understanding-improving-virtual

Mwalumbwe, I., & Mtebe, J. S. (2017). Using learning analytics to predict students' performance in Moodle learning management system: A case of Mbeya University of Science and Technology. T*he Electronic Journal of Information Systems in Developing Countries, 79*(1), 1-13. https://doi.org/10.1002/j.1681-4835.2017.tb00577.x

Oliver, K., Kellogg, S., & Patel, R. (2012). An investigation into reported differences between online foreign language instruction and other subject areas in a virtual school. *Calico Journal*, *29*(2), 269–296. doi:10.11139/cj.29.2.269-296

Oliver, K., Osborne, J., & Brady, K. (2009). What are secondary students' expectations for teachers in virtual school environments? *Distance Education*, *30*(1), 23–45. https://doi.org/10.1080/01587910902845923

Paulus, L., Spinath, F. M., & Hahn, E. (2021). How do educational inequalities develop? The role of socioeconomic status, cognitive ability, home environment, and self-efficacy along the educational path. *Intelligence*, *86*.

Pazzaglia, A. M., Clements, M., Lavigne, H. J., & Stafford, E. T. (2016). *An analysis of student engagement patterns and online course outcomes in Wisconsin* (REL 2016–147). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest. Retrieved from http://ies.ed.gov/ncee/edlabs

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future*, *8*(1), 133–141. https://doi.org/10.1177/2347631120983481

Poon, L. K. M., Kong, S., Yau, T. S. H., Wong, M., & Ling, M. H. (2017). Learning analytics for monitoring students participation online: Visualizing navigational patterns on learning management system. In S. K. S. Cheung, L. Kwok, W. W. K. Ma, L. Lee, & H. H. Yang (Eds.), *Blended Learning: New Challenges*

and Innovative Practices (pp. 166-176). Springer International Publishing. https://doi.org/10.1007/978-3-319-59360-9_15

Rauf, D. (2020, December 06). Coronavirus pushes schools closer to a computer for every student. Retrieved August 08, 2021, from https://www.edweek.org/technology/coronavirus-pushes-schools-closer-to-a-computer-for-every-student/2020/06

Raza, S. A., Qazi, W., Khan, K. A., & Salam, J. (2021). Social isolation and acceptance of the learning management system (LMS) in the time of COVID-19 pandemic: An expansion of the UTAUT model. *Journal of Educational Computing Research*, *59*(2), 183–208. https://doi.org/10.1177/0735633120960421

Shamir-Inbal, T., & Blau, I. (2021). Facilitating emergency remote K-12 teaching in computing-enhanced virtual learning environments during COVID-19 pandemic - blessing or curse? *Journal of Educational Computing Research.* https://doi.org/10.1177/0735633121992781

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). *American Journal of Distance Education, 33*(4), 289-306. doi:10.1080/08923647.2019.1663082

Soffer, T., & Cohen, A. (2019). Students' engagement characteristics predict success and completion of online courses. *Journal of Computer Assisted Learning*, *35*(3), 378–389. https://doi.org/10.1111/jcal.12340

Tara S, N., & Bindu, R. L. (2016). Effect of blended learning strategy on achievement in biology and social and environmental attitude of students at secondary level. *I-Manager's Journal on School Educational Technology*, *11*(4), 39–39. https://doi.org/10.26634/jsch.11.4.6011

Thompson, L. A., Ferdig, R., & Black, E. (2012). Online schools and children with special health and educational needs: Comparison with performance in traditional schools. *Journal of Medical Internet Research*, *14*(2), 15.

Tomasik, M. J., Helbling, L. A., & Moser, U. (2020). Educational gains of in-person vs. distance learning in primary and secondary schools: a natural experiment during the COVID-19 pandemic school closures in Switzerland. *International Journal of Psychology*, *(2020)*. https://doi.org/10.1002/ijop.12728

U. S. Census Bureau (2020). *Schooling during the COVID-19 pandemic*. Retrieved January 16, 2021, from https://www.census.gov/library/stories/2020/08/schooling-during-the-covid-19-pandemic.html

Utami, I. S. (2018). The effect of blended learning model on senior high school students' achievement. *SHS Web of Conferences*, *42*. https://doi.org/10.1051/shsconf/20184200027

Vargo, D., Zhu, L., Benwell, B., & Yan, Z. (2020). Digital technology use during COVID -19 pandemic: A rapid review. *Human Behavior and Emerging Technologies*, *3*(1), 13–24. https://doi.org/10.1002/hbe2.242

Wyse, A. E., Stickney, E. M., Butz, D., Beckler, A., & Close, C. N. (2020). The potential impact of COVID-19 on student learning and how schools can respond. *Educational Measurement: Issues & Practice, 39*(3), 60–64. https://doi-org /10.1111/emip.12357

Yapici, I. U., & Akbayin, H. (2012). The effect of blended learning model on high school students' biology achievement and on their attitudes towards the internet. *Turkish Online Journal of Educational Technology - Tojet*, *11*(2), 228–237. http://www.tojet.net/

Yeung, W.-J. J., & Pfeiffer, K. M. (2009). The black–white test score gap and early home environment. *Social Science Research*, *38*(2), 412–437.

Zeichner, O. (2018). The impact of cognitive and non-cognitive feedback on students' achievement in a distance learning environment. *I-Manager's Journal of Educational Technology, 14*(4), 13-27. https://doi.org/10.26634/jet.14.4.13976

Zheng, B., Lin, C.-H., & Kwon, J. B. (2020). The impact of learner-, instructor-, and course-level factors on online learning. *Computers & Education*, *150*. https://doi.org/10.1016/j.compedu.2020.103851

Author Information

Kendall D. Naceanceno

https://orcid.org/0000-0002-2929-6007

Middle Tennessee State University

1301 E Main St, Murfreesboro, TN 37132

United States

Contact e-mail: *kdn3f@mtmail.mtsu.edu*

Usenime M. Akpanudo

https://orcid.org/0000-0002-5467-898X

Harding University

915 E. Market Ave. Searcy, AR 72149

United States