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# PERSISTENCE AND ACADEMIC PERFORMANCE OF MEDICAL STUDENTS IN ONLINE LEARNING ENVIRONMENT DURING THE COVID-19 PANDEMIC LOCKDOWN

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**Abstract:**


Government response to the COVID 19 pandemic in the spring of 2020 came as a wave of physical closures requiring sudden change in the method of instruction from face-to-face to a completely online. Assessment of student's adaptation to this change during emergency lockdown is the focus of this study. Students' test scores related to perception of persistence levels were studied using correlation analysis. In addition, a regression analysis was performed to examine prediction factors of medical student grades during COVID-19. Students' grades in the module during COVID-19 were significantly higher compared to the grades in recent prior years at the  $p < .001$  level [ $F(3, 692) = 9.08$ ]. Pearson product-moment correlation results showed a strong and positive correlation between students' persistence level ( $M = 3.46$ ,  $SD = .997$ ,  $n = 79$ ), and their module grade during COVID-19 ( $M = 258.777$ ,  $SD = 14.6878$ ,  $n = 79$ ),  $r = .33$ ,  $p = < .01$ . The multiple linear regression analysis accounts for 14% of the variance in students' module grades and the variance was statistically significant at  $p < .05$ . As such, we conclude that students' persistence to adjust to a new learning environment, coupled with module directors and faculty successfully employing remote education methods, met the learning challenges during the pandemic and students maintained a high level of academic success.


**Keywords:** Medical education, Persistence, Social Cognitive Theory, COVID-19, Online learning


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## INTRODUCTION

Spring semester 2020 will always be remembered as the semester of academic interruption caused by the COVID-19 Pandemic. In mid-March 2020, the University of Arkansas for Medical Sciences (UAMS) cancelled face-to-face classes and moved instruction completely online in response to mandatory lockdown for the safety of students, faculty, and staff. Medical education methods required emergency adaptation due to mandatory lockdown, providing an impetus for pedagogical innovations (Dedeilia et al., 2020). Lockdown began the first day of the Brain and Behavior Module and changed every aspect of the normal learning environment for instructors and students alike.

The pedagogical transformation of medical school curricula including changes in student contact hours, classroom technologies, laboratories, and implementation of active self-directed learning had been a trend for several years (Irby et al., 2010; Rose, 2020) with UAMS being no exception. The pandemic hastened this transformation, but created hitherto unaddressed problems, including how to adapt laboratory and clinical hands-on activities using cadaveric laboratory material, standardized patients, team collaboration, and student-instructor interaction in-person. Other difficulties included unequal access to remote technology, unreliability of rural internet bandwidth, variable home environments, stress of potential of illness, and variation in students' learning styles.

Possible effects on students' ability to adapt to necessary sudden changes in instructional methods used in the 2020 UAMS brain and behavior module during lockdown became the impetus for this study. Social Cognitive Theory (SCT) was used to look for factors affecting the academic performance of medical students in the sudden academic interruption.

Many studies indicated that teaching online requires different pedagogy and students are required to self-regulate their learning to successfully complete online courses (Moore et al., 2011; Rovai & Downey, 2010; Schroeder & Levin, 2012). Despite presumed flexibility, an online learning environment requires students to choose their learning time and pace, and many students often struggle to effectively regulate their learning process (Azevedo, 2005; Bol & Garner, 2011). Self-regulated learning is very crucial for students' learning because it enables students to initiate and direct their own efforts to acquire knowledge and to be actively involved in learning.

Researchers classified self-regulation strategies into three broad and overlapped areas: personal, behavioral, and environmental (e.g., Delen & Liew, 2016; Pintrich, 1999; Wang et al., 2009; Wolters & Rosenthal, 2000; Zimmerman, 1989). Personal traits in students such as persistence, self-control, or the capacity to regulate attention, emotion, and behavior in the presence of challenges have been highlighted as important for student success (Davis, 2015; Duckworth & Gross, 2014; Tough, 2012). Specifically, many scholars have postulated the importance of students' persistence to their academic outcomes and successful degree completion (Duckworth et al., 2011; Duckworth & Quinn, 2009; Rojas et al., 2012).

The significance for this study is grounded on its novel assessment of medical student academic performance during emergency as well as the contribution to an already large body of research investigating the advantages and disadvantages of online teaching strategies in different contexts. After examining prior research, the following research questions will guide this study:

1. Is there a relationship between students' module grades and their persistence level in an online learning environment during COVID-19 academic interruption?
2. What factors best predict the module grades of medical students during COVID-19 academic interruption?
3. Do medical students' grades during the COVID-19 academic interruption differ compared to students' grades prior to COVID-19?

## METHOD

### *Theoretical framework*

The present study adopted a theoretical framework founded on Bandura's Social Cognitive Theory (SCT) to examine the different influence of three factors in students' learning (personal, behavioral and environmental) (Bandura, 1986, 1997). Bandura suggested that these three factors can contribute to enhancing learners' self-efficacy through attending the consequences of their learning activities. Bandura defined self-efficacy as "the beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997). According to Bandura (1997), people would make their choices based on their self-efficacy beliefs and these beliefs are not about the number of skills they possess but what they can accomplish with those skills under different situations. Additionally, people's self-efficacy beliefs impact their efforts to complete their tasks and their resolve to cope with difficult situations. According to Bandura (2001), learning can be acquired by engaging students in setting goals for themselves then directing their action accordingly. Thus, in the context of the present study, there are three factors contributing to students' learning that can be observed through the following actions: behavioral (participation in online activities); cognitive (process of learning); and environmental (course materials). According to SCT, students taking an active role in the process of learning are expected to change their learning strategies leading to mastering the learning content. Figure 1 Presents the theoretical framework model based on Bandura's Social Cognitive Theory.

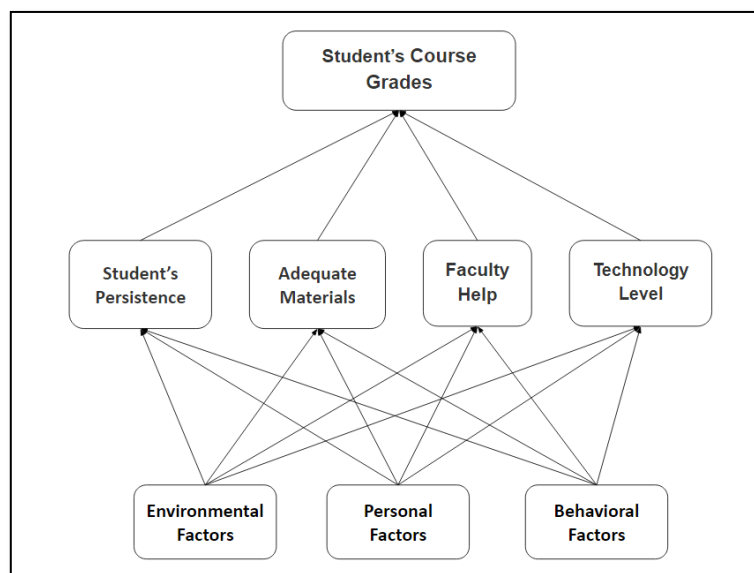


Figure 1. Theoretical framework based on Bandura's Social Cognitive Theory

### *Research Design*

The present study used the social cognitive theory framework to examine factors affecting the academic performance of medical students as they adapted to the fully online learning environments during the COVID-19 academic interruption. Correlation analysis was used to examine the relationship between students' test scores and their persistence level during COVID-19. This study explored factors that best predict course grades for medical students during the pandemic. A comparison design was used between students' academic performance in two different conditions (during and before COVID-19).

The present study adopted Bandura's Social Cognitive Theory (SCT) as a theoretical framework to examine the interplay between three factors in students' learning (personal, behavioral and environmental) (Bandura, 1986). According to SCT, students immersed in their learning activities and taking an active role in the process of learning are expected to change their learning strategies, leading to mastering the learning content. The investigators of this study have employed a between-subject design. The study included one dependent variable (students' grades in the module) and five independent variables (comfort level of online learning, comfort level of using technology, faculty help, online learning materials, and student perception of their persistence levels during COVID-19).

#### *Module Description:*

The Brain and Behavior Module originated through combination of interdisciplinary neuroscience course and a behavioral science course. It covers a broad range of topics focusing primarily on neurology, neuropathology, and psychiatry.

#### *Module Learning Assessments:*

The investigators used students' exam scores to evaluate them. A total of 90 seconds per each exam question was allotted both prior to and during the pandemic. To accommodate environmental challenges in the remote situation, students had an extended timeframe for starting the exam remotely but not for completing the exam questions.

#### *Sampling and Participants:*

In this study, the investigators utilized the convenience sampling technique to recruit the participants. Voluntary participation of students was solicited online via electronic mail. Participants in this study were 79 students enrolled in College of Medicine M1. Participants included 30 male, 45 female and 4 preferred not to answer. There were 56 students aged between 22-24, 14 students age between 25-28 and 9 students aged 29 and above. There were 56 White students, 5 Hispanic/Latino students, 1 Black/African American student, 5 Native American or Alaska Native students, and 12 Asian students.

#### *Data Collection and IRB:*

Approval from the university's institutional review board (IRB) was obtained before data was collected. The investigators de-identified the collected data to afford student anonymity. After data collection via the online survey instrument, the records were housed on the university's secure server.

#### *Measures and Instrument:*

Prior to the development of the research instrument, a literature review of online learning was conducted. Faculty members in the College of Medicine reviewed the instrument. The

instrumentation consisted of the following: students' demographics, a twenty-question survey with 5-level Likert scale for assessment of student perception of persistence levels during the academic interruption caused by COVID-19, student use of module learning materials, and the level of student satisfaction with help received during online learning.

#### *Survey of student perception of online learning:*

This survey allowed assessment of students' perception of persistence levels and overall experience in the emergency online learning setting. All items in this questionnaire were adapted from published works and were discussed with academic scholars to ensure construct validity prior to conducting the study. To improve clarity, comprehensiveness, and relevance of this instrument, as well as to check for content validity, college students in different courses took this survey and instructors' inputs were applied. The investigators then formulated the questionnaire to include six items concerning students' perception of their experience with the online learning in the College of Medicine. These six items addressed four concepts: 1) perceived positive and negative online experiences, 2) satisfaction with online learning content, 3) satisfaction with the help provided by faculty, and 4) perception of persistence levels during COVID-19 interruption.

#### *Example question of student perception of online learning:*

Each respondent was asked to rate the following statement: "I have never been excited about the online learning". Students had the choice to select one of the following answers: 5 = Strongly Agree, 4 = Agree, 3 = neither Agree nor Disagree, 2 = Disagree, 1 = Strongly Disagree.

#### *Survey of students' perception of academic impact:*

This survey used a Likert-scale questionnaire to assess students' perceptions of the academic impact of Covid19 and student adaptation to a fully online format. Students were asked to voluntarily participate in this 29-question survey at the end of the semester.

#### *Example question asked in the students' perception of academic impact survey:*

Sudden change in teaching was stressful at first but improved as the module continued. Students taking the survey have the choice to indicate their agreement or disagreement with this statement with answers on a scale between 5 (Strongly Agree) to 1 (Strongly Disagree).

#### *Ethical Considerations*

All procedures performed in the current study were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments and the comparable ethical standards (University of Arkansas for Medical Sciences Institutional Review Board classified this study (IRB # 261199) as Exempt, category [1], on 07/13/2020, based on Title 45 CFR 46.101.).

## RESULTS

### *Question 1*

Is there a relationship between students' module grades and their persistence level during COVID-19 academic interruption?

To answer this question, a Pearson product-moment correlation was conducted to assess the relationship between students' module grade and their persistence level during COVID-19 academic interruption. The analysis revealed that there was a strong and positive relationship between students' persistence level ( $M = 3.46$ ,  $SD = .997$ ,  $n = 79$ ), and their module grade during COVID-19 ( $M = 258.777$ ,  $SD = 14.6878$ ,  $n = 79$ ),  $r = .33$ ,  $p < .01$ . Overall, higher students' persistence level was associated with their higher module grade during COVID-19. Table 1 summarizes the correlation analysis.

**Table 1**

*Correlations between 79 UAMS medical students' grades of the brain and behavior module2during the COVID-19 academic interruption and their reported persistence level*

		Students' persistence level	Module Grade during COVID-19
Students' persistence level	Pearson Correlation	1	.330**
	Sig. (2-tailed)		.003
	Sum of Squares and Cross-products	77.595	377.620
	Covariance	.995	4.841
	N	79	79

**Note.** *Statistically significant differences, at 0.01 level (2-tailed)*

### Question 2:

What factors best predict the module grades of medical students during COVID-19 academic interruption?

To address the second question, the investigators conducted multiple regression analysis.

**Multiple Regression Assumptions:** The investigators the regression descriptive statistics output to check for multicollinearity assumption between predictor variables. The results output showed that correlations between variables were less than 0.6. The output indicated that none of included predictors has multicollinearity. The investigators found that predictor variables correlate with the outcome variable (module grade) and the relationship was in a straight line and the regression standardized residual on the y-axis and the x-axis within negative 3 to 3. Finally, the Cooks Distance was minimum of .000 and the maximum .101.

**Multiple Regression Finding:** The following are the included variables: students' familiarity with online learning, students' familiarity with technology use, the faculty help, the learning materials provided and students' perception about their persistence level. The investigators found that the predictor model was able to account for 14% of the variance in the dependent variable and it was statistically significant at  $p < .05$ . Individual predictors were examined further, and the result indicated that the only statistically significant predictor of students' module grades during COVID-19 academic interruption was their perception about their persistence ( $t = 2.731$ ,  $p = .008$ ). Tables 2 & 3 summarize the multiple regression finding.

**Table 2**

Model Summary Predictors: Online level, technology level, faculty help, learning materials and persistence level for 79 UAMS medical students

Model	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics					
				R Square Change	F Change	df1	df2	Sig. F Change	
1	.374a	.140	.081	14.0823	.140	2.370	5	73	.047

**Note:** Dependent Variable: Total module Grade during COVID-19

**Table 3**

Unstandardized and standardized coefficients and significance of independent variables

Model	Unstandardized Coefficients		Standardized Coefficients		Correlations				Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	255.058	13.995		18.225	.000					
Enjoy online	-.911	1.700	-.060	-.536	.594	-.007	-.063	-.058	.930	1.075
Technology level	-.665	2.035	-.038	-.327	.745	-.120	-.038	-.036	.863	1.159
Faculty help	1.920	1.671	.136	1.149	.254	.150	.133	.125	.839	1.192
Enough Materials	-.371	.305	-.140	-1.216	.228	-.058	-.141	-.132	.883	1.132
Student's Persistence	4.725	1.730	.321	2.731	.008	.330	.305	.297	.854	1.171

**Note:** Dependent Variable: Total module Grade. Predictors: (Constant), Enjoy online, Good with technology, Faculty help, Enough Materials and persistence level

### Research question 3:

Do medical students' grades during the COVID-19 academic interruption differ compared to students' grades prior to the pandemic?

To answer this question, the investigators conducted a one-way between subject's ANOVA to compare the effect of the COVID-19 academic interruption on medical students' grades compared to medical students' grades before the academic interruption. Prior to the analysis, the ANOVA assumption of equal variances was checked using Levene's Test (homoscedasticity). The result of Levene's test revealed that the homogeneity of variance assumption was violated. Therefore, the Robust Tests of Equality of Means was used to determine the significance of difference by using the Brown Forsythe. A one-way between subjects' ANOVA was then conducted to compare students' module grades of brain and behavior during the COVID-19 (spring 2020 semester) and students' grades in the three years prior to the COVID-19. The results indicated that there was a significant difference at the  $p < .001$  level for all four years [ $F(3, 692) = 9.08, p = 0.001$ ]. Post hoc comparisons using the Tukey HSD test indicated that the mean scores of students' in the brain and behavior module during COVID-19 ( $M = 88.78, SD = 5.61$ ) was significantly higher compared to the mean scores of students' in the brain and behavior module during 2019 ( $M = 86.25, SD = 6.78$ ), 2018 ( $M = 85.84, SD = 6.62$ ), and during 2017 ( $M = 85.03, SD = 8.91$ ). Taken together, these results suggest that students' grades in the brain and behavior during the COVID-19 academic interruption were the highest compared to the prior three years and these differences were statistically significant. Specifically, our results suggested that students' academic performance improved during COVID-19. Table 4 summarizes results from the ANOVA.



**Table 4**

*Results of one-way between subjects' (ANOVA) compare between 174 UAMS medical students' grades of the brain and behavior module during the COVID-19 academic interruption and students' grades in the three years prior to the COVID-19 semester*

Students' Grade	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1367.324	3	455.775	9.084	.000
Within Groups	34719.753	692	50.173		
Total	36087.078	695			

**Note:** \*. The mean difference is significant at the 0.05 level.

## DISCUSSION

The purpose of this study was to evaluate medical student persistence and academic performance in an online learning format developed during COVID-19 academic interruption. For this evaluation, medical students voluntarily participated in a survey which was developed related to medical students' persistence and academic performance during spring semester 2020.

Examination of the relationship between students' module grades and their perceived persistence level during COVID-19 academic interruption indicated a strong and positive relationship between students' brain and behavior module grades and their perceived persistence level during spring semester 2020. Specifically, students who reported higher persistence level also received higher module grades during COVID-19. These results are also consistent with the findings from other studies that concluded that persistence is a significant factor in students' success (Shechtman et al., 2013). Further, many studies implicate that individuals who persist to work and study through challenges are likely to reach higher achievement compared to others who lack similar facets (Duckworth & Gross, 2014; Huéscar Hernández et al., 2020; Miller-Matero et al., 2018).

Out of all the included variables in this study, the only statistically significant predictor of students' module grades during the COVID-19 academic interruption was their perception about their persistence. Our findings are consistent with the findings of other studies indicating that students' persistence is a significant predictor for their academic success (Bliss & Jacobson, 2020; Duckworth & Gross, 2014; Huéscar Hernández et al., 2020; Miller-Matero et al., 2018; Shechtman et al., 2013). A possible interpretation of these findings is that, in the context of the present study, it appeared that medical students have high levels of determination in the face of the extraordinary circumstances during the COVID-19 academic interruption. Furthermore, medical students with higher levels of persistence are more likely to overcome the problems they were faced during the spring semester 2020 and they were able to perform academically better. Further, that students' beliefs in their ability to learn are predictive of their subsequent perseverance. This interpretation is consistent with other findings indicating that students' persistence level predicts their academic achievement over and beyond their talent (Duckworth & Quinn, 2009).

Interestingly, student grades in the Brain and Behavior Module during the COVID-19 lockdown were higher compared to grades in three years prior to the COVID-19. Together,

these findings suggest that the persistence of medical students allowed them to adapt to meet and surpass the challenges triggered by the COVID-19 learning environment. A possible interpretation of these results is that students included in this study were freshman medical students with a high level of academic persistence, adaptability, and intelligence. Students adapted and successfully used the remote learning materials and their administration provided by the Brain and Behavior faculty. Despite having no time to prepare, the faculty considered students' diverse learning styles to counterbalance the missing elements of the face-to-face instruction in the emergency. Online learning contents included blackboard collaborate live- and pre-recorded lectures, live reviews via Zoom, live Q&A sessions using Turning Point mobile polling with Blackboard and electronic mail, use of audio narrated Power Point slides, and YouTube video demonstrations including games, reinforcing course contents. This interpretation is consistent with prior research that indicated students' personal factors such as persistence level and self-beliefs are the most powerful predictors of first year students' success. These factors regarding intentions to persist, fail or drop out of school are incorporated as they navigate their first independent experiences in the adult world (Walsh & Robinson Kurpius, 2016). Interestingly, many researchers have found first year students' self-beliefs strongly related to their academic persistence across ethnicity and gender (Gloria, 1997; Gloria et al., 2005; Gloria et al., 1999; Gloria & Robinson Kurpius, 2001; Rayle et al., 2005; Rayle et al., 2006).

Limitations of this study include student sample size and the switch to a pass/fail grading system to alleviate student stress unlike in prior years.

## CONCLUSION

This study was conducted to examine the possible impact of COVID-19 lockdown on the medical students' academic performances. Despite the pandemic related challenges, students were able to maintain an adequate effort and succeed through their persistence. In absence of in-person communication with the faculty and peers, live online events to keep students engaged proved useful and were appreciated by the students. Brain and Behavior Module grades in the three years before the pandemic compared to those during COVID-19 indicated student's grades were higher during the COVID-19 semester. We concluded that the students' persistence as they adapted to an emergency that created a new, fully remote learning environment with steps taken by the module directors and other faculty allowed students to overcome the learning challenges and maintain high level of academic success.

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## Biographical notes:

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**Noor Akhter:** Noor Akhter is an Associate Professor University of Arkansas for Medical Sciences, College of Medicine, United States. Her research interest includes Steroid regulation of somatotropes in the male.

**Mohamed Ibrahim:** Mohamed Mostafa Ibrahim is an Associate Professor of Instructional Design and Technology, and the Director of Master of Education: Instructional Design & Technology College of Education, Arkansas Tech University, United States. His research focuses on educational technology, multimedia and cognition.

**Laura C. Stanley:** Laura C. Stanley is an associate Professor University of Arkansas for Medical Sciences, College of Medicine, United States. Her research interest includes Cellular aspects of neurodegeneration in dementing disorders, Melatonin used in treating chronic, debilitating migraine headaches with a sleep component.

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### *Author(s)' statements on ethics and conflict of interest*

**Ethics statement:** We hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. We take full responsibility for the content of the paper in case of dispute.

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