DLSU RESEARCH CONGRESS 2023
MANILA, PHILIPPINES
JULY 5-7, 2023
Fostering a Humane and Green Future:
Pathways to Inclusive Societies and Sustainable Development

Online Learning Behavior, Cognition, Environment, and Perceived Academic Performance: An Analysis of College Students' Perceived Learning Loss and Gains in Online Learning

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Abstract

School closure during pandemic has forced schools to shift to online learning, affecting students in all aspects. One of the effects of school closures is learning loss. Learning loss during the pandemic was estimated to be equivalent to roughly half a year's worth of learning. Most studies made use of achievement test for analyzing learning loss and gains. However, these can also be presented in terms of development or deterioration of non-cognitive factors such as student engagement, motivation/interest, attendance, and communication. This study sought to determine the effects of online learning on college students based on Bandura's ternary learning theory. The theory posits that learning occurs in a social context with a dynamic and reciprocal interaction among three elements: learning behavior, learning cognition, and learning environment. The study involved 360 college students enrolled in hybrid classes who responded to standardized scales. Data were analyzed using descriptive statistics, t-test, Pearson correlation, and regression analysis. Diagnostics for regression analysis were conducted. The possible presence of multicollinearity was tested through estimation of the Variance Inflation Factor (VIF) and Tolerance (TOL). Results showed VIFs below 4.0 and TOLs above .25, indicating no multicollinearity (i.e., VIFs = 1.857 to 2.402 and TOLs = 0.416 to 0.539). The Weighted Least Square model was also used to account for homoscedasticity. Results showed significant and positive relationships among the three variables, i.e., (1) between learning environment, and learning behavior and learning cognition, and (2) between learning behavior and learning cognition. The three variables also significantly predicted perceived academic performance, explaining 53% of the variance in the dependent variable. Students also reported having more learning gains than losses in online learning. It is recommended that teachers come up with teaching strategies, activities and learning environment that will best motivate students in online learning modality. Students are also encouraged to be engaged extensively in their online classes to be able to achieve good learning outcomes.

Key Words: online learning behavior; online learning cognition; online learning environment; perceived academic performance; learning gains and losses

1. INTRODUCTION

School closure during the COVID-19 pandemic has forced schools to shift to online learning and has affected the students in all aspects. The United Nations (2020) reported that "the COVID-19 pandemic has created the largest disruptions of education systems in history, affecting nearly 1.6 billion learners in more than 190 countries and all continents" (p. 2).

One of the adverse effects of school closure is learning loss. Learning loss refers to any specific or general loss of knowledge and skills or to reversals in academic progress, most commonly due to extended gaps or discontinuities in a student's education." (The Glossary of Education Reform, 2013). An analysis of thirty-six robust studies by World Bank on learning loss covering 20 countries reported learning losses equivalent to roughly half a year's worth of learning (Patrinos, et al., 2022).

Most studies made use of achievement test results as bases for analysis of learning loss and gains. However, this only tells a partial picture as the other part of the story might actually be indicating different kinds of learning gain that have occurred in students experiencing non-cognitive learning opportunities during the COVID-19 pandemic (Chen & Krieger, 2022). Learning loss and gains during online learning can also be measured by indicators other than students' performance in standardized tests. They can also be presented in terms of development or deterioration of non-cognitive factors such as student engagement, motivation/interest, attendance, communication, among others before, during and after school closure. For example, a study by Leong, et al. (2022) which explored the learning losses among undergraduate students in UC-Berkeley identified various types of learning losses, which ranged from diminished learning skills to decrease in academic confidence, motivation, and focus, brought about by lack of opportunity for social interaction, lack of learning structure, excessive screen time/other technical difficulties, and diminished quality of instruction. Likewise, they identified learning gains from virtual learning, which include accessibility, flexibility, convenience, and ability to customize learning preferences to learning needs. They also found other types of learning, such as enhancement of self-efficacy and resourcefulness, resilience, motivation, self- and time-management skills, and technical skills.

This study sought to determine the effects of online learning on college students during the pandemic based on Bandura's ternary learning theory. Bandura (1986) theorized that learning occurs in a social context with dynamic and reciprocal interaction among three elements: learning behavior, personal factors (such as cognition), and learning environment [Figure 1]. From this perspective, learning cognitions (e.g., motivation), behavior (e.g., self-engagement), and environmental factors (e.g., teaching and learning conditions) are mutually interactive influences, such that changing some of these elements will affect the type and extent of learning outcomes.

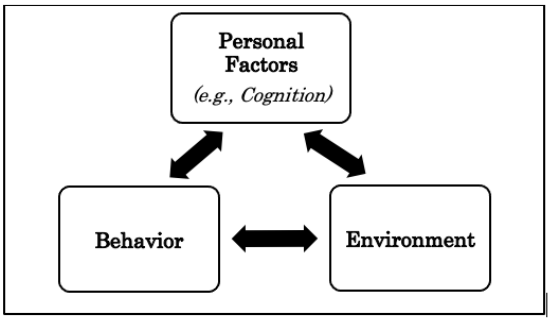

Figure 1: Bandura's Triadic Reciprocal Determinism

Zhu, et al. (2022) posited that Bandura's framework also applies to online learning of college students. They said that in an online environment where there is no time and space limitation, students' learning behavior and learning cognition are highlighted. At the same time, individual cognition has a guiding effect on students' learning behavior and vice versa. Studies have also shown that learning behavior, cognition, and environment affect academic performance in the online courses. For example, significant positive relationships were found between academic performance and learning behaviors (Chao, et al., 2018), student engagement (Gray & DiLoreto, 2016; Moubayed, et al., 2018), motivation (Marlina, et al., 2021; Meng & Hu, 2023; Ozer & Badem, 2021), metacognitive learning strategies (Hayat, et al., 2020), online environment (Gray & DiLoreto, 2016), and teacher characteristics (Marlina, et al., 2021).

For this study, online learning behavior was presented in terms of behavioral dimensions of students' engagement, that is, self-study strategies, management of learning environment, time management, and goal-setting. Learning cognition was measured through three indicators: learning motivation, information perception, and adaptability (Zhu, et al., 2022). The online learning environment was indicated by the quality of communication/interaction, teacher support, enthusiasm, feedback, and language, ease of use of online system, and meeting of needs. These three variables constitute a learning system that has a profound impact on online learning [Figure 2].

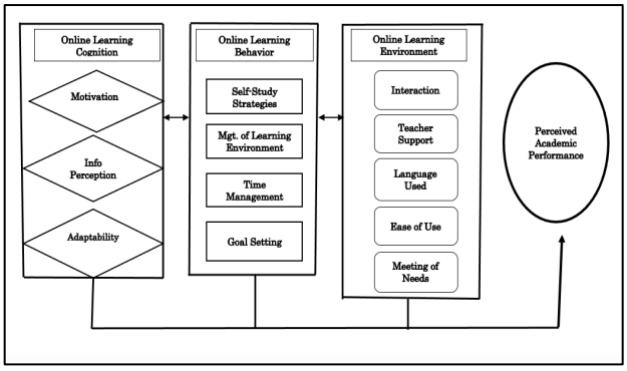

Figure 2: Conceptual Framework

Online learning effects (i.e., gains and losses) were specified in terms of students' perception of the quality of their learning behavior, cognition, satisfaction with learning environment, as well as their academic performance and outcomes in online learning. Since there were no pretest data on these outcomes, comparison was not done before and during the pandemic, which is the general practice when quantifying learning loss/gains in the cognitive area.

While schools started to open and welcome students on campus when the pandemic began to ease up, many schools still opted to continue conducting online classes in addition to F2F classes (i.e., hybrid learning). It is therefore important to understand the impact of online learning on the students' processes and outcomes to help teachers come up with teaching strategies and activities that will best motivate and guide students on how best to perform in online classes to achieve utmost academic performance.

Objectives of the Study

This study aimed to determine the relationships among three elements of learning process and their effects on the academic performance of college students in online classes. Specifically, it sought to answer the following questions:

1. Are there significant relationships between students' online learning behavior, learning cognition, and satisfaction with online learning environment?
2. What are the effects of students' online learning behavior, cognition, and satisfaction with learning environment on their perceived academic performance?
3. What are the perceived learning gains and losses of students in online learning?

2. METHOD

The study involved 360 randomly selected college students enrolled in hybrid classes for at least two terms who responded to the online survey. It made use of Questionnaire on Self-Regulated Learning Strategies in Online Learning Environment (Prudente & Acar, 2021), Online Course Satisfaction Scale (Bayrak, et al., 2020), and Perceived Academic Performance Scale (Verner-Filion & Vallerand, 2016). Online Learning Cognition Scale and Perceived Learning Effects Scale were also developed for this study. The survey forms were administered to students through Google form. Data were analyzed using descriptive statistics, t-test, correlation, and regression analysis. Diagnostics for regression analysis were conducted. The possible presence of multicollinearity was tested through estimation of the Variance Inflation Factor (VIF) and Tolerance (TOL). Results showed VIFs below 4.0 and TOLs above .25, indicating no multicollinearity (i.e., VIFs = 1.857 to 2.402 and TOLs = 0.416 to 0.539). The Weighted Least Square model was also used to account for homoscedasticity.

3. RESULTS AND DISCUSSION

Results in Table 1 show significant and positive relationships among the three variables, that is, (1) learning environment with learning behavior [r(327)=.0.534, p<.001] and learning cognition [r(327)=.0.681, p<.001], and (2) between learning behavior and cognition [r(327)=.0.670, p<.001]. The three variables also posted significant and positive relationships with perceived academic performance. This indicates that satisfaction with online learning environment is related to acceptable learning behavior and cognition in online learning set-up, better online learning behavior results to better online learning cognition, and lastly, acceptable online learning behavior and cognition and high level of satisfaction with online learning environment bring about good learning outcomes.

Table 1. Correlations Among Variables

Variables	LBeh	LCog	LEnv
Learning Behavior (LBeh)			
Learning Cognition (LCog)	0.670		
Learning Environment (LEnv)	0.534	0.681	
Perceived Acad. Perf. (PAP)	0.637	0.658	0.495

The positive relationship between learning cognition (e.g., motivation) and learning behavior (e.g., student engagement, self-regulated learning behavior) has been established in numerous studies (Afzal & Crawford, 2022; Singh, et al., 2022; Tokan & Imakulata 2019; Turan, et al., 2022). Motivation is an internal process that encourages and directs behaviors in achieving certain academic goals, such that, students who are motivated tend to be more engaged, to spend more time in studying, to organize their behaviors and environment, and to perform better in the subject.

Furthermore, results of the regression analysis showed the utility of the predictive model was significant [F(3, 323) = 121.80, p < .001]. The three independent variables significantly predicted perceived academic performance, explaining 53% of the variance in the dependent variable. The results showed that online learning behavior, learning cognition, and learning environment are significant positive predictors of academic performance (ß=0.12, t=6.28, p<.0001; ß=0.16, t=5.82, p≤.0001; and ß=0.08, t=2.22, p≤.05, respectively). [Table 2]

Table 2: Regression Analysis Results

	Estimate	Std. Error	t-value
(Intercept)	3.101	0.991	3.13**
LBeh	0.119	0.019	6.28***
LCog	0.159	0.026	5.82***
LEnv	0.082	0.370	2.22*

Residual Standard Error: 1.329 on df=323

Again, the result is consistent with previous studies showing behavioral and cognitive dimensions as critical factors for academic success (Adrian Chin, et al., 2019; Ito & Umemoto, 2022; Khan, et al., 2020; Martin, et al., 2021). For example, a study by Meng and Hu (2023) confirmed the mediating role of online learning behavior on the relationship between motivation and academic performance. Extrinsic motivation was found to positively influence academic performance both directly and indirectly through online learning behavior, while intrinsic motivation affected academic performance indirectly only. Martin, et al. (2016) found adaptability, which is an important dimension of learning cognition, to be associated with greater positive behavioral engagement (i.e., persistence, planning, task management) and lower negative behavioral engagement (disengagement, self-handicapping) and to indirectly predicted greater GPA (via lower negative behavioral engagement). Likewise, Afzal & Crawford (2022), through structural equation modeling, found that student engagement is significantly related to students' performance in online learning.

Results in Table 3 also show that students reported more learning gains than losses in online learning set-up. Generally, students indicated that they were highly engaged in their online learning as they reported establishing self-study strategies, managing structure learning environment, exercising time management, and setting their online learning goals to a great extent. They also rated themselves as highly motivated, receptive, and comfortable/adept in e-learning, and highly satisfied with the online learning environment. They also perceived themselves to have high academic performance in the online learning set-up.

Students also reported that their communication, collaboration, critical and logical thinking, time management, and self-study skills were enhanced. They were also able to learn to do

things independently, and discover new hobbies, skills/interests, and ways to earn money (through online selling, jobs, and social media postings). Furthermore, they also did not experience learning losses as the online learning set-up did not affect their academic performance, attendance in both synchronous and asynchronous classes, focus and concentration in their studies, motivation, and academic load.

Table 3: Perceived Learning Gains and Losses

Learning Gains and Losses	*M*	VI
Online Learning Behavior		
Set self-study strategies	3.92	GE
Managed learning environment	3.99	GE
Exercised time management	3.84	GE
Set online learning goals	4.14	GE
Online Learning Cognition		
Motivation	3.51	H
Information Perception	3.77	H
Adaptability	4.10	H
Online Learning Environment	3.85	S
Perceived Academic Perf.	4.01	H
Learning Gains		
Enhanced communication skills	3.48	T
Learned to collaborate	3.89	T
Improved critical thinking	3.94	T
Discovered new hobbies	4.18	T
Learned new skills/ interests	4.13	T
Re-evaluated priorities in life	4.23	T
Learned a lot about self	4.30	T
Learned doing things independently	4.30	T
Managed time wisely	3.86	T
Gained new ways to earn	3.58	T
Learning Losses		
Academic perf. improved	2.74	MT
Often skipped classes	2.34	ST
Cannot concentrate in learning	3.21	MT
Felt less motivated in online	3.22	MT
Enrolled in less subjects	2.25	ST
Unable to enroll in OJT	2.16	ST
Applied for LOA	1.78	ST
Not able to graduate on time	2.06	ST

M=Mean VI=Verbal Interpretation GE=Great Extent
H=High S= Satisfied T= True of Them
MT=Moderately True ST=Slightly True

Previous research has shown the benefits of online learning among students. Sari and Oktaviani (2021) found that students in online learning set-up strived to keep their motivation and interest balanced to accomplish the online learning process, became comfortable communicating and interacting with classmates and lecturers, and managed their study time and self-discipline. Suwastini, et al. (2023) argued that online learning positively affects students' autonomy, motivation, and collaboration skills while providing flexible learning for the learners. However, they also cautioned that these benefits come with a set of drawbacks especially for students whose autonomy and motivation are low and who have limited access to compatible digital device, internet access, and electricity.

4. CONCLUSION

Results have shown significant and positive relationships among learning environment, learning behavior, and learning cognition. This indicates significant impact of online learning environment, students' online learning behavior, and cognition on each other. Online learning behavior and cognition were also found to significantly relate to perceived academic performance, suggesting that students who have managed their online learning behavior and cognitive processes are more likely to perform academically better in their online courses.

Online learning is here to stay and will continuously make a much stronger contribution and impact on higher education and specifically on the students in the years to come. It is therefore recommended that teachers come up with teaching strategies, activities and learning environment that will best motivate students in online learning. They should also encourage students to be extensively engaged in their online classes, create conducive learning environment at home, observe productive learning behavior, be receptive to every information discussed in class, and be adaptable to new opportunities and challenges brought about by ever changing learning conditions and environment. These learning behaviors will help them achieve good academic outcomes.

Students need to be motivated, engaged, and willing to learn since no matter how intelligent and gifted students are, no matter how much effort and professionalism teachers put into their jobs, and no matter how many resources schools devote for students, they will not be able to reach their highest

potential if they do not put efforts in their studies. Academic motivation and student engagement are two very important ingredients for student achievement, in school and eventually in life. Academic motivation determines a student's attitude towards academic task and how much time and energy that a student is willing to spend on that task (Mieczkowski, 2022). In many cases, individuals with greater motivation and commitment to reach their goals, are more likely to succeed than those who have talent but are not capable of setting goals for themselves and staying focused on achieving them. This is true for both F2F and online learning.

Researchers have put some suggestions on how to enhance learning in an online set-up. Their suggestions pertain to the curriculum (e.g., instruction, content), infrastructure (e.g., ICT and learning support), teachers (e.g., pedagogical and technical competency, efficient use of technology) and students (e.g., well-being, self-efficacy, motivation) (Martin, 2020; Dhawan, 2020).

More studies need to be conducted to determine how to fully motivate and engage students in an online learning setup. While applying various motivational theories to traditional F2F learning environments has proven to be productive and effective, research on how existing motivation and learning theories can be adapted to optimize student engagement and online learning outcomes within complex, multifaceted, and technology infused online learning environments are still under-investigated (Chiu, et al., 2021).

5. ACKNOWLEDGEMENT

The authors are grateful to their colleagues and students who participated in the study.

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