

Analyzing Online Learning Experiences During the COVID-19 Pandemic

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The COVID-19 pandemic resulted in many institutions teaching in on-line only learning environments. The on-line learning environment impacted students in a variety of ways including study skills, sleeping, and communication approaches. This study highlights the changes in behavior of students and examined cognitive-based design methods for learning and perception. The researchers used a mixed-method design to determine the changes and their impact on learning and motivation. This article includes recommendations for instruction in face-to-face and on-line environments in a post-pandemic environment in higher education. Future research in remote environments and interaction has the potential to increase motivation for students and improve learning outcomes.

Keywords: COVID-19 pandemic, distance learning, higher education, cognitive design, online learning

Introduction

The Coronavirus pandemic has forced students to adjust to online school immediately. Understanding the perceptions of higher education learning in the virtual environment and how it supports student learning is constructed to inform online learning and determine (a) student perception categorized by behavioral patterns and environment; (b) how to appeal to various learner types characterized by learning style and their new environments, and (c) identify performance differences based on various facets. An evaluation of general online learning theory and theories specific to COVID-19 are presented. Furthermore, a cognitivist approach identifies design principles that support and enhance the online approach to education while expectancy theory explores the gap between student effort and expected performance.

Online Learning Theory

Moore (2013) describes a conglomerate of distance learning terms that include "...e-learning, online learning, and blended learning" (p. 5). This type of non-traditional learning occurred away from the classroom and became the theory of transactional distance defining pedagogical education. The prevalent shift to online learning, cognitive presence, massive open online courses (MOOC), blended learning, satisfaction, flipped classroom, content knowledge, and the teacher and community were trending themes spanning from 2013 to 2017 (Park & Shea, 2020).

Empirical findings suggest topics of structure that support or undermine distance learning. Learner satisfaction is reinforced with the instructor's social presence and feedback; the opposite occurs with insufficient timely feedback, communication experienced from group activities, and lack of online learning experience (Moore, 2013). Advances in educational methods and technological tools reflect the societal impacts and adjustments for the adaptive learner. An analysis of online learning design considerations is shown in Table 1 (Dhawan, 2020).

Table 1
Online Learning Strengths and Weaknesses

Strengths	Weaknesses
<ul style="list-style-type: none"> • Time and location flexibility • Opportunity for innovative programs • Increases student problem-solving skills • Screen, text, and file sharing abilities • Recorded lectures and immediate feedback 	<ul style="list-style-type: none"> • Technical complications • Time management difficulties • Inadequate personal attention • Increased levels of anxiety, confusion, and distraction • Difficulty learning for those who are digitally illiterate

COVID-19 Related Online Learning

The sudden shift to online learning identified skill levels of teacher readiness necessary for distance learning adoption. A study sampled 739 higher education teachers from 58 countries exposed various readiness levels classified by background, disciplines, and preparation (Scherer, Howard, Tondeur, & Siddiq, 2021). Results suggest that readiness is constructed from factors including teacher experience, online experience, academic discipline, online preparation, and institutional support. Furthermore, necessary factors apply to both those voluntarily enrolled in online learning courses and those forced into online learning due to the pandemic.

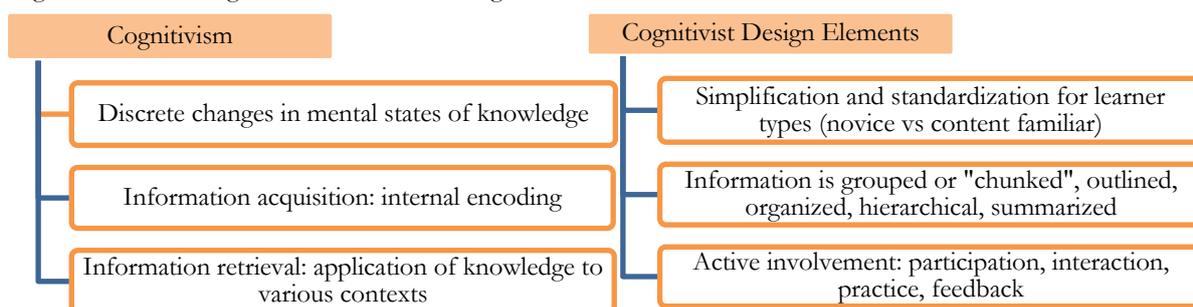
A study from 270 college students suggests that “knowledge, concentration, engagement, attendance, and interest” declined during the emergency shift to online learning (Aguilera-Hermida, 2020, p. 6). However, this study reported that student scholastic self-efficacy encourages their ability to control their engagement with online learning. Therefore, student recognition of personal capability encourages reliance on past knowledge during an online performance. Student readiness was tested among 913 online college students that identified technology readiness, learner control, online communication self-efficacy, self-directed learning, and motivation for learning contributes to online learning (Tang et al., 2021).

Cognitivist Design Approach to Online Learning Theory

Learning is defined as “an increase, through experience, of ability to gain goals in spite of obstacles” (Washburne, 1936, p. 603). In this context, online learning is considered an obstacle to inquiry. Distance education has progressed to utilizing technology, big data, MOOCs, learning analytics, and game-based learning coupled with online learning pedagogy to enable effective interaction between students and their teachers (Park & Shea, 2020). Aligning learner approaches to teaching becomes significant when relying on cognitive information processing to help organize knowledge retrieval as learning theories are identified as a “source of verified instructional strategies, tactics, and techniques” (Ertmer & Newby, 1993, p. 51). Therefore, online education designed with activities that promote the acquisition, processing, and integration of knowledge illustrates an environment of enhanced learning (Arghode, Brieger, & McLean, 2017).

In addition to structured designs for online education, cognitive presence defines the inquiry process of an event using the exploration of information, integration of ideas, and resolution of the application of new ideas (Garrison, 2009). A study of 278 students from four institutions in the United States and Canada suggests that teaching and social presence influence cognitive presence, and teacher presence influences social presence (Garrison, Cleveland-Innes, & Fung, 2010). Teaching presence is evidenced by online curriculum design and methods that facilitate discourse through conversations and instruction that narrows to solve issues. This study focuses on cognitivist mechanisms influencing content presentation and presence for engaging knowledge acquisition, processing, and assimilation (see Figure 1).

Figure 1
Cognitivism and Design Elements of a Learning Environment



Source: Adapted from (Ertmer & Newby, 1993)

A study highlighting the opportunities and failures of mandated e-learning environments resulted in non-traditional pedagogical teaching approaches (Dhawan, 2020). The author’s teaching mechanisms that provide content are supported by solid Internet connectivity, Open Board Software tools, and the following Google products: Hangouts, Jam Board and Drawing, Gmail, Classroom, Drive, Calendar, and Forms. For these mechanisms to be effective, online platforms operate efficiently with the following environment (See Table 2).

Dhawan (2020) explored the development of EdTech startups and concluded that online learning has the capabilities to be effective even after the pandemic ends. Many applications like ZOOM, Khan Academy, and Kahoot may enhance teachers’ instruction for learning environments to become meaningful, especially when combined with face-to-face instruction. The strengths of online learning include time and location flexibility. However, weaknesses of

online learning arise for students with technical complications, difficulty properly managing time, lower confidence levels, inadequate personal attention, and increased distractions, resulting in higher levels of anxiety and confusion.

Table 2
Online Platform

Online Platform	A strong Internet connection
	Allow a large number of students to learn synchronously
	Include features that allow sharing of screens, video, written text, and audio
	Be suitable for organic discussions
	Be available for the use of different types of devices such as phones and laptops
	Permit students to submit assignments virtually and receive immediate feedback
	Provide the availability of recording lectures, which may be available for later review

Expectancy Theory

Intrinsic or extrinsic motivation is guided by desired achievement processes varied by individual effort (Parijat & Bagga, 2014). Expectancy is the “relationship between effort and performance” (p. 2). The rational process of evaluating alternatives may evolve in various levels of work performance. Furthermore, expectancy theory is foundational to the motivation between people and work “...people make decisions that they believe to be optimal at the time they make them” (Vroom 1995, p. 100). In this viewpoint, the selection of goals is motivated by individual differences and circumstances. The perceived expectancy’s relationship between effort and performance shows how subjective probability of an action or effort leads to an outcome or performance (Van Eerde & Thierry, 1996).

Vroom’s (1964) model of motivation suggests the conduit to performance is effort. Individual differences that motivate higher education students using online learning presents predictions of characteristics. A year long study of 77 undergraduate students found that gender, employment status, and motivational factors influence online learning (Lim & Kim, 2003). The effort and expected outcomes are correlated to motivation. Motivation is a factor of individual expectations of (a) expectancy of effort and performance, (b) an instrumentality of perceived effort levels and associated results, and (c) valence or outcome preference. This is illustrated as motivation = expectancy x instrumentality x valence (Lunenburg, 2011). Therefore, the cognitive process and individual limits result in varying motivation levels.

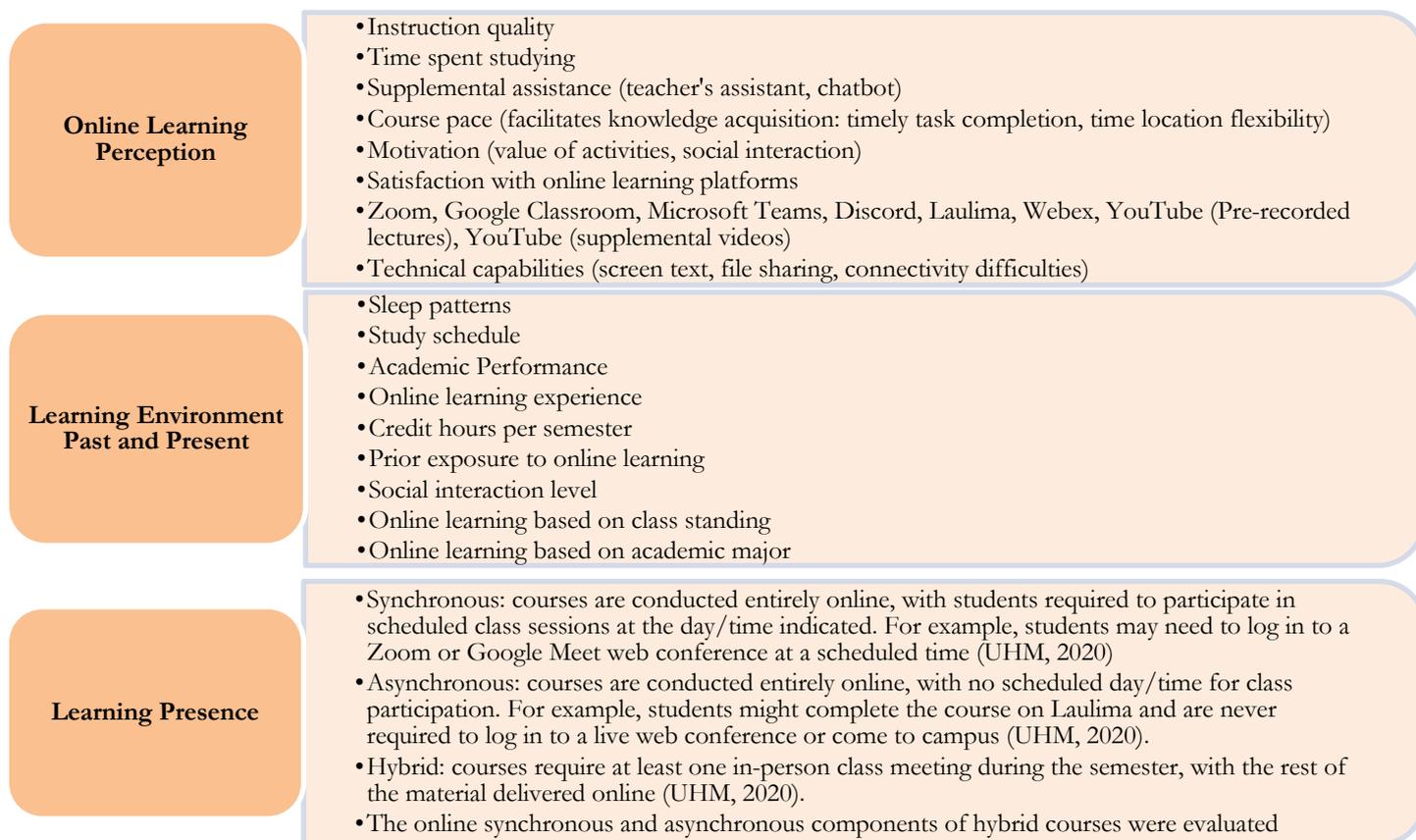
This background in online learning highlights the importance of efforts and outcomes. Based on online learning occurrences during the pandemic, it is critical to research the following areas: (1) what student behavioral differences in sleeping patterns and study habits occurred between the pandemic learning environment and the pre-pandemic environment? and (2) what is the relationship between student perception and course performance of online learning?.

Research Design & Methods

This study quantifies a convenience sampling of university students’ online learning perception and performance. The methodological process was pilot surveyed and expanded to include questions of online learning performance by identifying courses to compare perceived and performance behaviors. Anonymized survey data was collected from the population sample of 133 adult students attending the University of Hawai‘i at Mānoa. The convenience sample contained voluntary responses from students required to take online courses due to the COVID-19 pandemic. The survey collected non-identifiable and categorizable information about class standing, grade point average, credit hours per semester, major(s), gender, and study behaviors. To investigate the degree of online learning perceptions, the Google Forms survey utilized two points of view: open-ended questions and a five-point Likert scale (1) Strongly Dissatisfied, (2) Dissatisfied, (3) Neutral, (4) Satisfied, and (5) Strongly Satisfied to assess the level of agreeability with the survey question.

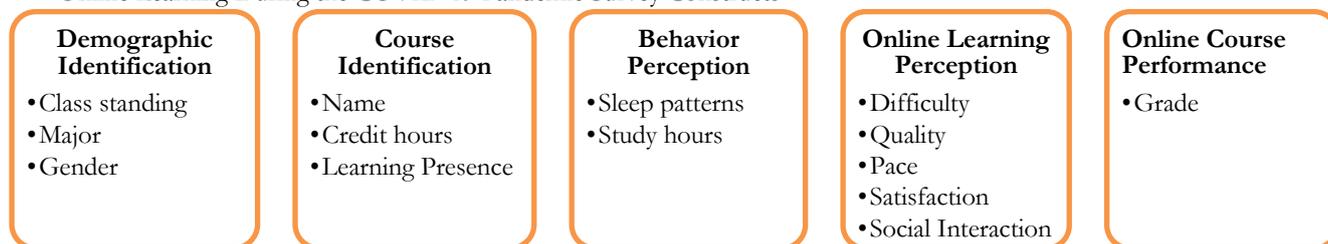
The construct and variables for the survey are listed in Figure 2. The operationalization of variables is considered to reflect latent traits such as performance and abilities that can be addressed with question items that function identically between groups (Spector, 2004). Once the students completed the surveys, the researcher reviewed each submission for completeness that each question was answered. Valid surveys were manually tabulated using an Excel spreadsheet. After the data was organized, it was analyzed using IBM’s statistical package for the social sciences (SPSS) that determined the correlations and differences between groups. Statistical tests on the data were investigated using an analysis of variance (ANOVA) for significant results that answered the study’s research questions and hypothesis. Data analysis determined the correlation between the surveyed groups.

Figure 2
Learning Behavioral and Environmental Constructs for Online Survey



Respondent data provided answers to questions of perception and performance for a range of four to six classes. The optional online learning experiences section collected 240 comments from 103 students. Content analysis quantifies text from each respondent into groups of online learning themes: positive experience, mixed (negative and positive experience), and negative online experience. Thematic analysis extracted central topics from content (Spector, 2004). Repeated comments were identified and sorted to reveal patterns and define categories that characterize student encounters with online learning. This coding scheme acquired uniform data by tallying words in groups for classification analysis.

Figure 3
Online Learning During the COVID-19 Pandemic Survey Constructs



Results

After a manual review of the 135 student answers collected over five days, it was determined that answers were incomplete from two students not counted in this study. Therefore, 98% of the data were used from the sample.

Demographics Data

The sample is categorized by class standing, major, and gender. Most students were sophomores, having earned 30 to 59 credits. There were slightly more females (50%) than males (48%). Detailed demographic data frequencies are presented in Figures 4 to 5 and Table 3.

Figure 4
Student Demographics: Class Standing

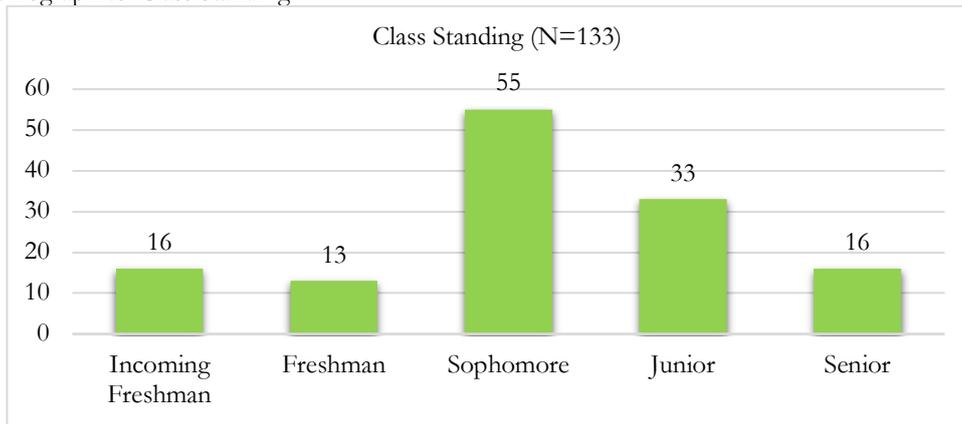


Figure 5
Student Demographics: Major

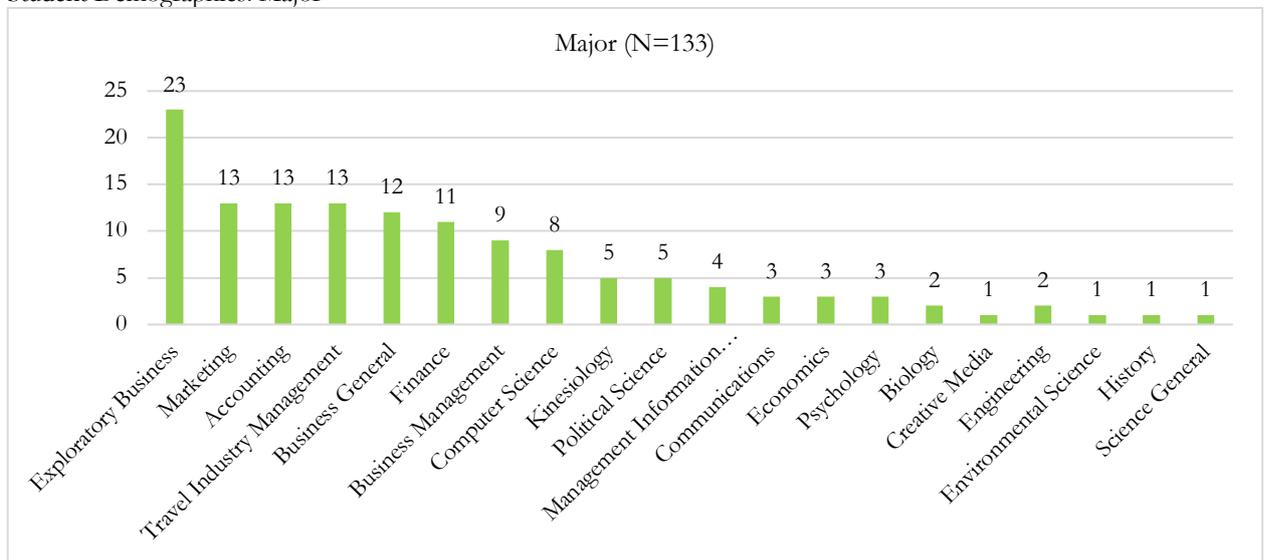


Table 3
Student Grades and Courses N=601

Grade	Frequency	Percentage
A	319	53
B	166	28
C	82	14
D	19	3
F	15	2
Total	601	100

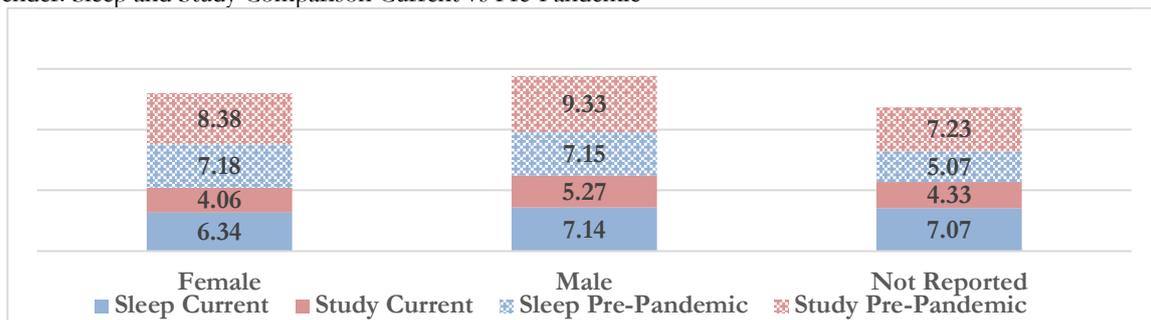
Course Identification

The survey identified 599 courses employing asynchronous, synchronous, or both presence methods. The three virtual learning modes are hierarchically ranked by synchronous, asynchronous, and the combination of both strategies are Synchronous 285 (47%), Asynchronous 178 (30%), and Asynchronous & Synchronous 136 (23%).

Student Sleep and Study Behavior Perception Identification

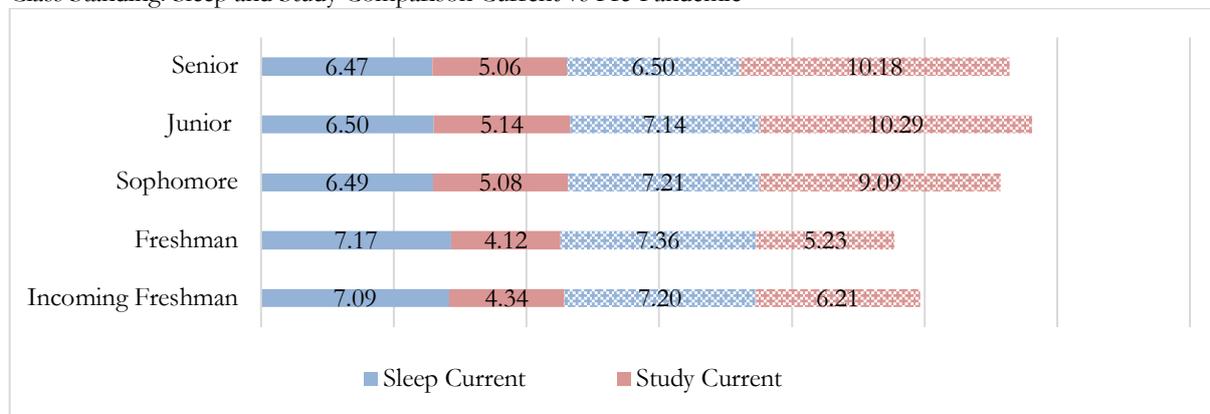
As shown in Figure 6, sleep and study comparisons demonstrate the lessening of hours spent sleeping and studying than pre-pandemic. Female students reported a sleep decrease of 44 minutes versus that of 1 minute for males. Study differences contrast the reduction of 4.32 hours for females and 4.06 hours for males.

Figure 6
Gender: Sleep and Study Comparison Current vs Pre-Pandemic



Further comparisons were made by class standing: juniors, seniors, and sophomores perceived a reduction of current study time by 5.15 hours, 5.12 hours, and 4.01 hours respectively (see Figure 7).

Figure 7
Class Standing: Sleep and Study Comparison Current vs Pre-Pandemic



Student Online Course Perception and Performance

Student grades from 607 classes were compared with course perception means: difficulty, instruction quality, pace, social interaction, online platform satisfaction, and GPA prior to the pandemic (see Table 4).

Table 4
Comparison of Online Learning Experiences and Grade Performance Means

Grade	N	Course Difficulty	Instruction Quality	Course Pace	Social Interaction Quality	Learning Platform Satisfaction	GPA Prior To Pandemic
A	322	**3.01	**3.66	**3.29	**2.89	**3.81	**3.512
B	167	**3.31	**3.43	**3.32	**2.83	**3.47	**3.282
C	84	**3.58	**3.25	**3.43	**2.62	**3.20	**3.126
D	19	**4.16	**3.00	**3.95	**2.16	**2.95	**3.029
F	15	**4.00	**3.33	**3.87	**1.87	**2.67	**3.206

Computed using alpha = .05
Computed using Equal Variances Assumed: Tukey HSD

An ANOVA was used to test the significance between grades received and five categories of course factor perception. A significant effect is observed between the final grade and online learning perceptions. The differences among the final grades (A-F) received by students in their courses and their perceived performance are as follows: (a) course difficulty: $F(4, 602) = 11.481, p < .001$, (b) instruction quality: $F(4, 602) = 3.867, p = .004$, (c) course pace: $F(4, 602) = 5.655, p < .001$ (d) social interaction quality: $F(4, 602) = 3.784, p = .005$, and (e) learning platform satisfaction: $F(4, 602) = 11.774, p < .001$. Additionally, a significant effect was observed between the final grade and pre-COVID-19 GPA: $F(4, 501) = 5.7775, p < .001$. These results support the rejection of the null hypothesis H_0 . An ANOVA was used to test the significance between grades received and study hours per week (see Tables 5 and 6). There is a significant difference between grades received and study hours per week, $F(4, 618) = 4.700, p < .001$.

Table 5
Comparison of Grades (N=623) and Study Hours

Grade	N	Mean	SD
A	333	3.805	3.065
B	169	4.320	3.117
C	86	5.122	3.996
D	19	5.632	2.833
F	16	2.656	0.708

Computed using alpha = .05
Computed using Equal Variances Assumed: Tukey HSD

Table 6
Weekly Study Hours Mean Per Class (N=626)

Study Hours (N)	Mean	SD
626	4.154	3.232

Hypothesis Testing

The study’s null hypothesis, H₀: there is no relationship between student online learning perception and course performance, was rejected based on the ANOVA significance testing results for all factors.

Discussion

Discussion of Research Question 1

All students reported behavioral differences with online learning environments during the pandemic with reduced sleep and study hours. Although females slept 44 minutes less and males slept 1 minute less, the study differences were lessened by an average of 4.19 hours for both genders. An evaluation of overall class standing reported an average increase of 6 minutes of sleep; students currently studied 3.05 hours less than before the pandemic. Seniors and juniors reported the most considerable average reduction of 5.14 study hours. According to the Centers for Disease Control and Prevention (2017), the recommended sleep duration for adults is ≥ 7 hours. Therefore, the average reported sleep for students’ current sleep pattern was currently reduced by 7% of sufficient sleep. In comparison, average study hours had a greater reduction impact of 53% after the pandemic.

Discussion of Research Question 2

Based on an ANOVA, this study suggests that the comparisons of course perception significantly impact student performance. Grades are affected by perceived course difficulty, instruction quality, course pace, social interaction quality, and meeting platform satisfaction. While students with higher grades perceive overall learning with lower course difficulty and platform satisfaction. With lower grades, the satisfaction with instruction quality, social interaction, and learning platform also decreases. Table 7 illustrates the significant differences in perceptions and grade performance. Further ANOVA testing suggests that study hours significantly impact grades. Although the study hours mean is 4 hours per week, students with higher grades seem to study less than those receiving lower grades, not including individuals who failed courses. This could be dependent upon student engagement during synchronous classes.

Positive relationships between meeting platform, instruction quality, and social interaction perceptions and grade performances represent affirmative experiences of information processing (Dawson, 2013). Negative relationships among course difficulty and meeting platform perceptions increase with lower grades. Positive perceptions of these factors appear to influence grades.

Table 7
Perception and Performance Correlations

Course Difficulty	Instruction Quality	Social Interaction	Course Pace	Meeting Platform	Prior GPA
CD	IQ	SI	CP	MP	PGPA
Grade	Grade	Grade	Grade	Grade	Grade
CP	CP	CP			
MP	MP	MP			
	SI		SI	SI	
		IQ	IQ	IQ	
			CD	CD	

Conclusion

Practical Implications and Future Research

Practical approaches to support online learning platforms aim to increase technology choices and operational capabilities. Professional development for instructional design approaches to better translate in-person instruction to online environments can help address difficulties with motivation and social interaction, which were major concerns identified in this study. For example, creating classroom groups in online learning may increase motivation and interaction among students and between students and professors. Groups may have different feature sets for synchronous and asynchronous instruction. Additional inquiry into technology functionality with features such as online break-out rooms, collaboration abilities, recorded lectures, and immediate feedback on assignments may help to address interaction difficulties from learning online. Interaction with classmates, professors, content, and technology and how they influence each other may lead to further studies about student motivation.

Future research intended for long-term changes and practice of online learning seeks to advance and strengthen distance educational programs. We are also interested in studying the student's remote environment. Although time and location flexibility assist remote learning, the design of students' environment and house rules aim to provide optimum adaptability from a remote location that encourages studying across spaces and supports online student learning. Additionally, we are interested in how these factors are correlated, which may divulge further information on the relationship between student perception and course performance. A qualitative study may uncover additional unexpected phenomena. We hope to identify factors to promote student persistence and adaptability for online courses.

According to Dawson (2013), applying prior knowledge relevant to similar experiences allows perceived emphasis on grade performance in online learning to reflect the differences between thought processes and action. Although individual negative insights resulted in positive outputs, this manipulation of information processing produced positive grade performance. This article gives additional insight into recommendations for practitioners. Suggestions for instruction in face-to-face and on-line environments in a post-pandemic environment in higher education include verbal communication such as frequent specific feedback, a supportive tone of voice, relation on a personal and professional level, as well as multiple forms of instructor contact such as online office hours. Multiple modalities for office hours may be critical because students expressed a desire for flexibility in working with their teachers. Faculty should use many of these approaches to combat low motivation when many assignments are due at the end of the semester. Online meeting platform training can increase the use of available virtual functions since students expressed difficulty adjusting to fully online learning platforms abruptly. In smaller class settings, ZOOM can be used efficiently with breakout rooms for greater interaction, polls for additional engagement, and feedback in the chat to ensure understanding, which are all active learning experiences that align with student preference. When students are able to interact with each other and cycle information, they remember better because they have extra ways of coding the messages received, which enforces learning and feedback.

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References

- Aguilera-Hermida, A. P. (2020). College students' use and acceptance of emergency online learning due to COVID-19. *International Journal of Educational Research Open*, 1, 100011.
- Centers for Disease Control and Prevention. (2017, May 2). *CDC - data and statistics - sleep and sleep disorders*. Centers for Disease Control and Prevention. Retrieved April 12, 2022, from https://www.cdc.gov/sleep/data_statistics.html
- Dawson, M. R. (2013). *Mind, body, world: foundations of cognitive science*. Athabasca University Press.
- Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, 49(1), 5-22.
- Effort. (n.d.). Merriam-Webster Online. In Merriam-Webster. Retrieved from <https://www.merriam-webster.com/dictionary/effort>.
- Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, 6(4), 50-72.

- Friedenberg, J., Silverman, G., & Spivey, M. J. (2021). *Cognitive science: an introduction to the study of mind*. Sage Publications.
- Garrison, D. R. (2009). Communities of inquiry in online learning. *Encyclopedia of Distance Learning, Second edition* (pp. 352-355). IGI Global.
- Garrison, D. R., Cleveland-Innes, M., & Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. *The Internet and Higher Education, 13*(1-2), 31-36.
- Lim, D. H., & Kim, H. (2003). Motivation and learner characteristics affecting online learning and learning application. *Journal of Educational Technology Systems, 31*(4), 423-439.
- Lunenburg, F. C. (2011). Expectancy Theory of Motivation; Motivation by Altering Expectations". *International Journal of Management, Business and Administration, 15* (1).
- Moore, M. G. (Ed.). (2013). *Handbook of Distance Education*. Routledge
- Negative. (n.d.). Merriam-Webster Online. In Merriam-Webster. Retrieved from <https://www.merriam-webster.com/dictionary/negative>
- Park, H., & Shea, P. (2020). A review of ten-year research through co-citation analysis: Online learning, distance learning, and blended learning. *Online Learning, 24*(2), 225-244.
- Parijat, P., & Bagga, S. (2014). Victor Vroom's expectancy theory of motivation—An evaluation. *International Research Journal of Business and Management, 7*(9), 1-8.
- Positive. (n.d.). Merriam-Webster Online. In Merriam-Webster. Retrieved from <https://www.merriam-webster.com/dictionary/positive>
- Scherer, R., Howard, S. K., Tondeur, J., & Siddiq, F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready?. *Computers in Human Behavior, 118*, 106675.
- Spector, P. E. (2004). Sage encyclopedia of social science research methods. In *The SAGE Encyclopedia of Social Science Research Methods*. Sage Publications, Inc..
- Tang, Y. M., Chen, P. C., Law, K. M., Wu, C. H., Lau, Y. Y., Guan, J., ... & Ho, G. T. (2021). Comparative analysis of Student's live online learning readiness during the coronavirus (COVID-19) pandemic in the higher education sector. *Computers & Education, 168*, 104211.
- UHM (2020). University of Hawai'i Fall 2020 Student Online Experience. Manoa Distance Learning Advisory Committee.
- Van Eerde, W., & Thierry, H. (1996). Vroom's expectancy models and work-related criteria: A meta-analysis. *Journal of applied psychology, 81*(5), 575.
- Vroom, Victor H. (1995). *Work and Motivation*. Jossey-Bass Inc. Originally published in 1964 by John Wiley & Sons, Inc.
- Washburne, J. N. (1936). The definition of learning. *Journal of Educational Psychology, 27*(8), 603.