The Mediated Effect of Stress on Uncertainty and Students' Perceived Performance in Online Classes: A Mediation Analysis

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ABSTRACT

Changes from the mode of learning in person to learning online due to the global pandemic have brought up tremendous difficulties for both teachers and students. Changes disrupt previous learning routines developed under the mode of face-to-face learning, thus creating uncertainties. Previous research demonstrated that uncertainty is positively related to stress. The rise of uncertainties amidst the new changes will be likely to lead to a higher stress level. Previous research showed that stress levels correlate with students' academic performance negatively. Thus, this study investigated mediated role of stress on the relationship of uncertainty and students' academic performance during the pandemic. The mediation analysis results showed that the indirect effect of uncertainty on academic performance through stress is significant.

Keywords: Online learning, Uncertainty, Stress, Academic Performance, Mediation Analysis.

1. INTRODUCTION

The global pandemic that erupted in March 2020 has had a tremendous impact on the way students learn and the teaching approach. At the beginning of the pandemic, schools were forced to close, and students were faced with forced, hard, pause in their learning. However, schools cannot remain close forever, and students should not keep losing their precious time for learning and personal growth. Therefore, schools around the world started to offer flexible teaching with the help of technology, such as utilizing conferencing tools to deliver lessons. However, changes from the mode of learning in person to learning online brought up tremendous difficulties for both teachers and students. Both teachers and students were set to learning new technologies, and they have to adapt to the new mode of learning and teaching. Changes disrupt previous learning routines developed under the mode of face-to-face learning, thus creating uncertainties. Uncertainty rises when students are constantly dealing with the need to adapt to the new ways of learning (e.g., new conferencing tools, new classroom interaction tools). Previous research demonstrated that uncertainty is positively related to stress. The rise of uncertainties amidst the new changes will be likely to lead to a higher stress level. Previous research showed that stress levels correlate with students' academic performance negatively. Thus, it is necessary to investigate how stress mediates the relationship between uncertainty and students' academic performance during the pandemic.

2. VIRTUAL LEARNING ENVIRONMENT, TECHNOLOGY ADOPTION, AND STUDENTS' ACCEPTANCE

Successful learning in the online environment depends on students' acceptance of the virtual learning environment and the technology used. A virtual learning environment is a virtual place online (disregard the platforms) that affords teachers and students to communicate and to access different learning tools (e.g., course content, reading materials, resources, assignments) [1]. Various technologies (e.g., conferencing tools, discussion board) and tools are in place to form a virtual learning environment. Studies suggested that multiple psychological factors (e.g., perceived usefulness; perceived ease of use) affect students' acceptance of both virtual learning environment and the technologies in place, thus eventually affecting the way students use both virtual learning environment and the technologies in place [2]. Social influences (e.g., gender, age, experiences) and

facilitating conditions (e.g., individual's work style, the availability of assistance) also affect students' level of adoption of the virtual learning environment and the technologies [3]. Despite those factors, personality traits (e.g., personal innovativeness, computer anxiety) also play an important role in students' technology adoption processes [4]. Therefore, during the transition from face-to-face learning to virtual learning, all those factors mentioned above that could impact students' virtual learning experiences are constantly changing and ever evolving since China does not have a solid foundation in online learning as other developed countries such as United States, UK, Australia, etc.

3. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

3.1. Stress and Academic Performance

Literature generally showed that stress correlates with students' academic performance negatively. For example, Elias et al. [5] investigated 376 undergraduate students' level of stress and their academic achievement, and they found a significant but weak negative relationship between their stress level and academic achievement. Also, Solomon et al. [6] measured 162 Manchester Metropolitan University Psychology freshman and sophomore students' resilience, perceived stress, and academic achievement. Their results suggested that low-stress perception and high resilience can lead to high academic achievement. Nevertheless, Rafidah et al. [7] investigated 154 Pre-Diploma Science students in a Malaysian public institution. They found that the correlation was not statistically significant between the level of perceived stress at the beginning and middle of the semester but was obvious between the end of the semester and students' academic performance. According to Ye et al. [8], the study had made a generally negative relationship between Chinese adolescents' academic stress and academic achievement. Therefore, the following hypothesis is posited:

Hypothesis 1: The increase of the sense of stress will lead to a decrease in academic performance.

When students are forced to adapt to the new virtual learning environment or technologies, students have to figure out new ways of learning as effectively as in the previous face-to-face environment. It is time-sensitive and could create stress when they feel like they need to achieve that within a short amount of time.

In the contemporary era, fierce competition can be seen anywhere in society, including schools and classrooms. At school, students are friends, but they are also competitors, specifically in the context of China. Online courses create a physical distance between students and their fellow competitors that they don't

know what their fellow competitors behind the screen to outperform them. The image, invisible, competition caused by the online division could thus increase students' feeling of stress. Moreover, parents' high expectations and the imaged and invisible competition make students more stressed during the transition from face-to-face learning to online learning amidst the pandemic.

Literature has shown that stress makes it hard for students to focus by increasing students' feelings of anxiety and worry and thus leads them to mistakes that were caused by non-intellectual factors. Therefore, students' academic performance may be lower than before learning in a physical classroom.

3.2. Uncertainty and Academic Performance

Literature generally showed that uncertainty correlates with students' academic performance negatively. For instance, Kornilova et al. [9] tested 60 typically developing adults and examined the contribution of tolerance/intolerance for uncertainty. The result showed that tolerance of uncertainty contributes to risk in decision making after trial failure, potentially limiting learning in uncertain conditions through risk aversion. Nevertheless, Tang [10] had found that resilience is the strongest positive predictor of intolerance of uncertainty, which was significantly related to the factors of self-referent implications and "spoiled everything." In addition, Thibodeau et al. [11] tested how intolerance of uncertainty impacts behaviour. The test results showed that intolerance of uncertainty might negatively impact day-to-day behaviours and contribute to undesired consequences. Therefore, the following hypothesis is posited:

Hypothesis 2: The increase of uncertainty will lead to a decrease in academic performance.

When students are forced to adapt to the new virtual learning environment or technologies, the new learning curve creates uncertainty. Some students who have higher resilience will have a stronger tolerance for uncertainty and thus can adapt to a new environment. As a result, they suffer less from uncertainty than those who do not have higher resilience and stronger tolerance at getting used to new situations.

Also, due to the physical disconnection between people caused by the online division, students are more likely to feel uncertain about things when they lose the connection. Most people will need to get used to the disconnected feeling in the new environment before the uncertainty goes away.

Literature has shown that the sense of uncertainty affects students' decision-making process negatively, thus negatively impacting students' day-to-day learning behaviours and contributing to undesired consequences

that will lead to lower academic performance. Learning under uncertainty makes it more difficult for students to concentrate on the things at hand. That's what lowers their efficiency while studying, and thus their academic performance is more likely to be negatively influenced.

3.3. Stress and Uncertainty

Literature generally showed that stress correlates with students' intolerance of uncertainty positively. Just as Oglesby et al. [12] found, the results showed that pre-trauma intolerance of uncertainty acts as a significant predictor of elevated post-traumatic stress symptoms following the campus shooting. The result remained significant after covarying for pre-trauma levels of anxiety sensitivity. Moreover, Yook et al.'s [13] study indicated that even though worry, rumination, intolerance of uncertainty, anxiety, and depressive symptoms correlated substantially with each other, worry partially mediated the relationship between intolerance of uncertainty and anxiety. Therefore, the following hypothesis is posited:

Hypothesis 3: Uncertainty affects students' academic performance by increasing the sense of pressure.

Under the situation of the sudden change in learning methods, students are required to get used to loads of new things such as a new learning environment, technology, invisible competition, disconnection that all bring students more uncertainty and pressure. An increase in uncertainty will negatively affect study efficiency and academic performance, and students would face more stress when suffering from lower tests scores. In addition to the stress created by adapting to the new learning environment, the pressure will also come from the expectations from teachers and parents, high demand on oneself, and the excellent performance made by their peer competitors. Thus, students' academic performance could be negatively influenced by all these circumstances.

4. METHODS

4.1. Context and Participants

This study happened in Eastern China, and the targeted participants are students who were experiencing a transition from face-to-face learning to online learning. A convenient sampling strategy was applied to select participants from the researcher's personal network to complete the surveys. There were 116 survey responses collected, and 100 of them were valid. The valid percentage was 86.20%. Female students took up 73.2%, while most of them were high school students. Please refer to the following Table 1 for detailed participant information.

Table 1. Participant Information

Variable		Number	Percentage
Gender	Male	31	26.7
	Female	85	73.2
Education Background	Middle School	28	24.1
	High School	78	67.2
	University	10	8.62

4.2. Instruments

To examine the hypothesis, two instruments were adopted from existing scales. The instrument of Intolerance of Uncertainty was adopted from the Why Do People Worry scale designed to understand why people worry [14]. The instrument of Feeling of Stress was adopted from The Depression Anxiety Stress Scale (DASS), a 42-item self-administered questionnaire designed to measure the magnitude of three negative emotional states: depression, anxiety, and stress [15]. The instrument for perceived academic performance was a single survey question asking participants to evaluate how much their academic performance has changed during online learning.

4.2.1. Intolerance of Uncertainty

This original scale was from the Why Do People Worry scale designed to understand why people worry [14]. The original scale contains 44 questions asking participants to self-evaluate their levels of Intolerance of uncertainty from the following six themes representing different aspects of intolerance of uncertainty: (1) the emotional and behavioural consequences when feeling uncertain, (2) how uncertainty reflects on one's character, (3) expectation that future is predictable, (4) frustration when it's unpredictable, (5) attempts to take control of the future, and (6) desperate responses in uncertain situations. The items are all on a five-point scale varying from 1—not at all representative—to 5—Completely representative.

4.2.2. Feeling of Stress

The scale was adopted from Lovibond's The Depression Anxiety Stress Scale [15] that aims to evaluate the magnitude of three negative emotional states: depression, anxiety, and stress. The scale was made up of three themes: depression, anxiety, and stress. This experiment only takes the items on stress for the purpose of this study. The stress scales contain five aspects representing stress: difficulty in relaxation, frequently feeling tense and nervous, ease to get upset, overreaction, and feelings of impatience. The items are

rated on a four-point scale varying from 1—Did not apply to me at all— to 4 –Apply to me always.

4.2.3. Perceived Academic Performance

Participants were required to evaluate their academic performance based on their perceptions of academic performances before and after turning to online learning for the perceived academic performance. The self-rating varying from 1—Has lagged behind a lot— to 5—has made much progress.

4.3. Data Analysis: A Mediation Analysis

A mediation analysis was performed using Process Model 4 with the bootstrap of 1000 to determine how a given mediator—stress—affects the relationship between an independent variable—uncertainty—and an outcome variable—the perceived academic performance, quantifying the overall effect (the association between the independent and outcome variables), the direct effect (the overall effect unaffected by the mediator), and the indirect effect (the effect of the independent variable on the outcome variable attributed to the mediator).

5. RESULTS AND DISCUSSION

The indirect effects from independent variables to dependent variables were estimated with a bootstrap of 1000 samples using the Process model 4 method.

5.1. Hypothesis 1: The increase in stress will lead to a decrease in academic performance

The correlation analysis of the relationship between stress and academic performance shows that the correlation between stress and academic performance is 0.5383, indicating that the relationship between the two is positively correlated. Data analysis demonstrated a positive correlation between stress and academic performance, which means that academic performance will likely increase when students' sense of stress increases. This result does not align with the prior literature that stress often correlates with students' academic performance negatively, which means that the prior conclusion about the relationships of these two factors does not apply to the context of learning online in this particular case. Three factors possibly cause the misalignment between the result of this study and the prior literature. First, the sample of the study is too small. Second, this study only measured students' perceived academic performance instead of their actual performance. Third, stress, to some extent, could motivate students' learning positively even though prior studies have proved too much stress that it will impact students' learning negatively. Thus, I suggest schools or teachers monitor students' stress levels by providing

informal consultation/check-in with students regularly to ensure students' stress levels are within the range and do not harm students.

5.2. Hypothesis 2: The increase of uncertainty will lead to the decrease of the academic performance

Correlation analysis demonstrated increased uncertainty leads to the decreased academic performance. The result shows that the correlation between uncertainty and learning effect is -0.5115, indicating a negative correlation between the two. Data analysis demonstrated a negative correlation between uncertainty and academic performance, which means that academic performance will likely decrease when students' sense of uncertainty increases. This result aligns with the prior literature that uncertainty correlates with students' academic performance negatively, which means that prior conclusion about the relationships of these two factors also applies to the context of learning online. Therefore, I suggest that teachers should provide more training on how to use the new technologies and the new virtual learning platform in which online learning happens, specifically on how the modules work and where to locate course materials and resources. Explicit instructions are highly recommended for teachers to virtually "walk" students around the whole learning process. Also, in terms of the sense of uncertainty caused by the disconnection between people, I suggest schools or teachers host more online social events for students to have a place to connect and talk about things beyond courses.

5.3. Hypothesis 3: Uncertainty affects the learning effect by increasing the sense of pressure

The results of the bootstrap analysis show that the 95% confidence interval of the mediating path of pressure → uncertainty → learning effect is [.0126,.6495], without including 0, indicating that the stress takes effect as a mediator. The indirect effect of uncertainty on academic performance through stress perception is significant. (Effect size=.3480 , SE=.1615, CI=[.0126, .6495]). Therefore, I suggest that 1) schools and teachers should provide more training on using the new technologies and the new virtual learning platform in which online learning happens, specifically on how the modules work and where to locate course materials and resources. Explicit instructions are highly recommended for teachers to virtually "walk" students around the whole learning process. These methods could potentially lower student's sense of uncertainty so that stress levels could be maintained within a certain amount; 2) schools and teachers should also host more online social events for

students to have a place to connect and talk about things beyond courses to lower student's sense of uncertainty so that stress level could be maintained within a certain amount; 3) schools or teachers should monitor students' stress level and sense of uncertainty level by providing informal consultation/check-in with students regularly.

6. LIMITATIONS

The limitations of this study mostly related to the instruments and numbers of participants. First of all, the participants were asked to complete all the surveys in one sitting so their responses could be subjective. Second, the number of valid survey responses is only 100, and the participants are mainly concentrated in one region of China. Thus, the local culture, economy, and lifestyle can affect how the participants responded to the surveys. Lastly, academic performance data came from students' self-evaluation, and the results are subjective and can be influenced by many invisible factors.

7. IMPLICATIONS

The results of this study could benefit both students and teachers who are teaching and learning online due to the global pandemic. It can provide them with deeper insight into education under the background of lockdown and online teaching. Teachers should further refine or change their teaching methods to gain better teaching results. Teachers should also pay more attention to the level of intolerance of uncertainty and stress as they are significantly related to students' academic performance. Students should also actively seek out ways of self-care to manage their own levels of anxiety and stress to maintain efficiency for online learning.

Based on the results of this study, future studies can continue to explore more aspects related to the relationships between intolerance of uncertainty, levels of stress, and perceived academic performance such as efficacy. Moreover, future studies can also explore more psychological factors that influence academic performances, such as behavioural control, emotional control, and students' personalities.

8. CONCLUSION

According to the data collected and the analysis, I can conclude that uncertainty has a significant influence on academic performance by affecting stress. This study focused on studying whether online teaching has influences students under the circumstances of the outbreak of COVID-19 and lockdown via investigating the relationships between students' level of stress, intolerance of uncertainty, and their perceived academic performance. The finding showed that through influencing the students' level of uncertainty, feeling of stress is affected and thus indirectly influences students' academic performances.

Compared with a previous study that studied how uncertainty influences stress, this study focused on studying the mediating role of stress on uncertainty and academic performances under the situation of facing lockdown and long-distance learning.

REFERENCES

[1] Martins, L. L., & Kellermanns, F. W. (2004). A model of business school students' acceptance of a web-based course management system. Academy of Management Learning and Education, 3, 7–26.

[2] Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. Management Science, 46, 186–204.

[3] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: toward a unified view. MIS Quarterly, 27, 425–478..

[4] Karahanna, E., Ahuja, M., Srite, M., & Galvin, J. (2002). Individual differences and relative advantage: the case of GSS. Decision Support Systems, 32, 327–341.

[5] Elias, H., Ping, W. S., & Abdullah, M. C. (2011). Stress and academic achievement among undergraduate students in Universiti Putra Malaysia. Procedia-Social and Behavioral Sciences, 29, 646-655.

[6] Solomon, O. (2013). Exploring the relationship between resilience, perceived stress and academic achievement.

[7] Rafidah, K., Azizah, A., Norzaidi, M. D., Chong, S. C., Salwani, M. I., & Noraini, I. (2009). Stress and academic performance: Empirical evidence from university students. Academy of Educational Leadership Journal, 13(1), 37.

[8] Ye, L., Posada, A., & Liu, Y. (2019). A review on the relationship between Chinese adolescents' stress and academic achievement. New directions for child and adolescent development, 2019(163), 81-95.

[9] Kornilova, T. V., Chumakova, M. A., & Kornilov, S. A. (2018). Tolerance and intolerance for uncertainty as predictors of decision making and risk acceptance in gaming strategies of the Iowa gambling task. Psychology in Russia, 11(3), 86.

[10] Tang, W. K. (2019). Resilience and Self-Compassion Related with Achievement

Emotions, Test Anxiety, Intolerance of Uncertainty, and Academic Achievement. Psychological Studies, 64(1), 92-102.

[11] Thibodeau, M. A., Carleton, R. N., Gómez-Pérez, L., & Asmundson, G. J. (2013). "What if I make a mistake?": Intolerance of uncertainty is associated with poor behavioral performance. The Journal of nervous and mental disease, 201(9), 760-766.

[12] Oglesby, M. E., Boffa, J. W., Short, N. A., Raines, A. M., & Schmidt, N. B. (2016). Intolerance of uncertainty as a predictor of post-traumatic stress symptoms following a traumatic event. Journal of Anxiety Disorders, 41, 82-87.

[13] Yook, K., Kim, K. H., Suh, S. Y., & Lee, K. S. (2010). Intolerance of uncertainty, worry, and rumination in major depressive disorder and generalized anxiety disorder. Journal of anxiety disorders, 24(6), 623-628.

[14] Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry?. Personality and individual differences, 17(6), 791-802.

[15] Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour research and therapy, 33(3), 335-343.