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# Influence of learning flow and distance e-learning satisfaction on learning outcomes and the moderated mediation effect of social-evaluative anxiety in nursing college students during the COVID-19 pandemic: A cross-sectional study

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## ABSTRACT

**Aim:** The purpose of this study was to examine the potential mechanism underlying the association between learning flow and learning outcomes in nursing students in South Korea during the pandemic. In particular, we examined the mediation effect of distance e-learning satisfaction moderated by social-evaluative anxiety related to COVID-19 on the relationship between learning flow and learning outcomes.

**Background:** Despite the COVID-19 pandemic, the education of nursing students has continued by shifting the manner of delivering their education. Distance e-learning is being widely used under the strong social distancing policies currently in place and many educators are struggling to enhance the efficiency of this distance e-learning.

**Methods:** A cross-sectional study was conducted among 310 nursing students attending two colleges in South Korea. Data were collected from December 2–15 in 2020 by using an online survey.

**Results:** As a result, an association was observed between learning flow and learning outcomes and distance e-learning satisfaction mediated this association. Importantly, social-evaluative anxiety caused by COVID-19 moderated the mediation effect of distance e-learning satisfaction. Students' anxiety related to COVID-19 played a negative role in the distance e-learning mechanism for nursing students.

**Conclusions:** It is thus necessary for educators and staff in nursing schools to exert effort to reduce students' COVID-19-related anxiety to enhance the outcomes of distance e-learning in nursing students.

## 1. Introduction

The highly infectious coronavirus disease (COVID-19) has changed every aspect of our lives, including the way we educate. Most educational institutions, including schools, are closed under strong global "social distancing" policies. Nonetheless, educating and training students must continue; thus, activities related to teaching and training students are being implemented under conditions that avoid close, in-person meetings. From this movement, distance e-learning strategies are now emerging as the most accessible means for education (Kaup et al., 2020). Distance e-learning refers to technology-supported

learning provided by an instructor who is geographically remote from the learner (Moore et al., 2011).

Several previous studies have attempted to adopt various education strategies with different learning environment for students in health-related disciplines, such as medical and nursing students and many studies have reported no differences in student achievement among online instruction, traditional instruction, or a blended version of the two (Kyaw et al., 2019; Mccutcheon et al., 2015). Nonetheless, in terms of educating medical and nursing students, traditional face-to-face teaching and in-hospital trainings have been the primary approaches, while the adoption of online-based education has met relative resistance

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from both students and teachers (Camargo et al., 2020).

However, such changes in the learning environment seem to be not a matter of choice but one of necessity in the current situation regarding the COVID-19 pandemic where people must distance themselves from each other. Therefore, many researchers and educators are now reviewing the evidence relating to distance e-learning and determining the optimal way of adopting such an approach to continue the education and training of students in this turbulent social situation (Camargo et al., 2020; Schneider and Council, 2020). Indeed, a wide range of education-related factors for enhancing the effectiveness of distance e-learning have been explored, such as factors relating to learners and educators (e.g., satisfaction, learning flow, self-efficacy, technology-using skills and experiences), content and resources, interaction between educators and learners (e.g., prompt feedback and responses from the instructor), quality of operational strategies (e.g., quality of instruction) and learning environment (e.g., infrastructure of hardware, software and networks) (Kang et al., 2011; Lee and Yu, 2015; Song, 2012; Sowan and Jenkins, 2013).

So far, however, mental health-related factors have not been explored in regard to their influence on distance e-learning. In fact, various researchers are warning of the negative effects of COVID-19 on mental health around the globe, such as stress; anxiety; depression or post-traumatic stress disorder, which may result from long confinement; uncertainty; fear of infection; moral distress; loneliness; grief; and economic crisis (Galea et al., 2020; Kaur et al., 2020; Petet, 2020; Torales et al., 2020). According to Kaup et al. (2020), poor mental well-being may affect students' engagement and performance of distance e-learning during the pandemic; specifically, the students may feel a lack of support from peers and resources as well as a sense of isolation and, further, may experience anxiety or depression issues related to the public crisis. In particular, a feeling of isolation has been determined to be one of the challenges of distance e-learning even under more normal circumstances (Sowan and Jenkins, 2013), but these feelings of isolation may be exacerbated during the pandemic, especially in students who are confined to or quarantined in their homes. Therefore, in this study, we focused on nursing students' social-evaluative anxiety related to COVID-19 and its influence on their learning mechanisms during distance e-learning.

### 1.1. Hypothesis conceptual model of this study

Flow is a concept defined by Csikszentmihalyi (1990) as referring to a state where the entire mind is fully concentrated on a particular activity and is aware of nothing else. The concept of flow has been adopted in various areas, including web communication (Chen, 2006) and education (Lee and Yu, 2015). Chen (2006) adopted this concept for application regarding web communication when referring to a state where

web users' minds and actions merge into the web environment and their physical world fades away. Lee and Yu (2015) used the concept of learning flow in their study to refer students' optimal learning experiences through immersion in the relevant content. Learning flow is known to be an important variable to enhance the success of distance e-learning, in that it increases learners' learning achievement and satisfaction (Song, 2012).

The concept of learning outcome has various definitions in accordance with diverse views from equally diverse researchers; however, it is generally considered to be a final goal when evaluating education. Various factors have been identified to enhance learning outcomes in learners; in particular, one's satisfaction, learning flow and feeling of joy during learning experiences were determined to be influencing factors on learning outcomes (Lee and Yu, 2015; Sowan and Jenkins, 2013).

To summarize the above evidence discovered through our literature review, we developed a hypothesis conceptual model as illustrated in Fig. 1. We first hypothesized the influences of students' learning flow and distance e-learning satisfaction (DE-LS) on their learning outcomes during the pandemic. In particular, we hypothesized that learning flow may affect students' learning outcomes mediated by their DE-LS. Second, we hypothesized the effect of social-evaluative anxiety (SEA) on the mediating effect of DE-LS. Social-evaluative anxiety is defined as experiences of fear, distress, anxiety, or discomfort related to social circumstances (Watson and Friend, 1969). In this study, we operationally defined SEA as one's experiences of these negative emotions related to the COVID-19 pandemic. We hypothesized that SEA may moderate the relationship between learning flow and DE-LS. Because the reason the students are taking online-based distance classes is related to the pandemic, we assumed that their COVID-19-related anxiety would affect their DE-LS.

Therefore, the aim of the current study was to identify the potential mechanism underlying the association between learning flow and learning outcomes in nursing students in South Korea during the pandemic. In particular, we examined the mediation effect of DE-LS moderated by SEA on the relationship between learning flow and learning outcomes. The following hypotheses were tested:

**Hypothesis 1.** Distance e-learning satisfaction will mediate the relationship between learning flow and learning outcomes during the COVID-19 pandemic.

**Hypothesis 2.** In the relationship between learning flow and learning outcomes, the mediation effect of distance e-learning satisfaction will be moderated by social-evaluative anxiety related to the COVID-19 pandemic.



Fig. 1. A Hypothesis conceptual model of this study.

## 2. Method

### 2.1. Samples and procedure

This study used a descriptive and cross-sectional design with a convenience sampling method and followed the STROBE checklist for reporting cross-sectional studies (von Elm et al., 2008). Approval for this study was obtained from the institutional review board of S University (IRB#: SM-202010-072-1).

Data were collected from 2 to 15 December in 2020. Inclusion criteria for eligible participants were that they were nursing students who: 1) enrolled in more than one semester in 2020; 2) experienced distance e-learning in nursing curriculum during the semesters in 2020; and 3) understood the purpose of this study and voluntarily wished to participate. A Google survey was used to collect the data. Students enrolled in one of two nursing colleges received an email invitation leading to the Google survey. Students were able to participate in the survey after reading and completing an online informed consent. In total, 320 students participated in the survey (response rate: 18.2%). Data from 310 students were used for analysis after 10 unreliable responses were discarded. Our sample size was sufficient in accordance with a power analysis calculated by G\*power; the power was 100% with effect size.25 and a 5% alpha margin error.

### 2.2. Measurements

*Learning flow* was measured using the learning flow scale developed by Lee (2015) based on the theory of optimal experience (Cziksentmihalyi, 1990). It consists of 13 items and each item is scored on a 5-point scale from 1 = strongly disagree to 5 = strongly agree. Example items include "There are times when I'm so absorbed in studying that I don't know how time flies" and "During the lecture, I concentrate entirely on the contents of the lecture." The Cronbach's alpha of this tool was .88 in this study.

*Distance e-learning satisfaction* was assessed using a learning satisfaction tool developed by Bae (2018). It contains 16 items, which are rated on a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree. Example items were "Distance e-learning is not boring but easy to concentrate on" and "The contents of distance e-learning look fancy and are attractive and well organized." The Cronbach's alpha of the scale in this study was .90.

*Learning outcome from distance e-learning* was assessed with the learning outcome scale developed by Bae (2018). It was measured with four items, including "I think the contents of the distance e-learning achieved the course goals" and "In the future, I would like to take up an intensive course related to what I've learned via distance e-learning." The Cronbach's alpha of this scale was .95.

*Social-evaluative anxiety related to COVID-19* was assessed using the Social Avoidance and Distress scale (Watson and Friend, 1969). It consists of 28 items scored on a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree. Example items included "Even though a room is full of strangers, I may enter it anyway" and "I try to avoid places where I have to get along with people actively (Watson and Friend, 1969, p. 450)." In this study, the Cronbach's alpha of the scale was .93. We received permission to use the tools we used in this study from each measurement tool's original developer.

### 2.3. Data Analysis

PROCESS Macro (ver. 3.5) for SPSS 25.0 was used to analyze our data. Descriptive statistics were used to analyze the demographic characteristics of the participants. The relationships between the variables of this study were analyzed by performing Pearson's correlation analysis. The mediation and moderation effects were evaluated by the method suggested by Hayes and Rockwood (2020) by using PROCESS Macro Models 4 and 7. The variables were mean-centered to minimize a

multicollinearity. Through the bootstrapping method, 95% confidence intervals were calculated to determine the significance of mediating indirect effect size and moderated mediation index.

## 3. Results

### 3.1. Demographics of the samples

The sample characteristics are shown in Table 1. Males comprised of 13.5% of the total sample and females accounted for 86.5%. The mean age of the sample was 23.9 ( $\pm 3.79$ ) years old. Almost half of the sample was first-year students (43.5%) and second-, third- and fourth-year students accounted for 26.8%, 15.8% and 13.9%, respectively. Most students stayed in their own home with their families while taking the distance e-courses during the COVID-19 pandemic, whereas 18.1% and 11.6% of students stayed in dormitories and rented rooms near their schools, respectively.

### 3.2. Analysis of the correlation between the variables

Table 2 shows the analysis of the correlation between the variables. Students' learning outcome was positively related to learning flow ( $r = 0.44$ ,  $p < .001$ ) and DE-LS ( $r = 0.63$ ,  $p < .001$ ), whereas it was negatively related to SEA ( $r = -0.12$ ,  $p = .036$ ). DE-LS showed a significant positive correlation with learning flow ( $r = 0.55$ ,  $p < .001$ ).

### 3.3. Analysis of the mediation effect of distance e-learning satisfaction

Students' learning flow was a significant predictor of their learning outcomes ( $B = 0.72$ ,  $p < .001$ ) and DE-LS ( $B = 0.63$ ,  $p < .001$ ), as shown in Table 3. When both learning flow and DE-LS were entered into the model, significant associations were observed between learning flow and learning outcome ( $B = 0.22$ ,  $p = .012$ ) and between DE-LS and learning outcome ( $B = 0.80$ ,  $p < .001$ ). The bias-corrected bootstrap indicated that the mediating effect of DE-LS on the relationship between learning flow and learning outcome was .51 (95% CI [.36 ~.65]), which indicates that DE-LS significantly mediated the relationship between learning flow and learning outcome.

### 3.4. Analysis of the mediation effect of distance e-learning satisfaction moderated by social-evaluative anxiety

As shown in step 1 of Table 4, there was a significant direct effect of learning flow on DE-LS ( $B = 2.74$ ,  $p = .001$ ) and the learning flow  $\times$  SEA interaction effect on DE-LS was also significant ( $B = -0.59$ ,  $p = .009$ ). In step 2, the direct effect of learning flow on learning outcome was significant ( $B = 0.22$ ,  $p = .007$ ) and that of DE-LS on learning outcome was also significant ( $B = 0.80$ ,  $p < .001$ ).

The conditional indirect effect of SEA on the indirect path from learning flow through DE-LS to learning outcome was analyzed. The students who had higher SEA (+1SD) showed a reduced increase of DE-LS from learning flow, whereas the students who had lower SEA (-1SD)

**Table 1**  
Demographics of the Samples (n = 310).

Variable	Categories	N (%) or Mean $\pm$ SD
Gender	Male	42 (13.5)
	Female	268 (86.5)
Age (yrs old)		23.9 $\pm$ 3.79
School year	1st year	135 (43.5)
	2nd year	83 (26.8)
	3rd year	49 (15.8)
	4th year	43 (13.9)
Places of distance E-learning	Own home with the family	218 (70.3)
	Dormitory	56 (18.1)
	Rented room near school	36 (11.6)

**Table 2**  
Correlations between the variables (n = 310).

Variables	Learning flow	SEA	DE-LS	Learning outcome
	<i>r</i> ( <i>p</i> )			
Learning flow	1			
SEA	-0.10 (0.074)	1		
DE-LS	.55 (<0.001)	-0.02 (0.747)	1	
Learning outcome	.44 (<0.001)	-0.12 (0.036)	.63 (<0.001)	1
Mean±SD	3.34 ± 0.56	3.58 ± 0.20	3.30 ± 0.64	3.55 ± 0.93
Skewness	-0.13	-1.13	.42	.55
Kurtosis	.21	-5.03	.63	.19

SEA: social-evaluative anxiety; DE-LS: distance e-learning satisfaction

**Table 3**  
Mediation Effect of Distance E-Learning Satisfaction (n = 310).

Step	Variables	B	SE	<i>p</i>	95% CI		R <sup>2</sup>
					LLCI	ULCI	
1	X → Y	.72	.09	<0.001	.56	.90	.19
2	X → M	.63	.06	<0.001	.52	.74	.30
3	X → Y	.22	.09	.012	.05	.39	.42
	M → Y	.80	.08	<.001	.07	.95	
Indirect effect	X → M → Y	Effect	Boot SE	Boot 95% CI			
		.51	.08	.36 ~.65			

X: learning flow; Y: learning outcome; M: distance e-learning satisfaction; CI: confidence interval; LLCI: lower limit confidence interval; ULCI: upper limit confidence interval

showed an increase of DE-LS from learning flow. The moderated mediation index was -0.48 (95% CI [-1.04 ~ -0.08]), thereby indicating that the mediation effect of DE-LS was significantly moderated by SEA. Therefore, our hypothesis conceptual model was statistically confirmed. Fig. 2 illustrates our final model with path coefficients.

**4. Discussion**

In this study, we examined the relationship between learning flow and learning outcomes in nursing students during the COVID-19 pandemic in South Korea and the roles of SEA and DE-LS were investigated in relation to the association between learning flow and learning outcomes. As we first hypothesized, the results of this study reflected that there was an association between learning flow and learning outcomes in nursing students and that DE-LS mediated this association. The relationship between learning flow and learning outcomes had been

**Table 4**  
Moderated mediation effect of social-evaluative anxiety (n = 310).

Step	Independent variables	Dependent variables	B	SE	<i>p</i>	95% CI		R <sup>2</sup>
						LLCI	ULCI	
1	X	M	2.74	.81	.001	1.14	4.34	.31
	W		2.17	.80	.007	.59	3.75	
	X × W		-.59	.23	.009	-1.04	-.14	
2	X	Y	.22	.09	.007	.05	.39	.41
	M		.80	.08	<.001	.65	.95	
Conditional indirect effect		Social-evaluative anxiety	Indirect effect	Boot SE	<i>p</i>	95% CI		
						LLCI	ULCI	
			Mean -1SD	.73	.07	<0.001	.61	.87
			Mean	.62	.06	<0.001	.51	.73
		Mean+1SD	.50	.08	<0.001	.36	.65	
Moderated mediation Index = -0.48				.24		-1.04	-.08	

X: learning flow; Y: learning outcome; M: distance e-learning satisfaction; W: social-evaluative anxiety; CI: confidence interval; LLCI: lower limit confidence interval; ULCI: upper limit confidence interval

widely demonstrated in other previous studies as well, which commonly reported the vital role of learning flow in students' subjective and objective learning outcomes, including academic achievement, learning persistence and learning self-efficacy (Lee, 2011; Song, 2012). However, we identified one of the mechanisms of this relationship by observing the mediation effect of DE-LS. Kang et al. (2011) also stressed the importance of learning media satisfaction by reporting that when a new medium is introduced, the learner's satisfaction with it has a significant impact on whether they accept it and select it again and this, in turn, leads to learners' learning engagement and achievement (Kang et al., 2011). Conversely, cases of dissatisfaction with new media eventually interfered with learners' self-directed learning, which can lead to low engagement and achievement (Kang et al., 2011).

We secondly hypothesized the role of SEA on the learning mechanism and confirmed that SEA moderated the mediation effect of DE-LS. Thus, students' anxiety related to the current turbulent social circumstances associated with COVID-19 seemed to play a negative role in the learning mechanism and, ultimately, in the learning outcomes of nursing students. Indeed, anxiety caused by the current public health crisis seems to be a serious problem overall, not merely for certain vulnerable people. Despite limited access to research resources, multiple researchers around the country are reporting worsening mental health in populations due to COVID-19. In Hong Kong, for instance, 19% and 14% of the population reported depression and anxiety, respectively and 25.4% reported deteriorated mental health since the COVID-19 pandemic began (Choi et al., 2020).

University/college students are no exception. Heightened depression and anxiety in university students has also been revealed worldwide, including in Bangladesh, Spain and Switzerland (Elmer et al., 2020; Fawaz and Samaha, 2020; Odriozola-González et al., 2020). For instance, 21.34%, 34.19% and 28.14% of university students in Spain reported moderate to extremely severe anxiety, depression and stress, respectively (Odriozola-González et al., 2020). Researchers have assumed that social isolation, fear of infection and uncertainty might threaten people's mental well-being (Choi et al., 2020) and in particular, in terms of university students, the sudden shift to distance e-learning, lack of interaction with social networks and support and financial problems were determined to be triggers of negative mental health (Akhtarul Islam et al., 2020; Elmer et al., 2020; Fawaz and Samaha, 2020).

Nursing students, in particular, are considered a more vulnerable population among university students. Nursing students in general were likely to have higher anxiety levels than were students in other disciplines, which was related to their heavy course work load and clinical practicum (Savitsky et al., 2020). However, it has been reported that anxiety levels in nursing students became more severe during the public crisis (Savitsky et al., 2020). In the case of South Korea, it was reported that nursing students were afraid of the risk of infection when they



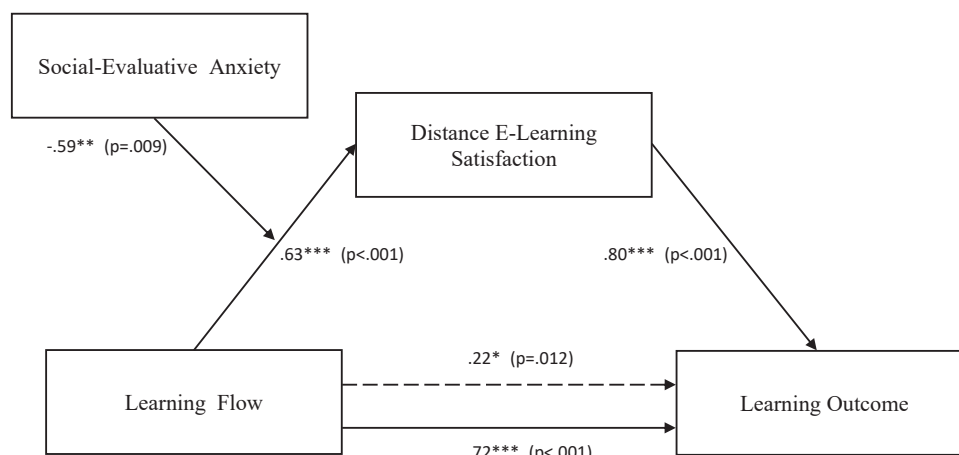


Fig. 2. A Hypothesis conceptual model with path coefficients.

participated in clinical practice during the pandemic, while they also felt anxious due to insufficient training and disadvantages in employment when they had to stop clinical practice due to COVID-19 (Park, 2020).

Based on the findings of this study, we suggest several important implications for education practice for nursing students: first, the sudden shift to distance e-learning has caused confusion for both educators and students all over the world. The unexpected shift forced schools and educators to focus on the alternative tasks and activities that students could perform from remote places in ways that involved no contact to complete their course credits, whereas the mental distress and anxiety of students related to the turbulent social situation was relatively neglected. However, students' anxiety was the important factor in terms of their learning mechanism, according to the findings of this study. Furthermore, when considering that COVID-19-related anxiety could lead to many negative mental consequences, including substance abuse, hopelessness and suicidal ideation (Galea et al., 2020; Lee, 2020), students' mental health should be closely monitored and supported along with formal education. Female students, in particular, are known to be more vulnerable to negative mental health effects during this public crises (Elmer et al., 2020; Savitsky et al., 2020). Therefore, special and careful consideration is needed regarding this population.

Second, educators should try to minimize negative consequences of distance e-learning by using diverse complementary and alternative class activities. Feelings of isolation, loneliness and lack of peer support are known to be negative aspects associated with distance e-learning (Rajabalee and Santally, 2020) and they may exacerbate poor mental health in students during the pandemic (Elmer et al., 2020). It will be necessary for educators to provide opportunities to students for online-based group projects during which they are able to communicate and cooperate with each other, to respond immediately and sensitively to students' needs and queries and to provide emotional support to students. Additionally, higher exposure time to computers, tablets and smart phone screens has been shown to be associated with stress and burnout (Mheidly et al., 2020); thereby, some paper-based class activities should be added to decrease students' levels of stress and burnout. Resilience, self-esteem and humor were identified as protective factors alleviating the anxiety levels of nursing students during the pandemic (Savitsky et al., 2020). Thus, educators can use these protective tactics during class to relieve students' anxiety.

Eventually, the pandemic will end and people will return to their daily lives. However, online-based education, which was once performed for unavoidable reasons, will become more advanced. With the advancement of globalization and Internet and advanced technology, distance-e learning can be a method to provide up-to-date educational content to larger populations across the borders. The findings of this study could provide great implications to the educators in this era to

enhance their educational outcomes.

This study has a few limitations. First, owing to the use of convenience sampling and self-reported measures, there could have been response bias. Second, because of the cross-sectional design, only limited data were obtained. These limitations should be considered when generalizing the results and inferring the causality from learning flow to learning outcome. In addition, technical difficulties and a poor internet connection are influencing factors in e-learning experiences among students (Abbasi et al., 2020; Rajabalee and Santally, 2020); however, since the region of South Korea where this study was conducted has fast internet connections, technical barriers were not considered in this study.

## 5. Conclusion

The sudden COVID-19 outbreak has caused rapid changes to individuals' typical way of life, including in the case of teaching and learning, which has led to substantial confusion among people. Under these turbulent circumstances, people are struggling to maintain their roles by using alternative non-contact approaches. In this study, we examined the influence of students' mental health, effected by COVID-19, on their learning mechanism as they continued their education and training in these chaotic global circumstances. Specifically, we examined the roles of DE-LS and SEA related to COVID-19 in the relationship between learning flow and learning outcomes in nursing students in South Korea during the COVID-19 pandemic. The results revealed that DE-LS mediated the association between learning flow and learning outcomes and SEA moderated the DE-LS mediation effect. Based on the findings of this study, we suggest that educators and staff in nursing schools around the world put considerable effort into reducing students' COVID-19-related anxiety to enhance the outcomes of distance e-learning.

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## CRediT authorship contribution statement

**Sin-Hyang Kim:** Conceptualization, Methodology, Investigation, Data curation, Formal analysis, **Sihyun Park:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Funding acquisition.

## Conflict of Interest

The authors have no conflicts of interest to declare.

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