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Exploring the Role of Interaction in Engagement and Satisfaction Within Virtual Learning Environments

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ABSTRACT

Empirical studies have recognized the significant role of student engagement and interaction in determining satisfaction within high-quality, synchronous virtual learning environments. A prevailing concept in research surrounding synchronous virtual satisfaction suggests that interaction is a key driver of learner engagement. However, very few research has delved into the underpinnings of this relationship. This study, therefore, aims to examine the potential mechanisms that link student engagement and satisfaction through interactions within a synchronous virtual learning environment. A sample of 200 South Korean secondary school students, comprising a balanced gender ratio (51% male, 49% female), was included in this research. The findings demonstrate a series of positive correlations among student engagement, interaction, and satisfaction. Furthermore, mediation analysis revealed a positive relationship between student engagement and satisfaction, with interaction serving as a mediating variable. The study's results suggest that high school students derive benefits when teachers take active steps to engage them. The findings of this study could guide future planners of synchronous virtual learning environments to prioritize student engagement as a strategic initiative for boosting satisfaction levels.

Introduction

The catastrophic COVID-19 pandemic has created immense strain within secondary and higher education systems worldwide. As a response, numerous educational institutions in South Korea transitioned from conventional in-person instruction to home-based virtual learning. This swift paradigm shift towards online education has brought about profound changes in both teaching methodologies and student learning experiences.

The terminology of "virtual learning" and "online learning" is often interchangeably used by educators and researchers, typically connoting the utilization of technology in facilitating educational access (Carliner, 2004; Conrad, 2002). Dillenbourg et al. (2002), however, define the virtual learning context as a distinct subset of online learning, describing it as a "social space" where "educational interactions convert spaces into places" (p. 3). Given the undeniable significance of the social context within learning environments, this study is designed to investigate satisfaction outcomes for learners in virtual learning environments.

Similar to traditional physical classrooms, student engagement and interaction within a virtual learning environment are believed to be fundamental determinants of successful educational outcomes. Students who actively engage and interact in class are typically more successful learners. However, the majority of previous research has largely focused on physical classrooms rather than virtual learning environments. This study aims to fill this research gap by investigating the relationships among factors influencing satisfaction in synchronous virtual learning environments, as well as examining whether the correlation between student engagement and satisfaction is mediated by interaction within these virtual contexts.

Through this investigation, the present study seeks to augment our understanding of students' perceptions of their engagement, interaction, and satisfaction within virtual learning environments, and more broadly, their overall learning satisfaction during the unprecedented era of the COVID-19 pandemic.

Empirical Research on Engagement and Interaction with Regard to Satisfaction in Virtual Learning Environments

Student engagement is considered an important source of academic success and satisfaction in education (Banna et al., 2015; Hew, 2016; Marks, 2000; Robinson, 2011). It has been shown that disengagement in school is one predictor of dropout (Achambault et al., 2009). Generally, engagement refers to "students' level of involvement with and effort in learning" (Fredricks, et al., 2004; Wang et al., 2017). While researchers and practitioners conceptualize student engagement in multiple ways (Azvedo, 2015), Kuh (2003) identifies student engagement in terms of "time and energy" devoted to educational activities, and Kuh's operationalization gave rise to four factors showing how students devote their time and energy in the classroom: skills engagement, participation engagement, emotional engagement, and performance engagement (Handelsman et al., 2005). Skills engagement is when students put forth effort (e.g., by doing a reading assignment). Participation engagement is when students actively discuss in small groups. Emotional engagement is when students apply the content of a lesson to their own lives. And performance engagement is when students do well on tests or receive a good course grade. In sum, student engagement involves both affective ad behavioral components.

In a recent study, Baloran et al. (2021) conducted a study of a sample of 529 university learners in the Philippines. The majority of the participants were male (56%) and many were first year (42%) college students at the university. This study was designed to examine the level of course satisfaction and student engagement in online learning. They identified student engagement in terms of Kuh's four domains: skills engagement, emotion engagement, participation engagement, and performance engagement. They found that participants who were satisfied with online classes also had a high level of online learning engagement ($r = .336$, $p < .001$). Moreover, the subdomains of student engagement were statistically correlated with student satisfaction (skills, $r = .333$; emotion, $r = .322$; participation, $r = .295$; and performance, $r = .229$).

Essentially the same conclusion was reached by Oraif and Elyas [22] in a study involving high school girls in Saudi Arabia. The authors examined the level of engagement among girls with their online classes. The correlation between students' engagement and satisfaction in online classes was positive and large. In particular, they found that the sampled students showed engagement with their online classes in relation to their classroom participation, interaction with peers and teachers, emotional involvement with the course material, performance in the class.

Furthermore, the existing literature shows that positive engagement has benefits across grade levels as well as academic disciplines. When investigating student engagement across grade levels in secondary schools in two subjects (mathematics and social studies), Marks (2000) reported that the pattern of engagement across grade levels was positive and consistent, and that mathematics classes had higher levels of engagement among students than social studies classes.

The concept of student interaction has been also shown to play a critical role in success in virtual learning contexts (Croxton, 2014; Martin & Bolliger, 2018). Previous research has suggested that the effects of interaction might be direct in virtual learning environment. However, this depends on the type of the virtual learning environment, whether it is a synchronous or asynchronous online learning environment. For example, Vuopala et al. (2016) conducted a study with 54 higher education students attending three universities in Europe. Students attended online classes lasting from 45 to 120 minutes, and their instruction involved both synchronous and asynchronous virtual learning. Employing a qualitative approach, the researchers found that student interaction could be fairly described as learners actively engaged in planning and organizing joint activities. They also found that forms of interaction differed between the synchronous and asynchronous environment. Synchronous interactions included more informal discussions amongst the students.

Martin and Bolliger (2018) proposed the current model of online interaction, which divides into three types: student-student, student-teacher, and student-content. Student-student interaction means the extent to which students are sharing and discussing information among themselves. Student-teacher means the level of involvement the teacher

has with the students. Student-content means the interaction between the learners and online materials like audio files, video clips, and PPTs. In a study involving post-secondary students, Martin and Bolliger (2018) explored the online learning of 146 (68% female, 21% male) graduate students, ranging in age from 20 to 67 and enrolled in a variety of graduate programs across eight universities in the United States. Based on Moore's (1993) research on interaction, the researchers developed a 36-item Likert-scale to investigate these three types of interaction. Their study found many strategies to increase interaction in online classrooms, including realistic and authentic materials for discussions, and announcements and email reminders.

Despite the growing literature on the importance of positive engagement and interaction on outcomes in the field of education, very little is known about the relationship between engagement and satisfaction vis-a-vis interaction in virtual learning contexts. Moreover, what prior research there is has often strictly focused on college students. The present study therefore seeks to explore how online interactions impact the association between engagement and satisfaction, with the aim of enhancing our understanding this process among Korean middle and high school students.

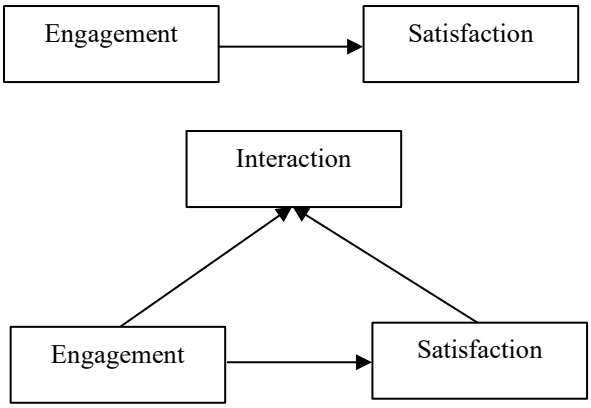

Figure 1. Conceptual model of relations among engagement, interaction, and satisfaction

The Present Study

The body of literature reviewed above suggests that interaction may play an important role in student satisfaction in synchronous virtual learning environments. Thus, this study aims to understand how secondary school students' interaction level explains their own perception of engagement and satisfaction in a synchronous online learning environment, and in turn how to promote virtual learning during the unprecedented COVID-19 pandemic. The following research questions guide my inquiry:

Research Question 1: What is the correlation among secondary school students' engagement, interaction, and satisfaction in a synchronous virtual learning environment?

Research Question 2: Do ssecondary students' interaction mediate the relationship between engagement and satisfaction in a synchronous virtual learning environment?

Methods

Participants

Participants in the study were secondary school students from Seoul in the Republic of Korea, with 30% (n = 59) of participants classified themselves as middle school students and 70% (n = 141) had high school student status. A total of 200 middle and high school students (n = 101, 51% male; n = 99, 49% female) responded to the questionnaire. Mean age for all participants was 16.42 years (SD = 1.48).

Measures

Measures of student engagement, interaction, and satisfaction were collected at the beginning of the summer of 2022. Table 1 shows all the items of the questionnaire for quantitative analysis. The items on the questionnaire aimed at the three domains (engagement, interaction, and satisfaction) of the study. Table 2 shows sub-domain, number of items per sub-domain, and reliability coefficients for all the sub-domains of the assessment. Specifically, the Cronbach's alpha reliability coefficient was also computed for each of the sub-domains of the assessment. The values ranged from .84 to .89, which showed acceptable internal reliability (Nunnally, 1978). The reliability of the full scale of 35 items was .93. In the following section, measures of student engagement, interaction, and satisfaction are described in detail.

Table 1. Questionnaire items by domain.

Domain	Sub-Domain	No.	Item
Engagement	Skill	1	Making sure to study on a regular basis.
	Emotion	2	Putting forth effort.
	Skill	3	Looking over class notes before getting online to make sure I understand the material.
	Skill	4	Looking over class notes before getting after to make sure I understand the material.
	Skill	5	Taking good notes over readings, PowerPoints, or video lectures.
	Skill	6	Listening/reading carefully.
	Emotion	7	Finding ways to make the course material relevant to my life.
	Emotion	8	Applying course material to my life.
	Participation	9	Having fun in online chats, discussions or via email with the instructor or other students.
	Participation	10	Participating actively in small-group discussion forums.
	Participation	11	Helping fellow students.
	Performance	12	Getting a good grade.
	Performance	13	Doing well on the tests/quizzes.
	Participation	14	Engaging in conversations online (chat, discussions, email).

	Participation	15	Posting in the discussion forum regularly.
	Participation	16	Getting to know other students in the class.
Interaction	Student-Student	17	Students interact with peers through discussions.
	Student-Student	18	Students work collaboratively using online communication tools to complete team projects.
	Student-Student	19	Students work collaboratively using online communication tools to complete homework.
	Student-Student	20	Students work collaboratively using online communication tools to complete problem solving assignments.
	Student-Teacher	21	The instructor sends/posts regular announcements or email reminders.
	Student-Teacher	22	The instructor provides students with opportunity to contact the instructor with questions about the course.
	Student-Teacher	23	The instructor posts a "due date checklist" at the end of each instructional unit.
	Student-Teacher	24	The instructor uses various features to interact with students (e.g., polls, emoticons, whiteboard, text, or audio and video chat).
	Student-Content	25	Students interact with content in more than one format (e.g., text, image,video, audio).
	Student-Content	26	Students search for and select applicable materials (e.g., articles, videos) based on their interests.
Satisfaction	Satisfaction	27	I am satisfied to communicate effectively with my teachers throughout the semester.
	Satisfaction	28	I am satisfied with the support of my teachers in accessing various educational materials related to the course.
	Satisfaction	29	I am satisfied that my teachers are enthusiastic about online learning.
	Satisfaction	30	I am satisfied to receive feedback from my teachers online.
	Satisfaction	31	I am satisfied with the speed of the online system.
	Satisfaction	32	I am satisfied that the online system is easy to use.
	Satisfaction	33	I have learned a great deal in online class.
	Satisfaction	34	Overall, I am satisfied with virtual learning courses.
	Satisfaction	35	The virtual learning courses offered by my school exceed my expectations.

Table 2. Domain, sub-domain, number of items, and cronbach's alphas per domain sets.

Domain	**Sub-Domain**	**Number of items**	**Cronbach's alpha**
Engagement	Skill	5	.89

	Participation	6	
	Emotion	3	
	Performance	2	
Interaction	Student-Student	4	.87
	Student-Teacher	4	
	Student-Content	2	
Satisfaction	Satisfaction	9	.84
Total		35	.93

Student Engagement

Student engagement was assessed using the modified Online Student Engagement Scale (OSE), which was developed by Dixson (2015). The questionnaire consisted of 16 items designed to assess a participant's level of engagement during online learning. There were four domains, with items comprising 5 items for skills engagement (Cronbach's alpha = .69), 6 items for participation engagement (Cronbach's alpha = .74), 3 items for emotional engagement (Cronbach's alpha = .58), and 2 items for performance engagement (Cronbach's alpha = .66). Each item was rated on a 5-point Likert scale (from 1 = *not at all characteristic of me* to 5 = *very characteristic of me*). The Cronbach's alpha reliability for student engagement was 0.89.

Student Interaction

Interaction was assessed with the modified 10-item Martin and Bolliger (2018) questionnaire, which measures participants' level of engagement across the three sub-domains: student-student, student-teacher, and student-content; 4 items assess student-student interaction (Cronbach's alpha = .67), 4 items assess student-teacher interaction (Cronbach's alpha = .79), and 2 items assess student-content interaction (Cronbach's alpha = .67). All items were rated on a 6-point Likert scale (from 1 = *strongly disagree* to 6 = *strongly agree*). The Cronbach's alpha reliability for student interaction was 0.87.

Student Satisfaction

Satisfaction was evaluated using the adapted Development of Online Course Satisfaction Scale, which is based on the work of Bayrak et al. (2020). The scale included 9 items are designed to assess students' online satisfaction. Participants reported on a 5-point Likert scale ranging (from 1 = *strongly disagree* to 5 = *strongly agree*). To determine reliability of satisfaction for online learning, Cronbach's alpha was computed. The reliability of this scale was .84.

Procedures

The data was collected through a field service company for two reasons. First, instead of isolating one middle or high school with homogenous demographics, a field service company allowed data on a representative sample of secondary students in Seoul to be collected. The second reason is due to convenience sampling: the Korean high school students are on their vacation and the sampling of secondary school students was possible through the field service company. The questionnaire was administered in an individual context, and took approximately 25 to 30 minutes to complete.

Data Analysis

In order to describe the study variables, means, standard deviations, minimums, maximums, skewness, and kurtosis were computed using SPSS Statistics 27 (IBM Corp, 2020). Correlations among all the study variables were also conducted in SPSS Statistics 27. A bootstrapping mediation analysis allowed for the testing of three key hypotheses of the mediation model: (1) the total effect of student engagement on virtual learning environment satisfaction; (2) the direct effect of student engagement on interaction and the direct effect of student interaction on virtual learning environment satisfaction, and (3) the indirect effect of student engagement on virtual learning environment satisfaction via student interaction. As recommended by Preacher and Hayes (2008), all the relationships of the mediation model were tested using a bootstrapping procedure.

Results

Means, standard deviations, minimums, maximums, skewness, and kurtosis among the main variables are reported in Table 3. The normality of the variables was examined: skewness and kurtosis values fell between -.17 and .01, and 2.82 and 3.69, respectively. These values were in the accepted range of normal distribution, with subsequent analysis conducted using raw values.

Inter-correlations among all study measures are displayed in Table 4. All associations were statistically significant. Specifically, middle and high school students' satisfaction was positive and strongly related to skills, emotion, participation, and performance ($.55 \leq rs \leq .74$). Student satisfaction showed a significantly positive relation to student-student, student-teacher, and student-content interaction ($.33 \leq rs \leq .63$). Overall, student satisfaction showed a strong positive association with engagement ($r = .89$) and interaction ($r = .52$).

The above findings provide support for Research Question 1 in that secondary students who had positive engagement and interaction were linked to their satisfaction in synchronous virtual learning environment. This finding is in line with the results of previous research suggesting the influence of engagement and interaction on students' satisfaction (e.g., Baloran et al., 2021; Marks, 2000; Oraif, and T. Elyas, 2021; Vuopala et a., 2016).

Table 3. Descriptive statistics of all study variables

	Engagement	**Interaction**	**Satisfaction**
Mean	3.13	2.78	2.72
SD	.66	.69	.66
Minimum	1	1	1
Maximum	5	5	5
Skewness	.01	-.17	-.06
Kurtosis	3.69	2.82	3.26

Table 4. Correlations of all study variables

		1	2	3	4	5	6	7	8	9	10
1	Skill	1.00									
2	Emotion	.68*	1.00								
3	Participation	.74*	.71*	1.00							
4	Performance	.55*	.53*	.66*	1.00						
5	Student-Student	.63*	.57*	.62*	.51*	1.00					

6	Student-Teacher	.63*	.57*	.62*	.51*	1.00*	1.00				
7	Student-Content	.33*	.29*	.40*	.32*	.52*	.52*	1.00			
8	Engagement	.89*	.83*	.93*	.76*	.69*	.69*	.40*	1.00		
9	Interaction	.52*	.52*	.60*	.46*	.83*	.83*	.83*	.63*	1.00	
10	Satisfaction	.36*	.36*	.50*	.39*	.58*	.58*	.73*	.48*	.81*	1.00

Note. $p < .01$

To test whether student interaction contributed to increased synchronous student satisfaction, a mediation analysis using bootstrapping was employed, following guidelines from Hayes and Preacher (2014). First, using a 95% confidence interval obtained from 5,000 bootstrap samples, the mediation analysis indicated that although the total effect of engagement on student satisfaction was statistically significant, $c = .30$, SE = .04, $p < .001$, there is no evidence that engagement directly influences student satisfaction, $c' = -.30$, SE = .03, $p = .434$. Second, the path from student engagement to interaction was statistically significant, $a = .41$, SE = .04, $p < .001$. Third, the path from student interaction to synchronous student satisfaction was statistically significant, $b = .80$, SE = .05, $p < .001$. Lastly, the indirect effect of engagement on satisfaction through student interaction was statistically significant, $ab = .33$, SE = .04, 95% bootstrap CI .25 to .41.

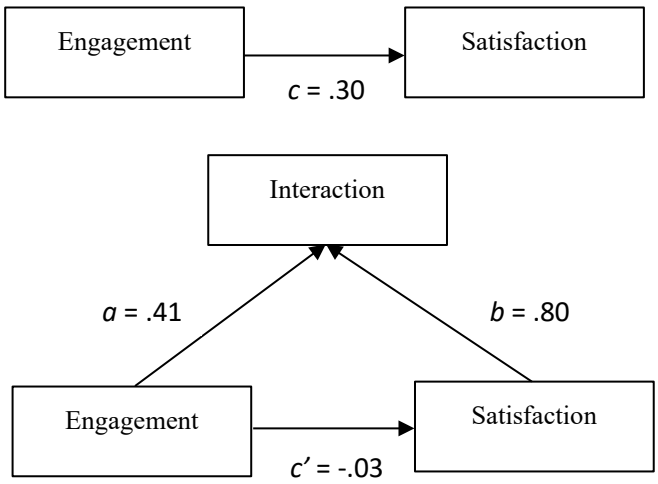

Figure 2. Results of the mediation analysis

Discussion

The findings of the current study illuminate several positive correlations among student engagement, interaction, and satisfaction within a synchronous virtual learning environment. Applying mediation analysis, I also found a positive relationship between student engagement and satisfaction, with interaction serving as a mediating factor. This suggests that high school students stand to benefit when their teachers strive to keep them engaged.

While these findings align with those of Baloran et al. (2021), Marks (2000), and Oraif and Elyas (2021), who identified positive correlations between engagement and satisfaction, our study diverges in a key area. Contrary to their research, the present study does not demonstrate a direct effect of engagement on satisfaction. Baloran et al. (2021) in particular, illustrated that student engagement positively influences students' level of satisfaction by enhancing their virtual learning skills, emotion, participation, and performance activities. However, our findings do not

directly support this assumption regarding student engagement in virtual learning activities. In fact, the direct effect of student engagement on satisfaction was found to be insignificant (c' = -.30, SE = .03, p = .434).

One plausible explanation for the apparent lack of impact of student engagement on virtual learning satisfaction pertains to teacher training. It is conceivable that during the COVID-19 pandemic, classroom teachers may not have received adequate training to effectively boost students' level of engagement and satisfaction. This could mean that the potential benefits of student engagement were not fully realized. Moreover, students may not have had sufficient exposure or experience with the online platform employed by their teachers. These factors may have jointly influenced the findings of our study. Future research is warranted to explore these potential mitigating factors in more detail.

Limitations

This study has several limitations that should be addressed in future investigations. The first one involves the sample selection. This study's participants were solely high school students from the South Korean educational system, potentially limiting the generalizability of the findings. Future research should include students from different cultural backgrounds and age groups to increase the generalizability of the results.

The second limitation stems from the use of self-reported data to gauge student engagement, interaction, and satisfaction. This is a common approach in empirical research within this field, but it could compromise the study's internal validity due to the potential for self-report bias. To mitigate subjectivity, future research should incorporate diverse measures and novel methods of assessment.

Lastly, this study did not utilize any alternative metrics for measuring engagement, interaction, or satisfaction. Despite utilizing multiple items for each construct, the absence of alternative measures poses a limitation. Therefore, future studies in this area should consider exploring alternative constructs and employ a variety of items for assessing specific classes or types of online learning environments.

Conclusion

Overall, the present study contributes to the growing literature examining students' satisfaction in virtual learning environments. The results of the study suggest that Korean secondary school students' interactions play a pivotal role through which positive engagement relates to satisfaction during virtual learning. These findings provide clear implications for middle and high school teachers: design curriculum and classroom learning activities to further promote students' online interaction. For example, educators are encouraged to develop online activities that are authentic, current, and interesting, facilitating students to interact not only with class materials but also with their teachers and their fellow learners. This study expands previous research by investigating secondary students in virtual learning contexts and confirming the significance and importance of interaction for pedagogical practices, as positive engagement is linked with students' virtual learning satisfaction.

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