

RESEARCH ARTICLE

# Student satisfaction and perceived learning in an online second language learning environment: A replication of Gray and DiLoreto (2016)

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## Abstract

The current study is an approximate replication of Gray and DiLoreto's (2016) study, which proposed a model predicting that course structure, learner interaction and instructor presence would influence students' perceived learning and satisfaction in online learning, with student engagement acting as a mediator between two of the predictors and the outcome variables. Using mixed methods, the current study investigated whether Gray and DiLoreto's model would be able to explain the relationships among the same variables in a computer-assisted language learning environment. A mediation analysis was conducted using survey responses from a sample of 215 college-level students, and qualitative analysis was conducted on the survey responses from a subsample of 50 students. Similar to Gray and DiLoreto's study, positive correlational relationships emerged between the variables. However, the model proposed by Gray and DiLoreto did not fit our data well, leading us to suggest alternative path-analytic models with both student engagement and learner interaction as mediators. These models showed that the role of course organization and instructor presence were pivotal in explaining the variation in students' perceived learning and satisfaction both directly and indirectly via student engagement and learner interaction. Moreover, qualitative analysis of students' responses to open-ended questions suggested that from students' perspectives, course structure was the most salient factor affecting their experiences within online language learning contexts, followed by learner interaction, and then by instructor presence.

**Keywords:** online learning; course structure; engagement; interaction; student satisfaction; perceived learning

## 1. Introduction

As noted by Chapelle (2007) over a decade ago, “the march of technology throughout all aspects of the lives of language learners is expanding whether it be through formal education or in their everyday lives” (p. 108). This statement is all the more relevant in today's post-COVID-19 era, where computer-mediated online learning environments in higher education have become widespread (Kohnke & Moorhouse, 2022). Now more than ever, a large number of language learners are studying language in computer-assisted language learning (CALL) environments (Chapelle, 2007; Macaro, Handley & Walter, 2012).

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In the South Korean context, teaching and learning English as a foreign language (EFL) through Zoom or other types of videoconferencing platforms has become increasingly popular in recent years, as it allows for flexibility and convenience in terms of time and location. However, the ways in which these environments affect students have not yet been thoroughly explored. In his affective filter hypothesis, Krashen (1986) argues that certain emotional and psychological states, such as anxiety or low motivation, can act as a “filter” that hinders second language (L2) learners’ ability to process and learn new language input. On the one hand, online language learning may lower students’ affective filters through reducing the anxiety they might feel in face-to-face settings; on the other hand, online language learning may heighten students’ affective filters through lowering their motivation. Furthermore, the interaction hypothesis (Long, 1996) suggests that L2 acquisition is primarily a social process, and that learners acquire language by engaging in communicative interaction with others. According to this hypothesis, online engagement and interaction between instructors and students can be presumed to assist in language learning through creating opportunities for negotiation of meaning and collaboration. However, the question of how online interaction is different in quantity and quality from face-to-face interaction and the effects of these differences on L2 learning remains. Overcoming cultural differences between students and instructors has also been one of the challenges often found in online language learning environments, as it can be difficult to establish rapport and create a sense of community in an online environment. Instructor presence, therefore, is critical in creating a sense of community in the online L2 course.

Despite the presence of many unanswered questions and challenges, online L2 learning and teaching in the Korean EFL context has been shown to be effective when appropriate strategies and technologies are employed to facilitate interaction and engagement among students and instructors (e.g. Lee, 2019). For example, the use of multimedia resources, collaborative activities, and authentic materials has been shown to create a more engaging and effective online learning experience for EFL students in Korea. The current replication study seeks to lend further insight into the determinants of student learning and satisfaction in online L2 learning.

## 2. Theoretical framework

Several theoretical frameworks have been put forth to describe the overall effectiveness of online learning environments. For example, Garrison, Anderson and Archer (1999) proposed that successful educational experiences are embedded within a community of inquiry (CoI) in which teachers and students are key participants. The CoI model identifies three core interacting elements that contribute to the educational experience: cognitive presence, social presence, and teaching presence. Cognitive presence refers to the extent to which participants in a CoI are able to “construct meaning through sustained communication” (p. 89) with one another. Social presence refers to participants’ ability to “project their personal characteristics into the community” (p. 89), interacting and connecting with other participants in a genuine way. Finally, teaching presence refers to the design and facilitation of the educational experience.

Another notable theoretical framework is that of Piccoli, Ahmad and Ives (2001), who identified two classes of determinants – a human dimension and a design dimension – that contribute to the effectiveness of virtual learning environments (VLE). The human dimension accounts for the role of students and instructors as principal agents in the learning environment, while the design dimension accounts for factors such as the learning model that underlies the instruction, the quality of the technology, the extent of learner control in learning, the content of instruction, and the extent of participant interaction.

Both of these theoretical frameworks have become popular models for online language learning courses, which are designed to provide a high level of interactivity among students and teachers using various online resources, such as discussion boards, blogs, wikis, and videoconferencing.

### 3. Previous empirical studies investigating students' experiences in online learning

In line with theoretical postulations, previous empirical studies suggest that learner-related factors, instructor-related factors, and course design attributes are important determinants of students' perceived learning and satisfaction in online learning (Eom, Wen & Ashill, 2006; Gray & DiLoreto, 2016; Kucuk & Richardson, 2019; Stewart & Lowenthal, 2022; Swan, 2001). However, depending on the specific context of the study, the nature of the interrelationships between these factors may vary.

For example, in Eom *et al.*'s (2006) study, the authors drew on Piccoli *et al.*'s (2001) VLE framework and proposed a hypothesized model related to students' perceived learning outcomes and satisfaction in online university programs. Their model predicted that learner factors such as students' self-motivation and learning style, instructor factors such as instructor feedback and instructor knowledge and facilitation, and course design dimensions such as interaction and course structure would affect students' perceived learning outcomes and satisfaction. Eom *et al.*'s participants were 397 students who had taken a minimum of one online course at a large Midwestern university in the United States (US). Results showed partial support for their hypothesized model. Although all six factors significantly impacted students' satisfaction, only two factors – students' learning styles and instructor feedback – significantly influenced students' perceived learning.

Using Eom *et al.*'s (2006) study as a model, Gray and DiLoreto (2016) also proposed a hypothesized model about how a set of factors – including course structure, learner interaction, instructor presence, and student engagement – were related to graduate students' satisfaction and perceived learning in an online learning program. Participants were 187 master's degree students enrolled in an online educational leadership program at a Southeastern university in the US. Results showed that course structure and instructor presence had a statistically significant impact on both student satisfaction and perceived learning, whereas learner interaction had a statistically significant impact only on perceived learning. Student engagement was found to fully mediate the effects of learner interaction and instructor presence on student learning; it partially mediated the effect of instructor presence on student satisfaction.

In a more recent study, Kucuk and Richardson (2019) investigated the experiences of 123 students enrolled in an online graduate program in a large Midwestern university in the US. Using CoI (Garrison *et al.*, 1999) as a theoretical framework, the authors predicted that teaching presence, social presence, and cognitive presence would positively impact student engagement. Moreover, they hypothesized that teaching presence, social presence, cognitive presence, and engagement would collectively influence students' satisfaction. The results showed a perfect match between the hypothesized model and the observed relationships among variables.

While the studies reviewed thus far (Eom *et al.*, 2006; Gray & DiLoreto, 2016; Kucuk & Richardson, 2019) involved samples of students enrolled in online courses or an online graduate program in a US university, they did not take into account how the specific course content or demographic features of the students might impact students' experiences with online learning. As stated by Landrum, Bannister, Garza and Rhame (2021), students' satisfaction with online learning may be more a matter of confluence and fit – in other words, the match between the course and students' expectations and purposes for taking a class rather than the quantity and quality of course features in and of themselves. Indeed, several studies that have investigated the online learning experiences of L2 learners have shown that these learners' experiences may be affected by the expectations and desires that they have about language courses.

For example, Harsch, Müller-Karabil and Buchminskaia (2021) investigated how teachers and students in a large language center in Germany perceived and experienced online language learning during the COVID-19 pandemic and, in particular, how they judged the amount and quality of online interaction. The results of online questionnaires revealed that students'

satisfaction levels with language courses were closely tied to their satisfaction with interaction. Students' satisfaction levels with different modes of interaction in the online setting were generally high. Nonetheless, the responses revealed that students as well as their teachers seemed to share the underlying assumption that language learning required “real’ interaction, which can best take place in face-to-face settings” (p. 9).

In another study involving L2 learners in an online language learning context, Ji, Park and Shin (2022) found that engagement was a significant predictor of Korean-L1 EFL university students' satisfaction at the end of an academic semester, and a closer analysis of the behavioral, cognitive, and emotional engagement strategies that students reported using showed that L2 learners utilized specific strategies to aid their language acquisition during online courses. For example, in order to make up for the lack of individualized feedback from professors in online courses, one student recorded her speech during a group debate so that she could check grammatical errors and pronunciation. Moreover, some students expressed that having breakout sessions during which learners could interact with different classmates was meaningful. While some students indicated positive feelings with online interaction, others expressed negative feelings (e.g. frustration, boredom) with the lack of face-to-face interaction.

Thompson and Ku (2005) conducted a smaller-scale qualitative study exploring seven Chinese international graduate students' experiences participating in online learning at a US university. Results of semi-structured interviews revealed that participants' attitudes toward online learning were mixed. Although most students appreciated the ease of sharing resources and keeping records of course materials, they were dissatisfied with the lack of immediate feedback from peers and instructors. Moreover, as most of the participants in the study desired to learn more about American culture during their studies in the US, they expressed disappointment in the lack of opportunities to engage in face-to-face interactions and cultural exchange.

Studies such as that of Harsch *et al.* (2021), Ji *et al.* (2022), and Thompson and Ku (2005) provide a more nuanced perspective on how the content of learning – in this case, language – may impact students' experiences in online education. These studies suggest that interactions that students have with their peers and instructors as well as the extent of engagement they feel may be a particularly important determinant of students' satisfaction and perceived learning in online language learning contexts. It should be noted that in previous studies that were *not* centered on language learning contexts, interaction has not always been shown to be a strong predictor of students' perceived learning and satisfaction (e.g. Alqurashi, 2019). In contrast to other learning contexts, the particular attention to and perceived importance of interaction in language learning contexts are unsurprising, given that interaction is regarded to be a driving force of L2 acquisition (Long, 1980).

In summary, previous studies illuminate how distinct course features are intricately associated with university students' experiences in computer-mediated learning environments. Further explorations in this realm of research have the potential to lead to a more nuanced understanding of online learning and in turn inform best practices for pedagogy. However, as not all online learning contexts are the same, research needs to be conducted in different contexts of learning with consideration of the unique features of the specific context and the expectations, needs, and goals of the students under investigation. In particular, the context of language learning and the experiences of language learners in online educational environments merits more investigation. Although previous research suggests that student engagement (Eom *et al.*, 2006; Gray & DiLoreto, 2016; Ji *et al.*, 2022; Kahu, Stephens, Leach & Zepke, 2013; Kucuk & Richardson, 2019; Murillo-Zamorano, Sánchez & Godoy-Caballero, 2019) and learner interaction (Harsch *et al.*, 2021; Thompson & Ku, 2005) may be important factors that affect students' experiences (e.g. perceived learning and satisfaction) in online learning, no study to our knowledge has investigated these variables in conjunction with other course features (e.g. course structure, instructor presence, student engagement) in computer-mediated language learning settings.

#### 4. Motivation for replication

In the current study, we conducted a replication of Gray and DiLoreto's (2016) study in an EFL context. We elected to replicate Gray and DiLoreto's (2016) study for several reasons. First, their hypothesized model and variables of interest aligned with well-known theoretical frameworks for instructional effectiveness in online education – such as the VLE (Piccoli *et al.*, 2001) and CoI frameworks (Garrison *et al.*, 1999) – and the variables were deemed relevant for the context of the current study. To the best of our knowledge, the majority of previous studies investigating online L2 learning (e.g. Bailey, 2022) have explored a small number of variables rather than providing a comprehensive picture of these variables and their interrelationships. Second, Gray and DiLoreto's study was one of the few studies that employed a researcher-developed survey questionnaire that was not only validated with other populations of learners but also readily accessible to other researchers.

Through this replication study, we aimed to shed light on whether the same or different findings from that of Gray and DiLoreto (2016) would emerge in an online language learning environment within a non-US university, where students have different needs, expectations, and goals for learning. In addition to the difference in setting, a key difference between Gray and DiLoreto and the current study was the application of a mixed-methods research design. In addition to administering Gray and DiLoreto's original survey questionnaire, we also asked our participants to respond to two open-ended questions in order to gain a more in-depth understanding of their experiences in online courses. While the original survey items were analyzed quantitatively, the open-ended questions were analyzed with a qualitative approach.

#### 5. Research questions

Following Gray and DiLoreto (2016), the current study investigated the interrelationships between the following variables in an online learning context: (1) course structure, (2) learner interaction, (3) instructor presence, (4) student engagement, (5) student satisfaction, and (6) students' perceived learning.

The research questions of the study were as follows:

1. What are the direct and indirect effects of course structure, learner interaction, instructor presence, and student engagement on EFL students' satisfaction and perceived student learning in an online class?
  - a. Does course structure impact student satisfaction and perceived student learning?
  - b. Does learner interaction impact student satisfaction and perceived student learning?
  - c. Does instructor presence impact student satisfaction and perceived student learning?
  - d. Does student engagement mediate the impact of learner interaction and instructor presence on student satisfaction and perceived student learning?
2. How do course structure, learner interaction, and instructor presence affect satisfaction and perceived student learning?

#### 6. Method

##### 6.1 Sample and context

In the current study, 215 undergraduate students (72% females) enrolled in the College of Education at a university located in Korea were recruited to participate in this study. Participating students ranged in age from 18 to 31 years. The students were native speakers of Korean who spoke English as a foreign language.

The sample included nine classrooms, with six of these classrooms focusing on integrated English listening, reading, speaking, and writing language skills. The remaining three classrooms

were content-based, English-medium courses that exposed the students to theories and practices in L2 pedagogies. Commonly employed in higher education, two of the content courses used a traditional instructor-led model with a heavy lecture focus, whereas one course was a flipped learning class, where digital and audiovisual components were integrated into the curriculum.

## 6.2 Measure and study procedure

### 6.2.1 Student Learning and Satisfaction in Online Learning Environments Instrument (SLS-OLE)

To measure the variables of interest, we employed the same instrument that was implemented in Gray and DiLoreto's (2016) study: the Student Learning and Satisfaction in Online Learning Environments Instrument (SLS-OLE) (see supplementary material). The SLS-OLE is composed of 34 items that constitute six subscales – course structure (5 items,  $\alpha = .79$ ; sample item: “Student learning outcomes was aligned to the learning activities”), learner interaction (7 items,  $\alpha = .81$ ; sample item: “I communicated often with other students within the course”), student engagement (5 items,  $\alpha = .72$ ; sample item: “I was not actively engaged in the activities required in the course”), instructor presence (5 items,  $\alpha = .72$ ; sample item: “I learned from the feedback that was provided during the course”), student satisfaction (6 items,  $\alpha = .86$ ; sample item: “I am satisfied with my overall experience in this course”), and perceived learning (6 items,  $\alpha = .82$ ; sample item: “I am pleased with what I learned in the course”) – that are all answered on a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*).

Inspection of the reliabilities of all the subscales ( $\alpha = .94$ ) were satisfactory. The survey took 15 to 20 minutes to complete. Both the original and the replication study collected student data using an online platform, Qualtrics and Google Forms, respectively.

### 6.2.2 Open-ended questions

The current study added two open-ended questions to Gray and DiLoreto's (2016) instrument. These questions were as follows:

1. Describe what and how much you learned from your Zoom course(s). In what ways did the course(s) help (or not help) your learning?
2. Describe your level of satisfaction or dissatisfaction with the Zoom course(s). What factors made it satisfactory? What factors made it dissatisfactory? What areas can be improved?

Through the inclusion of these questions, we aimed to gather additional in-depth information about the variables under investigation. Among the students who answered both open-ended questions, we randomly selected 50 participants and included their responses in our data set.

## 6.3 Data analysis

We used path analyses on the data derived from the SLS-OLE survey. We first specified the same mediation model as in Gray and DiLoreto (2016), following Gray and DiLoreto's predictive relationships using a maximum likelihood estimator, in AMOS, Version 28 (Arbuckle, 2021). Gray and DiLoreto's model specified course structure, learner interaction, and instructor presence as independent variables that would significantly impact both perceived learning and student satisfaction. Student engagement was specified as a mediating variable that would mediate the relationships between the independent variables learner interaction and instructor presence and the dependent variables perceived student learning and student satisfaction.

In order to find models with the most optimal fit for our data set, we also estimated alternative mediation models for each outcome variable (i.e. perceived learning and student satisfaction) that were different from the model presented in Gray and DiLoreto (2016). In these alternative models, the independent variables were course organization, instructor presence, student engagement, and

**Table 1.** Coding scheme

		Categories
1.	Outcome	Perceived Learning, Satisfaction, Dissatisfaction
2.	Contributing factor	Course Structure, Learner Interaction, Instructor Presence

student interaction. The resulting models are shown in Figures 2 and 3. The goodness-of-fit of the estimated models was evaluated by the following four indices: (a) chi-square statistics, (b) comparative fit index (CFI), (c) Tucker–Lewis index (TLI), and (d) root-mean-square error of approximation (RMSEA). The chi-square test evaluates the presence of potential misspecifications of the model to the data (Kline, 2016). CFI and TLI values greater than .95 are indicative of an excellent fitting model (Hu & Bentler, 1999), and RMSEA values below .08 (MacCallum, Browne & Sugawara, 1996) or .10 (Hu & Bentler, 1999) are considered acceptable.

In addition to the quantitative analysis, we also conducted supplemental qualitative content analysis on the data gleaned from the open-ended questions (from 50 participants' responses) in order to enrich our understanding. First, at the initial stages of analysis, responses to the two questions were read multiple times to develop familiarity with the content and identify salient phrases. Then, the data were coded line by line as the researchers searched for specific data segments that were related to students' learning experiences, behaviors, and perceptions (e.g. student presentations, physical comfort of online lectures, easy access to class materials, authentic course materials, difficulty concentrating, convenience, more opportunities to speak English, etc.).

Then, we applied a deductive approach, categorizing the codes according to whether they were contributing to one of three outcomes: (1) students' perceived learning, (2) students' satisfaction, and (3) students' dissatisfaction. Then, we further categorized the codes according to whether they were associated with one of the three contributing factors: course structure, learner interaction, and instructor presence (e.g. the code "student presentations" would be categorized as pertaining to "course structure"). The coding scheme is displayed in Table 1.

## 7. Results

### 7.1 Preliminary analysis and bivariate correlations among all study variables

Table 2 presents means, standard deviations, minimum, maximum, skewness, kurtosis, and correlations of all the study variables. Mean scores for students' perceived learning ( $M = 4.86$ ,  $SD = .46$ ) and satisfaction ( $M = 4.83$ ,  $SD = .40$ ) were similar. All variables were normally distributed; as shown in the table, the variables exhibited skewness and kurtosis that fell within the acceptable range of normality (i.e.  $\pm 2.0$  or  $\pm 7.0$ ; Curran, West & Finch, 1996).

Overall, the strength of associations between all the study variables was moderate to high. Specifically, the strongest relationships indicated students' perceived learning was positively and significantly associated with satisfaction ( $r = .73$ ,  $p < .05$ ). Statistically significant associations were also found between student engagement and learner interaction ( $r = .64$ ,  $p < .05$ ). These relationships, although positive, were generally lower than the correlations reported in Gray and DiLoreto's (2016) study. A difference was also found; course structure was moderately correlated with perceived learning ( $r = .53$ ,  $p < .05$ ). The remaining variables had low to moderate correlations ( $.29 < r < .53$ ,  $p < .05$ ).

### 7.2 Mediation analysis

We constructed our first model based on Gray and DiLoreto's (2016) study. The statistics obtained from the path-analytic mediation analysis using the bootstrapping procedure can be found in

**Table 2.** Descriptive statistics and bivariate correlations for SLS-OLE ( $N = 215$ )

	1	2	3	4	5	6
1. Course Structure/Organization	1.00					
2. Learner Interaction	.29*	1.00				
3. Student Engagement	.37*	.64*	1.00			
4. Instructor Presence	.35*	.46*	.52*	1.00		
5. Student Satisfaction	.49*	.54*	.48*	.45*	1.00	
6. Perceived Student Learning	.53*	.50*	.48*	.49*	.73*	1.00
<i>M</i>	3.80	4.63	4.22	4.32	4.83	4.86
<i>SD</i>	.29	.56	.57	.49	.40	.46
Minimum	2.80	2.14	2.40	2.50	3.17	3.33
Maximum	4.60	6.00	5.40	5.25	5.33	6.00
Skewness	-.90	.95	-.62	-1.02	-1.32	-.41
Kurtosis	4.17	4.90	3.19	3.82	4.55	4.00

\* $p < .05$ .

Table 3 and Figure 1. Course structure had a statistically significant positive impact on perceived learning ( $\beta = .35, p < .000$ ) and student satisfaction ( $\beta = .31, p < .000$ ). Similarly, learner interaction had a statistically significant positive effect on perceived learning ( $\beta = .25, p < .05$ ) and student satisfaction ( $\beta = .33, p < .001$ ). At the same time, instructor presence had a statistically significant effect on perceived learning ( $\beta = .21, p < .001$ ) and student satisfaction ( $\beta = .16, p < .05$ ).

Furthermore, all four of the mediation models satisfied the conditions for partial mediation (Baron & Kenny, 1986). Specifically, student engagement showed a statistically significant effect in all of the relationships between course features, and perceived learning and student satisfaction. However, there were no significant mediation effects among these relationships. With learner interaction as the predictor, there was an insignificant indirect effect through student engagement on perceived learning ( $\beta = .04, 95\% \text{ CI } [-.04, .15]$ ) and student satisfaction ( $\beta = .03, 95\% \text{ CI } [-.04, .13]$ ). Similarly, the indirect effects of instructor presence through student engagement on perceived learning ( $\beta = .02, 95\% \text{ CI } [-.02, .09]$ ) and student satisfaction ( $\beta = .02, 95\% \text{ CI } [-.02, .07]$ ) were not significant. The fit indices of this model were not satisfactory for our data set:  $\chi^2(2) = 27.05, p < .001$ ; CFI = .860; TLI = -.047; RMSEA = .415.

### 7.3 Testing the direct and indirect paths on perceived learning and student satisfaction

In order to find models that would explain our data with better fit indices, we estimated alternative model specifications to assess direct and indirect paths for the perceived learning and student satisfaction measures. This analysis was necessary to ascertain a more parsimonious mediation model for the sample data.

As previous studies (e.g. Harsch *et al.*, 2021) have shown that the quality of interaction is closely related to students' experiences in online language learning contexts, we tested two models in which both learner interaction and student engagement were two possible mediating variables. Course structure and instructor presence remained as potential predictors (i.e. independent variables) of students' perceived learning and satisfaction. Bootstrapping was set at 5,000 cycles, as recommended by Hayes (2022).



**Table 3.** Summary of standardized path coefficients on perceived learning and student satisfaction outcomes

Path		Gray & DiLoreto (2016)			Replication Study			
		Direct Without Mediator	Direct With Mediator	Indirect Effects	Direct Without Mediator	Direct With Mediator	Indirect Effects	
Structure	Learning	.41***			.35***			
Engagement	Learning	-.19***			.08			
Structure	Satisfaction	.16***			.31***			
Engagement	Satisfaction	.86***			.07			
Instructor Presence	Engagement	.45***			.29***			
Learner Interaction	Engagement	.72***			.51***			
Learner Interaction	Engagement	Learning	.15*	-.68	**	.25*	.29**	ns
Instructor Presence	Engagement	Learning	.34***	-.19	**	.21**	.24**	ns
Learner Interaction	Engagement	Satisfaction	-.01	.55	***	.33**	.36***	ns
Instructor Presence	Engagement	Satisfaction	.82***	.49*	***	.16*	.18*	ns

Note. ns = not significant. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

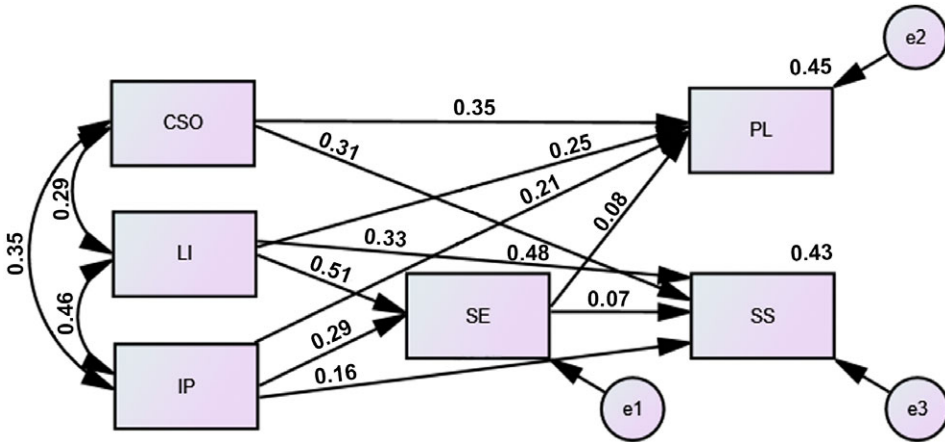


Figure 1. Hypothesized model of Gray and DiLoreto's (2016) study with standardized coefficients

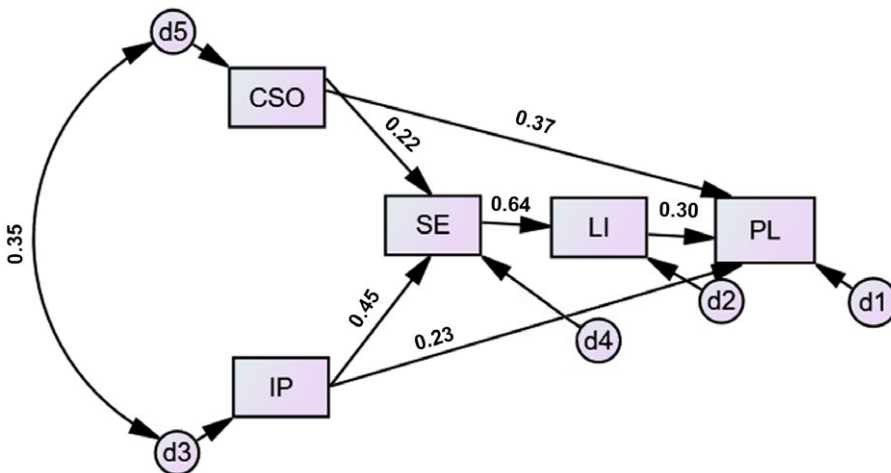
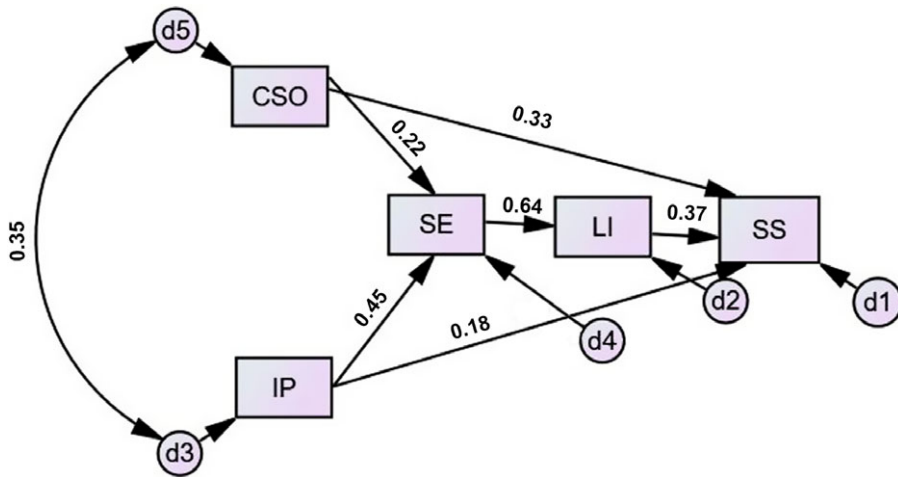


Figure 2. Model for predicting perceived learning via course features through student engagement and learner interaction. Standardized coefficients are reported

Standardized path coefficients for the models are shown in Figures 2 and 3. The path analysis revealed significant positive and direct effects of course structure ( $\beta = .37, p < .001$ ), instructor presence ( $\beta = .09, p < .001$ ), and learner interaction ( $\beta = .30, p < .001$ ) on perceived learning. There was a significant indirect effect of course structure on perceived learning via student engagement and learner interaction ( $\beta = .04, 95\% \text{ CI } [.01, .11]$ ). Similarly, there was a significant indirect effect of instructor presence on perceived learning via student engagement and learner interaction ( $\beta = .09, 95\% \text{ CI } [.03, .15]$ ). The association of student engagement on perceived learning was also significantly mediated by student interaction ( $\beta = .19, 95\% \text{ CI } [.07, .31]$ ). The fit indices from the path analysis were acceptable:  $\chi^2(3) = 2.17, p = .090$ ; CFI = .986; TLI = .952; RMSEA = .088.

When students' perceived satisfaction was substituted as the main outcome, the path analysis showed significant direct effects of course structure ( $\beta = .33, p < .001$ ), instructor presence ( $\beta = .18, p < .05$ ), and learner interaction ( $\beta = .37, p < .001$ ). Course structure had an indirect



**Figure 3.** Model for predicting student satisfaction via course features through student engagement and learner interaction. Standardized coefficients are reported

effect on student satisfaction via student engagement and learner interaction ( $\beta = .05$ , 95% CI [.01, .12]). Instructor presence had an indirect effect on student satisfaction via student engagement and learner interaction ( $\beta = .11$ , 95% CI [.06, .18]). We again observed a significant indirect effect of student engagement through student interaction on student satisfaction ( $\beta = .24$ , 95% CI [.14, .35]). The fit indices from the path analysis were adequate:  $\chi^2(3) = 2.07$ ,  $p = .103$ ; CFI = .987; TLI = .956; RMSEA = .084.

Overall, the newly proposed path models showed a better fit with the data when compared to Gray and DiLoreto's (2016) model. Taken together, these results showed that student engagement and learner interaction served as mediators in the association between course factors, and perceived learning and student satisfaction.

## 7.4 Results from qualitative analysis of open-ended questions

### 7.4.1 Perceived learning

As shown in Table 4, about half (52%) of the student responses to the question of their perceived learning mentioned factors related to course structure, about one third of the responses mentioned factors related to learner interaction, and about 14% of the responses mentioned factors related to instructor presence.

Regarding the impact of course structure on students' perceived learning, a recurring theme across a number of student responses was the notion of how the flipped nature of the course – during which students read or watched lectures individually during asynchronous class time and engaged in live discussions and application of knowledge during synchronous class time – was effective in furthering students' acquisition of knowledge.

**Example 1.** “The structure of the course that is similar with flipped-class: student firstly read the book chapter before class and participate in the discussion during the course. I thought this is more effective than a simple lecture-oriented class.”

Another theme was the availability of technological features and affordances that enabled students to learn at their own time in their preferred time frames. A number of students commented that the online class increased their learning because course components were recorded, enabling them to easily watch and rewatch (if necessary) the content of the lessons at a time and space that were convenient for them.

**Table 4.** Students' responses regarding how course structure/organization, learner interaction, and instructor presence contributed to learning ( $n = 50$ )

	Student responses
Course structure/organization	26 (52%)
Learner interaction	18 (36%)
Instructor presence	7 (14%)

**Example 2.** "I could watch the professor's lecture notes and listen to her while referring to the textbook and taking my notes at the same time . . . the technological support and convenience in time and space did help me to learn the contents more effectively."

A third theme was the perceived value of student presentations for enhancing learning. Many students expressed positive views on student presentations, both from the perspective of delivering presentations and listening to other students' presentations.

**Example 3.** "We had an opportunity to prepare a presentation on certain chapters. It was helpful to improve my content knowledge."

With respect to the question of how opportunities for learner interactions contributed to students' perceived learning, the data implied that students generally felt that there was a sufficient amount of opportunities for interaction, with both peers and instructors, and these opportunities contributed to their learning, in terms of both content knowledge and the acquisition of language skills. The majority of responses revealed highly positive views regarding interaction with peers. Students particularly appreciated the opportunities for small group discussions that were available through Zoom's breakout room feature.

**Example 4.** "I realized that after having frequent discussions with classmates I feel more confident speaking to foreigners in English."

Regarding the impact of instructor presence on perceived learning, responses were varied and several different themes emerged as students attributed their learning to a range of roles played by the instructor. One such role of the instructor was as a provider of knowledge and feedback, and another role of the instructor was as a guide and facilitator who was responsible for setting guidelines/rules, monitoring student interactions, and steering student discussions. A few students' comments revealed that the instructor was also seen as a provider of moral support, such as providing motivation for students and building their confidence and self-esteem.

**Example 5.** "At first time, it is really hard to speak but after this class, I was able to have no fear of speaking in English because professor did fix my words immediately and give active support whenever I give an opinion."

#### 7.4.2 Student satisfaction

As shown in Table 5, more than half (60%) of the students' responses to questions about satisfaction mentioned factors pertaining to course structure, 40% mentioned factors pertaining to learner interaction, and only 14% mentioned factors pertaining to instructor presence. Regarding factors that detracted from students' satisfaction with their courses (i.e. led to dissatisfaction), 28% of the responses mentioned factors that pertained to course structure, 32% mentioned factors pertaining to learner interaction, and only 8% mentioned factors pertaining to instructor presence. Therefore, all three independent variables (course structure, learner interaction, and instructor presence) contributed at times to increasing satisfaction levels and at times to decreasing satisfaction levels.

**Table 5.** Students' responses regarding how course structure, learner interaction, and instructor presence contributed to their satisfaction ( $n = 50$ )

Satisfactory		Dissatisfactory	
Course structure	30 (60%)	Course structure	14 (28%)
Learner interaction	20 (40%)	Learner interaction	16 (32%)
Instructor presence	7 (14%)	Instructor presence	4 (8%)

Similar to the responses about perceived learning, many students referred to the convenience and flexibility of the online course format as contributing to their satisfaction. For example, students particularly appreciated having the option of participating in the asynchronous portions of the classes at any time and place of their choosing. With respect to the synchronous components of the classes, they were satisfied with the opportunity to save time that they would otherwise have spent commuting to campus.

**Example 6.** "I liked the physical comfort of taking online lectures at home. In addition, it was very easy to use class materials because those could be presented directly on my monitor."

Among student responses mentioning features of course structure as diminishing their satisfaction with their courses, a recurring theme was the issue of technological glitches. Several students experienced connectivity and audio issues with the Zoom format. A second salient theme was the difficulty of focusing or concentrating in an online class relative to in-person courses.

**Example 7.** "However, my concentration was more often disturbed than face-to-face classes."

In terms of the impact of learner interaction, a substantial number of students were satisfied with peer interactions in virtual settings because they allowed them to speak with a greater number of students in the class and also precluded the limitations of physical distance. Some students remarked that the virtual setting lessened the awkwardness of speaking in English with peers compared to face-to-face settings. One student also mentioned the ease of receiving professors' feedback in Zoom breakout rooms.

**Example 8.** "I was satisfied that it was easier to speak in English online than offline. If it had been in-person, it would have been weird to switch from Korean to English when speaking to my classmates whom I would have conversed in Korean all the time."

On the other hand, other students remarked that they missed the face-to-face contact they would have been able to experience in traditional, in-person classes. These student responses showed that these students did not view computer-mediated peer interaction as capable of replacing the social and affective attributes of face-to-face peer interaction.

**Example 9.** "I was satisfied with zoom course except the fact that we couldn't meet each other face to face. That was the only dissatisfaction factor, which cannot be improved, sadly."

Among the few student responses that mentioned the effects of instructor presence on student satisfaction, one student mentioned that the professor's openness to ideas and sincere feedback contributed to his/her satisfaction with the course. Another student mentioned that the small amount of professor-led class time in the online course reduced his/her satisfaction with the course, as the student had a preference for instructor-led courses.

**Example 10.** "The most satisfying factor is that professor has quite generous point of view, so listen to our all ideas without prejudices and give sincere feedback for us to think about our ideas again."

## 8. Discussion

Our results revealed partial support for Gray and DiLoreto's (2016) hypothesized model. Course structure, instructor presence, and student interaction were significant predictors of students' perceived learning and satisfaction, but this relationship was mediated when student engagement was added to the model. This finding is in line with theoretical postulations concerning L2 learning (Krashen, 1986; Long, 1996) and learning effectiveness in online courses. It corroborates the CoI model (Garrison *et al.*, 1999), which predicts that cognitive presence (e.g. student engagement), social presence (e.g. learner interaction), and teaching presence (e.g. instructor presence) converge to impact successful educational experiences in university contexts, and also offers empirical support for Piccoli *et al.*'s (2001) assertion that both human and design dimensions contribute to the effectiveness of learning in VLEs. This finding is also consistent with that of previous empirical research, which has shown that student-related, instructor-related, and design-related features are predictive of students' perceived learning and satisfaction in online courses (Eom *et al.*, 2006; Gray & DiLoreto, 2016; Kucuk & Richardson, 2019).

However, contrary to Gray and DiLoreto's (2016) findings, we found that alternative path models – which specified both student engagement and learner interaction as two mediating variables rather than only student engagement as a single mediator variable – better explained our survey results. Moreover, the relationship between student engagement and the outcome variables was mediated by interaction, contrary to previous studies (e.g. Gray & DiLoreto, 2016; Kucuk & Richardson, 2019; Stewart & Lowenthal, 2022), showing student engagement, rather than interaction, to be the mediator with direct effects on learning and satisfaction. The reason why these alternative models explained our data better may be due to the strong direct relationship that interaction has with the effectiveness of L2 learning (Long, 1996). For example, Long's (1996) oft-cited interaction hypothesis stresses the primacy of interaction as a driving force of language acquisition. Moreover, as noted by previous studies (Harsch *et al.*, 2021; Peterson, 2009; Thompson & Ku, 2005), students who are language learners expect and desire to have opportunities to engage in meaningful and authentic interaction with their peers and instructors in the target language. More motivated and engaged learners may therefore engage more enthusiastically in interaction (both learner–instructor interaction and learner–learner interaction), which may then have positive effects on their learning experiences and outcomes. By contrast, less engaged learners may care less about interaction, which may lead to dissatisfaction and less learning.

Turning now to the findings from the qualitative data analysis, recall that our study adapted the survey used by Gray and DiLoreto (2016) by adding two open-ended questions. The first question asked participants to describe what and how much they learned from their Zoom courses, and in what ways the courses helped (or did not help) their learning. The second question asked participants to describe their level of satisfaction or dissatisfaction with the Zoom courses and to explain what factors made the courses satisfactory or dissatisfactory. We found that the most commonly mentioned factor was course structure, followed by learner interaction, followed by instructor presence. This suggests that from the EFL university students' perspectives, course structure was the most salient feature that contributed to their learning and satisfaction. This finding also aligns with the findings from the correlational analysis of the survey data, which showed that out of the three predictor variables, course structure had the largest correlation with students' perceived learning and the second largest correlation with students' satisfaction. The importance of course structure has also been emphasized in previous studies, such as that of Kucuk and Richardson (2019), who concluded that “effective instructional design and engaging teaching activities are extremely important in ensuring online learners' satisfaction” (p. 206).

In particular, many comments about course structure were about how the class resembled a “flipped classroom.” It is interesting that many students in our participant sample were familiar with this term and were able to draw this connection. This may have been due to the fact that the majority of our participants were education majors and thus likely to have been exposed to

terminology that pertains to pedagogy. Students commented on how a flipped classroom, which allowed students to read and view instructor-narrated content and video clips on PowerPoint before class and participate in discussion during class, was “more effective than a simple lecture-oriented class.” These types of comments indicate how the flipped structure of the class ultimately led to increased opportunities for learner interaction. This is in alignment with the predictions of our path-analytic model, which shows learner interaction as a mediator of course structure on perceived learning and student satisfaction.

Learner interaction was also alluded to relatively often within students’ responses to the open-ended questions. This finding also corroborates the findings of the correlational analysis of the survey data, which showed that among the predictor variables, learner interaction had the largest correlation with student satisfaction and the second largest with perceived learning. This implies that interaction is indeed an important component of students’ perceptions and experiences in contexts of computer-mediated language learning, as found in previous research (Harsch *et al.*, 2021).

The students’ comments regarding learner interaction are particularly noteworthy because the nature of online interactions, as compared to face-to-face interactions, at times proved to detract from students’ satisfaction, and at times proved to contribute to students’ satisfaction. For instance, students’ comments that they desired to meet face to face revealed that some of the participants shared the sentiment that effective language learning requires face-to-face interaction. This sentiment was prevalent in Harsh *et al.*’s (2021) study of students’ and instructors’ perspectives at a language center in Germany. However, the current study revealed that some students actually preferred online interaction over face-to-face interaction. One student commented that the online situation facilitated discussions that were otherwise difficult in face-to-face settings due to the difficulty of communicating with students in the class who were far away. Another student commented that it was also easier to receive instructor feedback during group discussions because instructors could join breakout rooms easily. Another student commented that it felt easier and less awkward to switch from Korean, the participants’ shared first language, to English when interacting with peers online. These comments reveal how online language learning settings may affect both the physical and affective aspects of interaction one may expect in traditional face-to-face settings. For language learners who share a first language, the difficulty of interacting and socializing with peers in another language that they feel less proficient in may possibly be mitigated in online learning environments.

In comparison to course structure and interaction, instructor presence was not as frequently mentioned within students’ responses to the open-ended questions. This implies that relative to features such as course organization and interaction, students do not attribute a large proportion of their experience within online learning with the specific presence and attributes of the instructor. Interestingly, Ji *et al.* (2022) also noted that the Korean-L1, English-L2 learners in their study did not often mention learner-to-instructor engagement strategies or the importance of instructor presence when asked about their engagement strategies and level of satisfaction with online learning. Overall, the addition of the qualitative analysis in the current study provided more nuanced insights into why course structure, learner interaction, and instructor presence were appearing to have high correlation with the outcome variables. For example, students’ comments about course structure revealed the popularity of the flipped classroom model in the EFL context, and students’ comments about interaction helped illuminate the various reasons why students may like or dislike online interaction.

The present study yields several practical implications for improving the perceived learning and satisfaction of Korean college students enrolled in online language learning courses. Considering that engagement and interaction are critical mediators between course features and perceived learning and satisfaction, instructors should pay greater heed to student engagement and further improve the quality and quantity of students’ online interaction. For example, students should engage with the instructor and course content by participating in discussions or chats. Students should be instructed to familiarize themselves with the course content and

complete their assignments prior to class, and this will in turn facilitate interaction during class time. Furthermore, teachers should provide plentiful opportunities for high-quality interaction through well-planned group work and team-based, collaborative problem-solving activities. Third, teachers can ensure that the course content is organized and structured and provide assessments with clear rubrics for grading. Lastly, teachers should provide feedback, an indispensable component in both online and offline courses, to increase student–student and student–teacher connections.

## 9. Conclusion

By approximately replicating Gray and DiLoreto (2016), the current study illuminates the impact of course structure, learner interaction, instructor presence, and student engagement on students' perceived learning and satisfaction in an underexplored L2 learning environment, that of foreign language learners in higher education. Moreover, unlike previous studies that have applied solely quantitative approaches (Gray & DiLoreto, 2016) or solely qualitative data analytic approaches (e.g. Thompson & Ku, 2005; Landrum *et al.*, 2021) to investigate students' perceptions and experiences with online learning, the current study employed a mixed-methods design in order to contribute to a deeper understanding of how determinants of students' satisfaction and perceived learning are tied to language learners' unique goals and expectations.

However, inherent in this study are a few limitations. First, factors that were not included in the study may also impact students' experiences in online learning. For example, self-motivation and self-efficacy of students (e.g. Sánchez-Castro & Strambi, 2017), which have been shown to affect satisfaction with online learning, were not accounted for in the current study. Second, the present study's findings were based on self-report instruments that collected information about students' perceptions of different course features as well as their perceived learning and satisfaction. Future studies that measure course features or student outcomes through other objective measures (e.g. number of certain course activities, amount of instructor feedback) may reveal how actual course features, rather than students' perceptions of these features, impact students' outcomes.

Despite its limitations, the current study presents robust models for predicting the relationship between course features and L2 students' satisfaction and learning in online course contexts. This study suggests that when course structure and instructor presence positively impact student engagement, this may lead to frequent, high-quality interaction, which is likely to have a positive influence on students' experiences. These findings largely support Landrum *et al.*'s (2021) assertion that students' satisfaction with online learning depends on the convergence of students' expectations and goals with the course dimensions. Hence, future research on online learning should not lose sight of how different contexts of learning, which entail students' goals and expectations for their courses, may shape the relationships between course features and student perceptions.

**Supplementary material.** To view supplementary material for this article, please visit <https://doi.org/10.1017/S0958344023000034>

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## References

- Alqurashi, E. (2019) Predicting student satisfaction and perceived learning within online learning environments. *Distance Education*, 40(1): 133–148. <https://doi.org/10.1080/01587919.2018.1553562>
- Arbuckle, J. L. (2021) *Amos* (Version 28.0). Chicago: IBM SPSS.
- Bailey, D. (2022) Interactivity during Covid-19: Mediation of learner interactions on social presence and expected learning outcome within videoconference EFL courses. *Journal of Computers in Education*, 9(2): 291–313. <https://doi.org/10.1007/s40692-021-00204-w>



- Baron, R. M. & Kenny, D. A. (1986) The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6): 1173–1182. <https://doi.org/10.1037/0022-3514.51.6.1173>
- Chapelle, C. A. (2007) Technology and second language acquisition. *Annual Review of Applied Linguistics*, 27: 98–114. <https://doi.org/10.1017/S0267190508070050>
- Curran, P. J., West, S. G. & Finch, J. F. (1996) The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, 1(1): 16–29. <https://doi.org/10.1037/1082-989X.1.1.16>
- Eom, S. B., Wen, H. J. & Ashill, N. (2006) The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation. *Decision Sciences Journal of Innovative Education*, 4(2): 215–235. <https://doi.org/10.1111/j.1540-4609.2006.00114.x>
- Garrison, D. R., Anderson, T. & Archer, W. (1999) Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2–3): 87–105. [https://doi.org/10.1016/S1096-7516\(00\)00016-6](https://doi.org/10.1016/S1096-7516(00)00016-6)
- Gray, J. A. & DiLoreto, M. (2016) The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation*, 11(1): 98–119.
- Harsch, C., Müller-Karabil, A. & Buchminskaia, E. (2021) Addressing the challenges of interaction in online language courses. *System*, 103: 1–15. <https://doi.org/10.1016/j.system.2021.102673>
- Hayes, A. F. (2022) *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (3rd ed.). New York: The Guilford Press.
- Hu, L. & Bentler, P. M. (1999) Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1): 1–55. <https://doi.org/10.1080/10705519909540118>
- Ji, H., Park, S. & Shin, H. W. (2022) Investigating the link between engagement, readiness, and satisfaction in a synchronous online second language learning environment. *System*, 105, Article 102720. <https://doi.org/10.1016/j.system.2022.102720>
- Kahu, E. R., Stephens, C., Leach, L. & Zepke, N. (2013) The engagement of mature distance students. *Higher Education Research & Development*, 32(5): 791–804. <https://doi.org/10.1080/07294360.2013.777036>
- Kline, R. B. (2016) *Principles and practice of structural equation modeling* (4th ed.). New York: The Guilford Press.
- Kohnke, L. & Moorhouse, B. L. (2022) Facilitating synchronous online language learning through Zoom. *RELC Journal*, 53(1): 296–301. <https://doi.org/10.1177/0033688220937235>
- Krashen, S. D. (1986) *Principles and practice in second language acquisition*. Oxford: Pergamon Press.
- Kucuk, S. & Richardson, J. C. (2019) A structural equation model of predictors of online learners' engagement and satisfaction. *Online Learning*, 23(2): 196–216. <https://doi.org/10.24059/olj.v23i2.1455>
- Landrum, B., Bannister, J., Garza, G. & Rhame, S. (2021) A class of one: Students' satisfaction with online learning. *Journal of Education for Business*, 96(2): 82–88. <https://doi.org/10.1080/08832323.2020.1757592>
- Lee, J. S. (2019) EFL students' views of willingness to communicate in the extramural digital context. *Computer Assisted Language Learning*, 32(7): 692–712. <https://doi.org/10.1080/09588221.2018.1535509>
- Long, M. H. (1980) *Input, interaction, and second language acquisition*. University of California, Los Angeles, unpublished PhD.
- Long, M. H. (1996). The role of the linguistic environment in second language acquisition. In Ritchie, W. C. & Bahtia, T. K. (eds.), *Handbook of second language acquisition*. New York, NY: Academic Press, 413–468.
- Macaro, E., Handley, Z. & Walter, C. (2012) A systematic review of CALL in English as a second language: Focus on primary and secondary education. *Language Teaching*, 45(1): 1–43. <https://doi.org/10.1017/S0261444811000395>
- MacCallum, R. C., Browne, M. W. & Sugawara, H. M. (1996) Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, 1(2): 130–149. <https://doi.org/10.1037/1082-989X.1.2.130>
- Murillo-Zamorano, L. R., Sánchez, J. Á. L. & Godoy-Caballero, A. L. (2019) How the flipped classroom affects knowledge, skills, and engagement in higher education: Effects on students' satisfaction. *Computers & Education*, 141: Article 103608. <https://doi.org/10.1016/j.compedu.2019.103608>
- Peterson, M. (2009) Learner interaction in synchronous CMC: A sociocultural perspective. *Computer Assisted Language Learning*, 22(4): 303–321. <https://doi.org/10.1080/09588220903184690>
- Piccoli, G., Ahmad, R. & Ives, B. (2001) Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly*, 25(4): 401–426. <https://doi.org/10.2307/3250989>
- Sánchez-Castro, O. & Strambi, A. (2017) Researching learner self-efficacy and online participation through speech functions: An exploratory study. *CALICO Journal*, 34(2): 219–242. <https://doi.org/10.1558/cj.26389>
- Stewart, W. H. & Lowenthal, P. R. (2022) Distance education under duress: A case study of exchange students' experience with online learning during the COVID-19 pandemic in the Republic of Korea. *Journal of Research on Technology in Education*, 54(Sup1): S273–S287. <https://doi.org/10.1080/15391523.2021.1891996>
- Swan, K. (2001) Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education*, 22(2): 306–331. <https://doi.org/10.1080/0158791010220208>
- Thompson, L. & Ku, H.-Y. (2005) Chinese graduate students' experiences and attitudes toward online learning. *Educational Media International*, 42(1): 33–47. <https://doi.org/10.1080/09523980500116878>

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