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Exploring Zoom Fatigue among International Students in U.S. Virtual Classes

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ABSTRACT

Online video conferencing platforms, such as Zoom, are widely used for virtual classes. Zoom platforms bring flexibility and convenience but also contribute to fatigue, which is called "Zoom fatigue." The purpose of this study is to investigate Zoom fatigue among international students at U.S. universities and its links to virtual classroom communication in the field of education. The study investigated how English competency and course engagement affected Zoom fatigue in virtual classes experienced by 152 international students. The results showed that English competency and course engagement had a negative relationship with Zoom fatigue. The study implied that when international students had high English competency, they had less Zoom fatigue experience. In addition, international students had less Zoom fatigue experience when they engaged in virtual classes. The study suggested future directions for decreasing Zoom fatigue and increasing course engagement among international students in virtual classes.

Keywords: computer-mediated communication, course engagement, English competency, international students, virtual classes, Zoom fatigue

In the digital age, technology is a pivotal resource for communicating with others. Instead of meeting in person, people communicate with each other through phone or online video conferencing platforms. Online platforms are convenient and flexible so that people can communicate from any place at any coordinated time. These conveniences and flexibilities impact our interpersonal communication in

the workplace and in school. In other words, people have started to replace in-person meetings or classes with video conferencing platforms. While offering convenience and flexibility, one drawback is that whenever the usage time increases, people start to express negative feelings regarding how these platforms leave them exhausted and burned out. Zoom Video Communications, Inc., is a U.S.-based company that provided one of the most common video conferencing platforms used when the COVID-19 pandemic swept the world in 2019; thus, this phenomenon has been referred to as "Zoom fatigue" (McCabe et al., 2023; Nesher Shoshan & Wehrt, 2022; Riedl, 2022).

"Zoom fatigue" emerged as a newly coined word from the workplace when people started relying on online video conferencing platforms. Many studies have shown that zoom fatigue occurs because of cognitive load (Lee, 2020; McCabe et al., 2023). The concept of cognitive load is that an individual has a limited capacity for working memory to interact with unlimited long-term memory for thinking and learning (McCabe et al., 2023). People feel fatigued in virtual meetings because they invest extra cognitive effort in computer-mediated communication (CMC) to acquire, store, produce, and interpret knowledge. Thus, CMC focuses on cognitive processes because meanings can be interpreted differently, formed or comprehended depending on communication media (Yao & Ling, 2020).

As video conferencing platforms have become embedded in our workplace and school, computer-mediated communication has become common in our lives. Current studies investigate how people use video conferencing platforms in workplaces and education and why people feel fatigued from these platforms (Epstein-Shuman & Kushlev, 2022; McCabe et al., 2023; Nesher Shoshan & Wehrt, 2022; Riedl, 2022). People tend to feel more fatigued in these platforms because more nonverbal cues are provided (e.g., viewing others/own screen, icons, chatting) than face-to-face communication media. Similarly, video conferencing platforms require more cognitive effort to interpret and produce information because of extra nonverbal cues (Bailenson, 2021; McCabe et al., 2023).

As the number of virtual classes has increased, especially since the pandemic, more studies on Zoom fatigue in virtual classes are needed. Specifically, studies should consider individual characteristics in computer-mediated communication to distinguish international students from domestic students because nonnative English-speaking students experience more language barriers than native speakers do. In this sense, international students may be especially prone to experience fatigue if English competency exacerbates Zoom fatigue because of increased cognitive load. In addition, studies should consider how course engagement is related to Zoom fatigue in virtual classes among international students. Thus, the current study provides theoretical explanations of media richness theory to explore how international students' English competency and course engagement

affect Zoom fatigue. This study utilizes a quantitative survey design to establish a baseline understanding of Zoom fatigue among a sample population of international students studying at a mid-sized state university in the U.S. The ultimate goal of the current research is to investigate Zoom-mediated communication to suggest future directions for decreasing Zoom fatigue and increasing course engagement among international students attending virtual classes at U.S. universities.

LITERATURE REVIEW

International students abroad

Many U.S. colleges or universities accept international students because they bring mutual benefits to students and institutions. First, international students can extend their perspective and enrich the learning environment by sharing their different views and cultures. International and domestic students can develop a deeper understanding by exchanging information, ideas, and support (Andrade, 2006; Grayson, 2008), which brings educational benefits to each other. Second, international students contribute to revenue because they pay full tuition fees. When domestic students take federal student loans to cover their tuition fees, the universities do not fully gain money because the federal student loan funds are disbursed to the U.S. Department of Education. Specifically, the U.S. Department of Education has the authority to regulate federal student loan funds to the university, and the funds can be used for only intended purposes (e.g., faculty salaries, campus maintenance, and academic programs). Thus, international students' tuition fees directly help the university support operations without any restrictions from the federal state or U.S. Department of Education. Third, international students earn personal development, such as improving foreign language skills, engaging in career development, and building networks (Costello, 2015).

The Institute of International Education indicates that total international enrollment reached 1,057,188, an increase of over 100,000 students compared to the 2021-22 figures (Nietzel, 2023). Since the number of international students has increased in U.S. colleges and universities, it is important to study their virtual learning experiences and course engagement related to Zoom fatigue. Zoom fatigue negatively affects mental health and well-being (Nesher Shoshan & Wehrt, 2022), which could jeopardize students' academic success and prompt them to question whether to continue their studies. Thus, exploring Zoom fatigue among international students to retain international students is important.

Zoom fatigue

Virtual classrooms are facilitated via online video conferencing platforms, also known as online education platforms (Zoom is an example of a commonly used platform), in which the person does not have to be physically present on campus

to learn or teach (Minhas et al., 2021). Many educators use the Zoom platform for their virtual classes because of high-quality audio and video. Zoom platforms assist people in maintaining their careers and relationships without physically being in the same space. Instead of going to classes, many students can take the course remotely (e.g., at home or in a coffee shop), which provides them with a comfortable atmosphere and convenience by saving commuting time.

Despite convenience, students who use Zoom platforms feel fatigued during virtual classes (Epstein-Shuman & Kushlev, 2022; McCabe et al., 2023). The fatigue that people experienced with the Zoom platform was first shown in the workplace. People reported feeling anxious, mentally or emotionally drained, or socially isolated as the duration of the video conference increased, prompting the label "Zoom fatigue" (Nesher Shoshan & Wehrt, 2022; Riedl, 2022). Zoom fatigue has been widely shown in video conferences because most employees feel physically trapped by staring at the screen for long periods, and women feel more fatigued than men do (Fauville et al., 2021). Similarly, Zoom fatigue was also experienced in education settings by students who attended virtual classes.

Students feel Zoom fatigue in virtual classes, especially when their cameras are on (Epstein-Shuman & Kushlev, 2022). For example, research by Nadler (2020) has demonstrated that Zoom fatigue occurs after a person starts at the screen for a long time, especially when there is less interaction. Although interaction is important in virtual classes to decrease Zoom fatigue, students can be easily distracted (e.g., doing their own tasks, accessing the internet, and interacting with their cell phones).

Moreover, research by Koo and Jiang (2022) and Koo and Nyunt (2022) revealed that international students learn more about American culture and enhance their English competency in face-to-face classes because of their social interactions. Additionally, Lorenzetti et al. (2023) showed that social interaction is an important element of academic success. These findings demonstrate that international students may have a lower chance of improving English competency in virtual classes because of fewer social interactions. Some studies have shown that Zoom tools increase course engagement in learning, but students continue to face the challenge of Zoom fatigue (Kohnke & Moorhouse, 2022; Peper & Yang, 2021). In addition to these findings, Zoom fatigue could be explained by Nadler's (2020) observation that students' understanding differed between online and face-to-face environments. This difference in locations in virtual classes emphasizes the modes through which Zoom-mediated communication is experienced by professors and students during classes. Therefore, Zoom fatigue hinges on international students' English competency to participate and interact in virtual classes.

English competency

English competency is one of the greatest challenges for international students adjusting to school and social groups (Andrade, 2006; Johnson, 1988; Wan et al., 1992; Yeh & Inose, 2003). English competency is intertwined with their daily lives (e.g., ordering food, getting groceries in a store), their social support (e.g., building social networks, sharing ideas and thoughts), and their academic work (e.g., understanding the courses, doing assignments). Many studies have revealed that low English competency increases international students' mental illness and academic stress to cope with those demands (Mori, 2000; Sandhu & Asrabadi, 1994; Wei et al., 2012). From this perspective, international students' academic achievement is undeniably associated with English competency, which warrants investigation into virtual learning via online video conferencing platforms. Face-to-face classes offer more opportunities to improve English from social interaction with peers and an instructor (Biesenbach-Lucas, 2003). Hence, language competency is an important component that international students consider in virtual learning platforms, which can also influence their academic work at U.S. universities.

Theoretical perspectives

To decrease Zoom fatigue in virtual classes, Zoom-mediated communication should be considered on the basis of international students' English competency for two reasons. First, virtual classes require multitasking, which causes Zoom fatigue. Specifically, Zoom fatigue has been explained by five theoretical nonverbal mechanisms: mirror anxiety, being physically trapped, hyper gaze, producing nonverbal cues, and interpreting nonverbal cues (Fauville et al., 2021; Raake et al., 2022). While international students can grasp information from speakers in face-to-face classes, it is more complex for international students to comprehend the information in virtual settings. As virtual learning platforms display multiple screens, people feel anxious because they are constantly viewing themselves and others, which can lead to depression (Fauville et al., 2021; Fejfar & Hoyle, 2000). Viewing oneself is referred to as mirror anxiety, whereas viewing others is referred to as hyper gaze (Fauville et al., 2021). Moreover, people feel physically trapped because they have to stay centered with the camera. These nonverbal mechanisms catalyze Zoom fatigue because of increased cognitive load (Fauville et al., 2021; Lee, 2020). The cognitive load explains that every individual has a limited-capacity information processing system to encode, store, and retrieve messages in interactions with people and environments (Lang, 2006). Given that, international students with lower English competency are likely to experience greater Zoom fatigue as they process course information throughout a virtual class.

Second, Zoom-mediated communication requires additional cognitive effort because of different and potentially limited communication cues compared with

being in the physical classroom. Media richness theory argues that the greater the number of communication cues a medium conveys, the richer the medium is, indicating that communication media convey different cues (Daft & Lengel, 1986; El-Shinnawy & Markus, 1992). For example, face-to-face communication is rich in cues compared with telephone and written documents because face-to-face communication allows rapid mutual feedback and permits multiple communication cues, such as nonverbal, verbal, and contextual cues (El-Shinnawy & Markus, 1992; Suh, 1999). In contrast, Zoom-mediated communication offers limited communication cues that are shown on the screen. For example, international students who are nonnative speakers can use their hand gestures and some body language to deliver their messages, but the Zoom platform shows only part of the body.

Moreover, media richness theory states that an effective communication channel hinges on communication cues (Daft & Lengel, 1986). Specifically, richer communication media holds more communication cues to yield the clearest communication opportunity (e.g., full body posture), whereas low richness holds fewer communication cues, allowing for more ambiguity and distortion in a message (Daft & Lengel, 1986). For example, ironic jokes or sarcasm can sometimes be easily understood face-to-face because there are more communication cues, such as nonverbal and contextual cues (i.e., situation and atmosphere), available to interpret peer reactions; however, virtual learning platforms can be more confusing for international students, who have to capture nuance and meanings from fewer cues, or they may misinterpret the joke. Thus, international students who have low English competency need more communication cues to grasp the full meaning or nuance of the information.

In addition to limited nonverbal cues, online video conferencing platforms provide high-quality visual and audio capabilities, replacing in-person classes with virtual classes facilitated by applications such as Zoom (de Oliveira Dias et al., 2020; Gordon, 2020; Serhan, 2020; Toney et al., 2021). However, these applications cause additional cognitive demands for international students. For example, when one of the students is presenting a presentation through Zoom, other students can simultaneously add information through chats or emojis. Engaging in this practice will demand more cognitive attention for reading and listening simultaneously, prompting Zoom fatigue.

Course engagement

Course engagement can be a pivotal factor for international students to continue their studies in colleges and universities in the U.S. because it motivates them to learn and achieve their academic goals (Appleton et al., 2008; Handelsman et al., 2005). Students' course engagement can be measured in two components: behavioral engagement (e.g., participation, doing homework, taking notes, attendance, etc.) and affective or emotional engagement (e.g., desiring to learn,

putting in effort, being confident, etc.) (Handelsman et al., 2005; Newmann et al., 1992; Willms, 2003). To extend this conceptual work, course engagement merits further investigation in virtual classes because the online environment is different from the physical environment. Virtual classes provide various tools (e.g., breakout rooms, captions, and annotation tools) to facilitate class (Kohnke & Moorhouse, 2022; Lee, 2021). Therefore, more studies are needed to investigate how international students' course engagement is related to Zoom fatigue experiences in virtual classes.

International and domestic students show different degrees of course engagement due to cultural differences that are compounded by their English competency. Dangeni (2023) reported that international students engage differently in the classroom depending on their culture, language, and educational background. For example, American students typically prefer assignments that demand critical thinking, whereas Asian students often favor tests that require finding correct answers. Another example is that American students are likely accustomed to asking questions and actively participating in small-group discussions because of their K-12 education experiences. Comparatively, international students might be hesitant to ask questions and participate actively because of differing cultural norms. For example, Asian students (e.g., Taiwanese and Chinese) prefer to be listeners rather than speakers. Furthermore, Asian students feel that it is impolite to interrupt professors in the middle of a lecture (Balas, 2000).

Moreover, Johnson (1988) and Wilson and Komba (2012) reported that low English competency causes poor performance in school. International students might feel shy about their ability to participate in class because their English proficiency can be evaluated instantly in terms of pronunciation and grammar. In addition, international graduate students feel less confident in English because it seems to be associated with their intelligence (Kuo, 2011). Specifically, if international graduate students do not speak fluent English in class, they believe that American students will see them as less intelligent. Furthermore, Kuo (2011) reported that English proficiency affects international students' schoolwork (e.g., writing essays or reports, participating in classroom discussions, and taking notes in the classroom). Therefore, English proficiency is one of the barriers for international students engaging in courses.

Interestingly, the Zoom platform helps international students overcome the English competency barrier and enables students to engage in course material despite being anonymous or being in different spaces with professors. Students show positive reactions to Zoom tools for their learning in Zoom classes (Kohnke & Moorhouse, 2022; Lee 2021; Minhas et al., 2021). Some studies have shown that virtual classes help students learn foreign languages by interacting in small groups (Lee, 2021; Vurdien, 2019) because virtual classes in small groups increase students' motivation and confidence in learning the language (Vurdien,

2019). In addition, the icons available in online learning platforms can be useful tools for engaging in class, such as the chat tool, which is useful for students who are not good at speaking in English (Kohnke & Moorhouse, 2022). Therefore, international students with low English competency will experience less stress and embarrassment in performing their English in virtual classes than in face-to-face classes because there is an indirect way to interact with classmates and professors through various tools (e.g., icons, 1:1 chat).

Additionally, coannotating and screen sharing facilitate student learning in virtual classes (Kohnke & Moorhouse, 2022; Minhas et al., 2021). These tools can assist international students in engaging in classes as they overcome their low English competency by using the available tools (e.g., using a 1:1 chat room, whiteboard, and viewing captions), searching for words, and accessing a translation program. Searching words might help international students follow during Zoom classes. Translation programs are beneficial for improving the speaking and writing of international students. This autonomy ability (e.g., using the internet and Zoom tools) can provide international students with comfort and confidence in their ability to engage in classes. Henceforth, the following hypotheses were proposed:

> H_1: International students' English competency is negatively related to Zoom fatigue in virtual classes for those who study at a U.S. university.
>
> H_2: International students' course engagement is negatively related to Zoom fatigue in virtual classes for those who study at a U.S. university.

METHOD

The study employed a purposive sampling method to recruit participants from the international student population at Minnesota State University, Mankato. A total of 329 participants responded to the Qualtrics survey, but 177 participants were excluded due to incomplete surveys and for nonbinary gender options due to the small proportion of students involved. The study included a final data set of 152 international students. The demographics measured included (1) biological sex (83 females, 55%), (2) age, measured in years ($M = 23.30$, $SD = 4.6$), and (3) years in college ($M = 3.27$ meaning junior, $SD = 1.83$). The survey included a measure of students' well-being, but it was not analyzed for the purpose of the current study. The survey took approximately 5 minutes to complete.

Control variables

According to previous studies, covariates were measured and included in the analyses to control for the relationships between measures of interest (Epstein-Shuman & Kushlev, 2022; Fauville et al., 2021; Nesher Shoshan & Wehrt, 2022). The participants were asked, "How do you define your gender?" (83 female, 55%), "How many Zoom classes are you taking this semester?" ($M = 1.30$,

meaning one class, *SD* = .60), "How much do you turn on-or-off video during the Zoom classes?" and used a Likert response set ranging from 1 (*Never*) to 5 (*Always*) (*M* = 2.75, *SD* = 1.48) and "How many minutes are you on Zoom in a typical class session?" (*M* = 86.66, meaning almost one hour and a half, *SD* = 39.60).

Independent variables

English competency was measured via the Perceived English Proficiency (PEP) scale adapted from Wei et al. (2012). The PEP includes five items to assess participants' perceptions of their English proficiency in listening, speaking, reading, writing, and overall English ability. The variable consists of five items and uses a Likert response scale ranging from 1 (*very poor*) to 5 (*excellent*). The individual scores of the variables were summed and averaged (*M* = 4.05, *SD* = .78). The five items of the PEP showed high internal consistency (Cronbach's α = .95). Additionally, the average factor loading of convergent validity showed strong intercorrelations among the items (λ = 0.83).

The Student Course Engagement Questionnaire (SCEQ) was adapted from Handlesman et al. (2005) and was used to measure college students' course engagement. Some of the questions were modified to make them more relevant for students who use Zoom (e.g., "Listening carefully in class or carefully reading online course discussion posts" was changed to "Listening carefully in class or carefully reading Zoom class material"). The variable consists of 23 items representing four subscales (i.e., participation, performance, skills, emotion) and uses a Likert response scale ranging from 1 (*not at all characteristic of me*) to 5 (*very characteristic of me*).

To test the course engagement scale's dimensionality, exploratory factor analysis using promax rotation was conducted via a statistical program to examine construct validity. Initially, some items were loaded on other factors, and those items were removed. In the end, nine items were clustered into three factors: participation, performance, and skills. The model revealed a good fit and retained three factors in the sample: Kaiser–Meyer–Olkin (KMO) = .83, $x^2(34) = 774.39$, $p < .001$ (see Table 1 for factor loadings of each construct and variance). Additionally, all nine items showed high internal consistency (Cronbach's α = .89). To develop a comprehensive measure of "course engagement", the individual scores of the retained variables associated with the three factors were summed and averaged (*M* = 3.44, *SD* = .80).

Table 1: Factor loading and variances of 9 items of course engagement

Course Engagement Items	Factor loading			Percentage of Variance	Cumulative
	1	2	3		
Factor 1: Participation					
1. Raising my hand or answering questions in the Zoom class.	**.95**	-.00	-.09	53%	53%
3. Asking questions when I don't understand the instructor.	**.83**	.09	-.03		
2. Participating actively in breakout rooms or discussion board.	**.76**	.02	.13		
Factor 2: Skills					
22. Applying course material to my life.	-.01	**.96**	-.01	14.72%	67.72
23. Listening carefully in class or carefully reading Zoom.	.00	**.94**	-.05		
20. Making sure to study on a regular basis.	.20	**.64**	.14		
Factor 3: Performance					
15. Getting a good grade.	-.12	.05	**.92**		
16. Doing well on tests.	.12	.17	**.81**	9.72%	77.45%
4. Doing all the homework problems	.26	-.22	**.78**		

Dependent variable

A 15-item scale to measure Zoom fatigue was developed by Fauville et al. (2021). To increase coherence in college course settings, scale items were modified to represent Zoom course facilitation (e.g., "How mentally drained do you feel after video conferencing?" was changed to "I feel mentally drained after Zoom classes"). The variable used a Likert response scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

To test the dimensionality of the Zoom fatigue scale, exploratory factor analysis using promax rotation was conducted via a statistical program to examine construct validity. In the initial factor analysis, one of the emotional items produced a split factor loading, which resulted in the response "I feel moody after

the Zoom class" remaining and the response "I feel emotionally drained after the Zoom class" and "I feel irritable after the Zoom class" being removed.

Table 2: Factors loading and variances of 12 items of Zoom fatigue

Zoom Fatigue Items	Factor loading				Percentage of Variance	Cumulative
	1	2	3	4		
Factor 1: General						
2. I feel exhausted after the Zoom class.	**.95**	-.04	.02	-.01		
3. I feel mentally drained after the Zoom class.	**.94**	.05	-.04	-.03	50.78%	50.78%
1. I feel tired after the Zoom class.	**.89**	-.01	.03	.01		
Factor 2: Visual						
4. I feel my vision gets blurred after the Zoom class.	.03	**.94**	.02	-.13	12.42%	63.21%
5. I feel my eyes get irritated after the Zoom class.	-.07	**.90**	-.03	.11		
6. I feel my eyes hurt after the Zoom class.	.05	**.87**	.01	.03		
Factor 3: Social						
14. I just want to be alone after the Zoom class.	-.05	.06	**.96**	-.02		
13. I avoid social situations after the Zoom class.	-.03	.05	**.89**	.00	11.40%	74.60%
15. I need time by myself after the Zoom class.	.10	-.11	**.84**	.04		
Factor 4: Motivational						
8. I feel like doing nothing after the Zoom class.	-.03	-.06	-.02	**.94**	6.64%	81.24%
9. I feel too tired to do other things after the Zoom class.	-.06	.01	.05	**.92**		
7. I feel dread doing somethings after the Zoom class.	.24	.12	.00	**.57**		

In the end, the twelve items were clustered into four factors: general, visual, motivational, and social. The model revealed a good fit and retained four factors in the sample: KMO = .87, $x^2(64) = 934.13$, $p < .001$ (see Table 2 for factor loadings of each construct and variance). Additionally, the reliability was satisfactory because all 12 items showed high internal consistency (Cronbach's $\alpha = .91$). To develop a comprehensive measure of "Zoom fatigue," the individual scores of the retained variables associated with the four factors were summed and averaged ($M = 2.67$, $SD = .75$).

RESULT

English competency and Zoom fatigue

Initial analyses involved testing for the significance of correlations between English competency and Zoom fatigue. This analysis revealed a negative relationship between English competency and Zoom fatigue, $r(116) = -.20^*$, $p = .036$. During the survey, some of the data were randomly missing, which influenced the total number of participants shown in the correlations and stepwise regression for the first and second hypothesis tests.

To test the first hypothesis between international students' English competency and Zoom fatigue, a stepwise regression model was used to test the prediction. The first block included control variables (biological sex, number of Zoom classes, Zoom class time, camera-on), and the second block included the independent variable of English competency. The second block of adjusted R^2 was .101, indicating that approximately 10% of the variance in Zoom fatigue in the sample accounted for international students' English competency. Additionally, the linear combination of Zoom fatigue with international students' English competency was significant ($F(5, 105) = 3.46$, $p = .006$). The results indicate that when international students' English competency is greater, international students report lower Zoom fatigue ($b = -.20$, $p = .028$) (see Table 3 for the results of the regression).

Course engagement and Zoom fatigue

To examine the second hypothesis of international student course engagement and Zoom fatigue, correlations between course engagement and Zoom fatigue were examined. This analysis revealed a negative relationship between course engagement and Zoom fatigue, $r(114) = -.24^*$, $p = .01$. The study used a stepwise regression model to test the prediction. The first block included control variables (biological sex, number of Zoom classes, Zoom class time, camera-on), and the second block included the independent variable of course engagement. The second block of adjusted R^2 was .166, which indicated that approximately 17% of the variance in Zoom fatigue accounted for international students' course engagement. Additionally, the linear combination of Zoom fatigue with

international students' course engagement was significant ($F(5, 103) = 5.30$, $p < .001$). The results indicate that when international students report higher course engagement, they experience lower Zoom fatigue ($b = -.35$, $p = <.001$) (see Table 4 for the results of the regression).

Table 3: The effect of English competency on Zoom fatigue

Variables	*B*	β	SE
Block 1:			
Control variables			
Gender (female = 1, male = 0)	.18	.13	.13
Number of Zoom classes	.26	.18	.13
Zoom classes time	.00	.07	.00
Camera-on	.10*	.20*	.05
R^2		.10	
Adjusted R^2		.07	
F value (4, 106)		2.97*	
Block 2:			
Independent variable			
English competency	-.20*	-.20*	.09
R^2		.14	
Adjusted R^2		.10	
F value (5, 105)		3.46**	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, $N = 111$.

DISCUSSION

The current study investigated how Zoom fatigue is predicted by international students' English competency and course engagement. The study involved an online survey and used a statistical program to run stepwise regression, which confirmed support for the first and second hypotheses.

The first hypothesis predicted English competency to be negatively related to Zoom fatigue among international students attending U.S. universities. This implies that students report lower Zoom fatigue when their English competency is high. This finding aligns with arguments regarding computer-mediated communication and cognitive load. Computer-mediated communication explains that students require extra cognitive effort to interpret, form, or comprehend information because computer-mediated communication involves fewer

communication cues than does face-to-face communication according to media richness theory. Nadler (2020) reported how nuances differ between virtual and face-to-face communication because of limited communication cues. Thus, international students might need extra cognitive effort to capture nuance and meanings because of their English proficiency and different cultural backgrounds. In addition, Zoom offers nonverbal cues through various features. These features require extra cognitive demands to international students for multitasking (e.g., listening to lectures and reading chats or emojis). Therefore, virtual classes exacerbate Zoom fatigue among international students.

Table 4: The effect of course engagement on Zoom fatigue

Variables	*B*	β	SE
Block 1:			
Control variables			
Gender (female = 1, male = 0)	.17	.12	.13
Number of Zoom classes	.25	.18	.13
Zoom classes time	.00	.06	.00
Camera-on	.10	.19	.05
R^2		.09	
Adjusted R^2		.06	
F value (4, 104)		2.70*	
Block 2:			
Independent variable			
course engagement	-.35***	-.35***	.09
R^2		.21	
Adjusted R^2		.17	
F value (5, 103)		5.30***	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, $N = 109$.

Furthermore, nonverbal mechanisms associated with the virtual environment, including mirror anxiety, feeling physically trapped, a hyper gaze, and producing and interpreting nonverbal cues, increase the cognitive load. Previous studies have shown that employees feel fatigued during video conferences because of the intensity of experiencing these nonverbal mechanisms (Fauville et al., 2021; Raake et al., 2022). The intense nonverbal cues might be the reason for Zoom fatigue, which intensifies the cognitive load for international students. Therefore, the study shows that international students who have low English competency are likely to experience more Zoom fatigue in virtual classes because of the complexity of managing the richness of cues offered through the media

environment while attempting to learn new course material and respond through the different communication channels it offers.

The second hypothesis predicts that course engagement is negatively related to Zoom fatigue among international students attending U.S. universities. This implies that international students report lower levels of Zoom fatigue when they report greater course engagement. This finding aligns with behavioral engagement, as the course engagement factors are participation (i.e., breakout rooms, discussion boards, asking questions, and answering questions), skills (i.e., making sure to study regularly, finding ways to make the course material relevant to one's life, applying a course to one's life), and performance (i.e., obtaining a good grade, doing well on the tests, solving all homework problems). Previous studies have shown that breakout rooms and nonverbal tools (e.g., written chats and icons) are useful tools for students to engage in classes, especially for those who are not fluent in English (Lee 2021; Kohnke & Moorhouse, 2022; Vurdien, 2019), which can decrease Zoom fatigue by enabling students to be involved. Additionally, international students who have low English competency can be more confident in their ability to participate in virtual classes because their faces are not always shown in virtual classes. Moreover, online learning platforms may lessen Zoom fatigue because the virtual classroom allows international students to engage more by using the internet or translation programs to overcome English barriers. Thus, online learning platforms may encourage international students to engage in virtual classes and decrease Zoom fatigue. In other words, international students are less likely to experience Zoom fatigue from engaging in virtual classes. Therefore, this study shows that course engagement is a pivotal element in decreasing Zoom fatigue for international students.

Limitations

Like any other study, this study has potential limitations. Since the data were gathered at one institution, the breadth of applicability and generalizability of the findings are restricted. Therefore, the results of this study should be examined in different institutions with a larger sample size. Additionally, the study did not measure the use of Zoom tools to determine how course engagement is negatively related to Zoom fatigue. Further studies are encouraged to measure the use of Zoom tools (e.g., chat rooms, sharing screens, and breakout room sections) to investigate how Zoom tools affect international students' course engagement.

Despite its limitations, this study is meaningful for investigating how English competency and course engagement are related to Zoom fatigue separately in virtual classes among international students. This study highlights the ambivalence of virtual classes, which can be harmful and beneficial for international students who have low English competency. In summary, international students with low English competency can decrease their Zoom fatigue through course engagement, and it may also offer a means to increase

competency levels in a learning environment that is less risky than face-to-face classrooms.

Implications

Further studies should be conducted to decrease international students' Zoom fatigue and increase course engagement. First, future studies can advance the current model by combining the two variables (i.e., English competency and course engagement) to determine how they affect Zoom fatigue. Second, advanced models should explore how English competency could mediate the relationship between course engagement and Zoom fatigues in future studies. Studies of this nature will identify the importance of English competency in the model and encourage future research to investigate how to engage international students in ways to build their language competency in virtual classes. Although some studies show that students engage in virtual classes more when they turn their camera on and when they show their facial and body expressions (e.g., nodding heads, giving thumbs up or down) (Epstein-Shuman & Kushlev, 2022; Peper & Yang, 2021), future work could investigate more thoroughly how it can be applied to international students related to their English competency and examine the ideal length for virtual classes, as Zoom fatigue is associated with the amount of time staring at the screen (Epstein-Shuman & Kushlev, 2022; Nesher Shoshan & Wehrt, 2022). Finally, there should be more studies about interpersonal communication in virtual classrooms with respect to emotional course engagement and Zoom fatigue. On the basis of the factor analysis, emotional factors of course engagement (e.g., having fun in class, desiring to learn the material, and thinking about the course between class meetings) and emotional factors of Zoom fatigue (e.g., feeling emotionally drained, feeling irritable, needing time by themselves after the Zoom classes) were removed. This can highlight the limitations of virtual classes because proximity can restrict the opportunity to build relationships with a professor and classmates (Bejerano, 2008). Therefore, further studies on the relationship between virtual classes and emotional course engagement could be conducted. A potential benefit of this future study would be to provide international students with social and academic support through interaction with other students and professors in virtual classes at U.S. universities.

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