


Adopting Web Conferencing in Online Teaching: A Perspective From Logistic Regression

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ABSTRACT

This study represented dimensions from the diffusion of innovations theory and the community of inquiry model to explore the adoption of web-conferencing. It used logistic regression to model the likelihood of adopting web-conferencing in online teaching with data collected from 66 college online instructors. In the logistic regression analyses, measures of the instructors' perception of the instructional benefits of web-conferencing, perception of web-conferencing as a tool for creating social presence and teaching presence, and perception of barriers of using web-conferencing in online instruction were the independent variables, and the binary dependent variable represented the instructors' adoption or non-adoption of the web-conferencing innovation. The results of the full logistic regression model (with all three independent variables) and the reduced models (with one or two independent variables at a time) are reported, and implications for promoting web-conferencing adoption and future research are discussed.

KEYWORDS

College Instructors, Diffusion of Innovation, Distance Learners, Online Instruction, Social Presence, Teaching Presence, Technology Adoption, Web-Conferencing

INTRODUCTION

With the rapid development of web-based audio and video conferencing technologies, the past decade has witnessed the use of web-conferencing in online instruction to simulate face-to-face learning experiences (Nedeva et al., 2014; Nicklen et al., 2018). As a synchronous solution for online teaching and learning, web-conferencing provides such advantages as creating real-time interactions; improving learning performance, motivation, and student satisfaction; helping students developing a sense of belonging; and promoting cooperative learning and student-instructor communication (Durrington et al., 2010; Hart et al., 2019; Watts, 2016; Hastie et al., 2010; Wang et al., 2010; Francescucci & Rohani, 2019). Despite the advantages, online teaching and learning relying on asynchronous technologies is still the dominant model at most institutions (Legon & Garrett, 2018). The Changing Landscape of Online Education (CHLOE) project at Quality Matters surveyed 182 Chief Online Officers (COOs) from U.S. colleges and universities, and the survey results indicated that 82% of the institutions have

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their online programs being wholly or mainly asynchronous and instructor preference for remaining asynchronous is the most common reason for not employing synchronous delivery (Legon & Garrett, 2018).

From a technology adoption perspective, the distance education literature related to the CHLOE survey results has indicated that online instructors' decision to adopt web-conferencing is key to a paradigm shift in the way online courses are taught and is essential for producing the advantages of teaching with web conferencing. Compared to asynchronous technologies such as discussion forums that have been associated with online learning environment early on, web-conferencing is relatively more recent and fits into the definition of an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit on adoption" (Rogers, 2003, p. 11). Rogers' (2003) diffusion of innovation (DOI) theory focuses on understanding the process of adoption and diffusion of innovations in a social system. According to DOI, people's decision to adopt or reject an innovation is greatly influenced by their perceptions of the five characteristics of the innovation: (1) relative advantage (the degree to which the innovation is perceived as being better than the idea it supersedes); (2) compatibility (the degree to which the innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters); (3) complexity (the degree to which the innovation is perceived as relatively difficult to understand and use); (4) trialability (the degree to which the innovation may be experimented with on a limited basis); and (5) observability (the degree to which the results of the innovation are visible to others). This study is a benchmark of Rogers' aspects of relative advantage and complexity immediately before the COVID-19 pandemic provided the widespread trialability and observability of web-conferencing through mandated synchronous web-conferencing implementation.

BACKGROUND

Traditional online instruction has been mostly asynchronous with learning and communication between instructors and students supported by discussion forums, emails, blogs, wikis, or text-based and pre-recorded video lectures (Huang & Hsiao, 2012; Ruiz et al., 2006; Zhang et al., 2004). Though offering distance learners the flexibility of learning at their own pace, the asynchronous model has such disadvantages and problems as lack of real-time interaction and collaboration, no opportunities for asking questions and getting instant feedback, causing sense of separation between instructors and students, and low student motivation and participation (Bower, 2011; Dumford & Miller, 2018; Gazan, 2020). Web-conferencing helps address these disadvantages and problems by transforming online learning into a synchronous, virtual classroom where the interaction and the sense of connectedness can be comparable to a face-to-face classroom (Beattie et al., 2017; Islam, 2019).

Instructional Benefits of Web-Conferencing

Widely used web-conferencing programs include Blackboard Collaborate, Elluminate Live, WebEx, Zoom, Google Meet, and Adobe Connect. These web-conferencing programs allow instructors and online learners to interact and collaborate in real-time through synchronous audio or video conferencing. In addition, web-conferencing programs offer various features (e.g., real-time polling and quizzes, screen sharing, text chat, video recording, whiteboard, and break-out rooms) for facilitating interaction and online learning activities and collaborations. Online students indicated their preference for online courses with synchronous web-conferencing lectures over courses with text-based asynchronous lectures (DeSantis et al., 2017). The multimodal affordances of web-conferencing have made it an online instructional tool that instructors can use for less transmissive and more active distance learning pedagogies (Bower, 2011). Based on their survey research of 79 online instructors, Martin and Parker (2014) suggested using web-conferencing to promote active online learning in the following ways: (1) discuss and debate the concepts presented in asynchronous course work; (2) teach course content from different locations; (3) facilitate dialogue in addition to

content delivery; (4) conduct online office hours and online lab sessions; (5) bring consultants and guest speakers from different locations; (6) archive virtual sessions for future viewing by students; (7) enhance interaction and build a sense of community among students by using breakout rooms; and (8) present course content virtually to students (p. 203).

With web-conferencing being used as an online instructional tool, there is an emergence of research on the effects of online teaching and learning using web-conferencing. Online students believed that synchronous classrooms using web conferencing improved their understanding of course materials and helped them learn more and earn better grades (Coetzee et al., 2018; Islam, 2019; Lietzau & Mann, 2009). Research also revealed that students in online synchronous courses demonstrated better performance than those in online asynchronous and traditional face-to-face courses (Basaran & Yalman, 2020). Additionally, web-conferencing was found to be positively correlated to students' satisfaction of online courses (Beattie et al., 2017; Huang & McConnell, 2010).

Using web-conferencing in online instruction can allow teaching and learning to take place in ways that are not possible with asynchronous instructional mode. Online instructors can use web-conferencing sessions to observe learners' progress more effectively and frequently to help increase their comprehension (Coffey, 2010). The features available in web-conferencing programs can allow instructors to effectively engage students and facilitate learning. The chat features in web-conferencing can not only promote interaction, community, and collaboration (Cook et al., 2011) but also help students develop critical thinking skills (Martin & Parker, 2014). According to Martin and Parker (2014), students can type questions in the chat area of an interactive synchronous class without interrupting the presenter and the questions can facilitate critical thinking building by causing the students to reflect on the questions and posit answers to them. Using a web-conferencing program, such as Adobe Connect, online instructors can use the break-out room features to simulate small group discussion for the purpose of facilitating collaboration and sharing ideas (Hudson et al., 2012). Other web-conferencing features that favored by online students as points of personal engagement include emoticons, hand raising, shared whiteboard, polling, and application sharing etc. (Martin & Parker, 2014).

Web-Conferencing as Tool for Social Presence and Teaching Presence

Web-conferencing tools offer the ability to create live sessions for instructor-to-student and student-to-student interaction and collaboration. As stated by Motteram (2001), synchronous tools are more effective for the social or community side of education. The Community of Inquiry (CoI) framework (Anderson et al., 2001; Garrison et al., 2000) identifies three core elements that are essential in a learning community including: social presence, teaching presence, and cognitive presence. Social presence and teaching presence in the CoI framework provide a good lens for understanding the social side of online instruction associated with web-conferencing. Cognitive presence is the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse (Garrison et al., 2001). Some courses of study (e.g., literature, design, philosophy) are enhanced by a CoI with cognitive presence; however, others (e.g., computer software or basic mathematics) do not because they require direct application. Since the level of cognitive presence can vary with different courses of study represented by this study's participants, the aspects of social and teaching presence are applicable for this study.

Social presence "describes the learning climate through open communication, cohesion, and interpersonal relationships" (Akyol & Garrison, 2011, p.185) and represents the level of connectedness to others felt by members in an online learning environment (Garrison & Akyol, 2013). The online synchronous teaching and learning environment supported by web-conferencing has such advantages as breaking down social isolation students may experience when learning at a distance and creating real-time social interaction among students (Edmunds et al., 2021); helping students develop the feeling of belonging (Watts, 2016); and allowing instructors and students to establish real-time communication and feel themselves as social beings (Hastie et al., 2010). These advantages reflect

the capacity of web-conferencing as a tool that can strengthen and promote social presence (Martin & Parker; 2014; Park & Bonk, 2007). Additionally, research has indicated that feedback tools in web-conferencing (e.g., emoticons, ticks, crosses, and applause) help promote a sense of “realness” (social presence) and online instructors have encouraged their students to use such tools in online learning environments (Cornelius, 2014; Martin & Parker, 2014).

Playing a regulatory and mediating role in the elements of the CoI framework, teaching presence is “the design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes” (Anderson et al., 2001, p. 5). Web-conferencing, with its technological affordances of promoting live interaction and collaboration, can allow online instructors to create teaching presence characterized by their virtual “visibility” in an online learning environment and enable them to direct and facilitate social/cognitive presences to achieve desired learning outcomes. Research has shown that students in online classes using web-conferencing have higher levels of teaching presence, social presence, and cognitive presence than those in classes not using web-conferencing (Stover & Miura, 2015). Substantial benefits accrue to students by using web-conferencing to bring experts in related fields into online classrooms to interact with students (Sternberger et al., 2011; Stover et al., 2014). The strategies, facilitation, and instructional responsibilities that define teaching presence (Akyol & Garrison, 2011) in experts’ virtual visits or web-conferencing sessions, in general, will create and support social and cognitive presences and will consequently improve learning experience and outcomes.

Barriers of Using Web-Conferencing in Online Teaching

Web-conferencing supported synchronous online learning environment has shown advantages over the asynchronous instructional mode. However, using web-conferencing to facilitate learning and teaching is more complex than teaching with asynchronous tools (Bower, 2011). Teaching with web-conferencing requires mastering several tools in a selected web-conferencing program, and failure to understand one subtle feature of a tool or its use can have a crippling impact on learning and lead to confusion (Bower, 2011). For online instructors, simultaneous utilization of various tools and media for synchronous correspondence in web-conferencing sessions can be overpowering and debilitating (Cornelius, 2014). Online teaching workload was believed to be heavier than face-to-face classes (Huang & Hsiao, 2012). Due to the complexity of teaching with web-conferencing as mentioned above, the workload for online instructors can become even heavier if they choose to offer synchronous online sessions. Additionally, successful teaching with web-conferencing requires online instructors to develop skills for managing, coordinating, and facilitating synchronous interaction and collaboration. This requirement will further increase online instructors’ workload and make them more hesitant to adopt web-conferencing in their online classes.

Web-conferencing relies on an Internet connection to function. Internet connectivity issues due to slow network speed or improperly licensed web-conferencing software, browser compatibility issues, and computer glitches will become barriers of having seamless web-conferencing sessions (Lewis et al., 2020; Tiwari & Tiwary, 2010; Wang & Hsu, 2008). As such, when technical problems happen on the students’ end, the instructor may have to spend quite amount of time helping individual students fix their problems and this would interfere with content delivery and cause pauses or delays in the synchronous sessions (Grant & Cheon, 2007; Huang & Hsiao, 2012). Other barriers affecting using web-conferencing in online teaching and learning are related to security concerns about using webcams or unwillingness to use webcams, confusion due to inappropriate turning on and off of microphones, misinterpretation due to communicating through webcamming rather than face-to-face, and difficulty of scheduling synchronous sessions (Coffey, 2010; Cornelius, 2014; Kozar, 2016; Wang & Hsu, 2008).

Perceptions of Web-Conferencing and Rogers’ Innovation Characteristics

As was previously mentioned, Rogers’ (2003) diffusion of innovation theory focuses on five characteristics of an innovation: relative advantage, compatibility, complexity, trialability, and

observability. The three perception variables of this study (i.e., perception of instructional benefits of web-conferencing, perception of web-conferencing as a tool for creating social presence and teaching presence, and perception of barriers of using web-conferencing in online instruction) emerged from the web-conferencing literature summarized above. From the perspective of Rogers' (2003) diffusion of innovation theory, the three perception variables of this study are related the "relative advantage" and "complexity" of web-conferencing. Specifically, perception of instructional benefits of web-conferencing is related to the "relative advantage" of web-conferencing over asynchronous online tools (e.g., Cao et al., 2009; Martin & Parker, 2014; Stephens & Mottet, 2008). Additionally, online instructors feel the need to use web-conferencing to create social and teaching presences (Beattie et al., 2017; Islam, 2019; Nedeva et al., 2014). Thus, the perception of web-conferencing as tool for creating social and teaching presences also is related to the "relative advantage" of web-conferencing. The "complexity" characteristic of web-conferencing is reflected in the perception of barriers of using web-conferencing in online instruction. Based on the relationship postulated in Rogers' theory (2003) between the likelihood of adopting an innovation and one's perception of the innovation's "relative advantage" and "complexity," one can expect that, while better perceptions of web-conferencing's "relative advantage" would associate with greater likelihood of adoption, perceptions of higher complexity involved in using web-conferencing would result in less likelihood of adopting it in online instruction.

THEORETICAL FRAMEWORK

The rationale for this study was twofold: to expand the benefits and barriers research to be more inclusive of the CoI affordances of web-conferencing and to begin to align that research with Roger's diffusion of innovations (DOI). Past research has explored the benefits of web conferencing for instruction (Drexhage et al., 2016; Jones, 2017), which aligns with the DOI dimension of "relative advantage," and the barriers for using it (Al-Samarraie, 2019; Cong, 2020; Jones, 2017; Kopcha, 2012), which align with the DOI dimension of "complexity." An additional source for viewing the relative advantage of web conferencing is through its ability to facilitate the creation of a Community of Inquiry (CoI). The CoI model focuses on three aspects: cognitive presence, teaching presence, and social presence (Anderson et al., 2001; Garrison et al., 2000). Since this study approaches the adoption of web-conferencing by instructors of classes with varying levels of cognitive inquiry, the study addressed the teaching presence and social presence. Thus, the theoretical framework for this study in Figure 1 is based on two dimensions of the DOI: "relative advantage" (i.e., instructional benefits and the creation of social and teaching presence) and "complexity" (i.e., barriers).

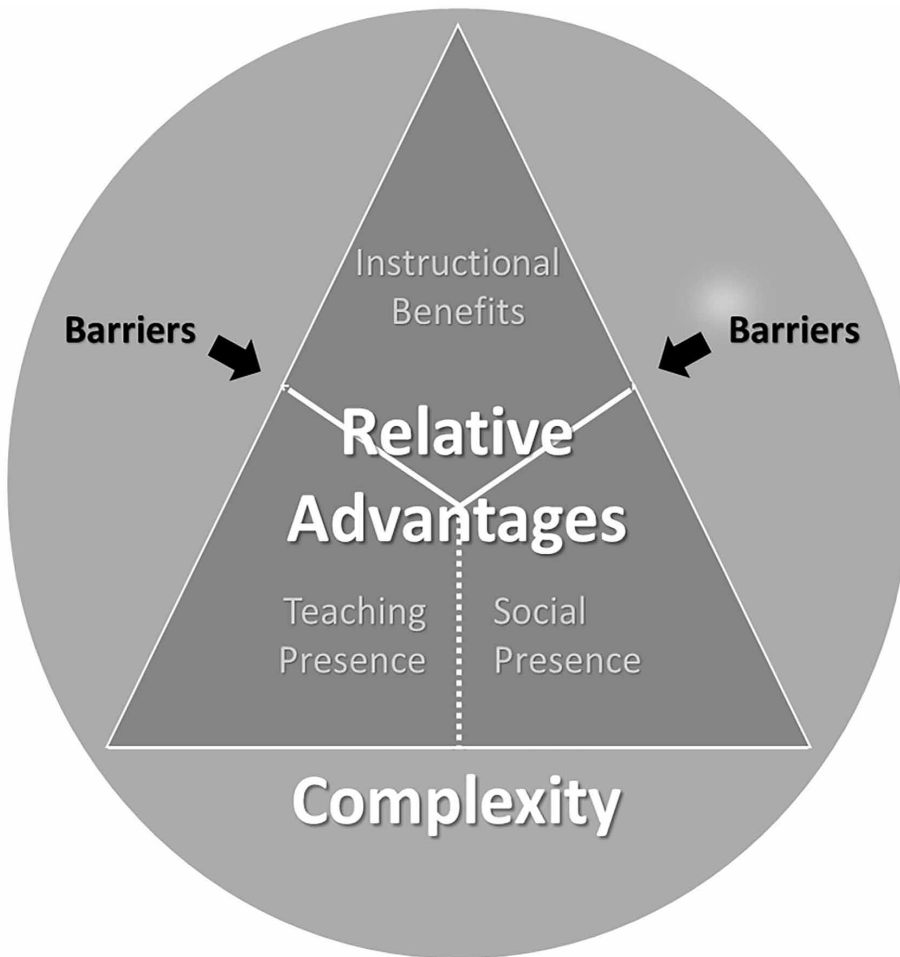
Grounded in the theoretical framework in Figure 1, this study adopted a quantitative survey research design to investigate how online college instructors' decision to adopt web-conferencing in online instruction is affected by their perceptions of: (1) instructional benefits of web-conferencing; (2) web-conferencing as a tool for creating social presence and teaching presence; and (3) barriers of using web-conferencing in online teaching. A logistic regression model was fitted using survey data collected from college online instructors using the *Assessment of Collegiate Instructors' Perceptions of the Use of Web-Conferencing for Online Instruction* questionnaire (Allen, 2020).

METHODOLOGY

Research Design

Adopting a quantitative survey research design, this study collected data from college online instructors. The data were analyzed to answer the research questions: (1) Do online college instructors' perceptions of instructional benefits of web-conferencing, web-conferencing as a tool for creating social and teaching presences, and barriers of using web-conferencing in online instruction affect the

Figure 1. Theoretical Framework



probability of adopting of web-conferencing (yes vs. no)?, and (2) If yes, how does the probability of adoption web-conferencing change for every addition unit increase in the score for each of the three perceptions?

Sample

The online instructors who taught in any of the three semesters of spring 2018, fall 2018, and spring 2019 in a southern university were invited to participate in the survey of this study. Sixty-two instructors responded to the survey and their responses to the survey were analyzed to answer the research questions. The demographic information regarding these instructors' gender, age, rank, race, and years of teaching experience was presented in Table 1.

Instrument

The survey instrument used in this study for data collection was the *Assessment of Collegiate Instructors' Perceptions of the Use of Web-Conferencing for Online Instruction* questionnaire (Allen, 2020). The questionnaire includes: (1) questions about participants' demographic information, (2) a "yes-or-no" question asking the survey participants if they used web-conferencing in their online

Table 1. Participants' Demographic Information

Category		n
Gender	Male	23
	Female	39
Age	Under 30	4
	30-35	5
	36-39	8
	40-45	6
	46-49	10
	50 and above	28
	No Response	1
Rank	Instructor	15
	Assistant Professor	6
	Associate Professor	13
	Full Professor	16
	Adjunct Professor	8
	Other	2
	No Response	2
Race	Black, African American	5
	Hispanic American	1
	Caucasian	53
	Multiracial	1
	No Response	2
Years of Teaching Experience	0-10	17
	11-20	22
	21-30	8
	31-40	6
	41-50	5
	51+	1
	No Response	3

instruction, and (3) three perception subscales: *subscale I* of perception of instructional benefits of web-conferencing (16 items); *subscale II* of perception of web-conferencing as a tool for creating social presence and teaching presence (14 items); and *subscale III* of perception of barriers to use web-conferencing (14 items). All items in the three subscales use a 6-point Likert scale from “strongly disagree” to “strong agree.” The Cronbach’s alpha scores for the three perception subscales were calculated with the survey data collected from the 62 online college instructors participating in this study. The alpha scores for the three subscales were .969, .970, and .887, indicating very good internal consistency. Table 2 lists all 44 items of the three subscales in the survey instrument.

Table 2. Three Subscales of the Survey Instrument (Allen, 2020)

<p><i>Subscale I (Perception of instructional benefits of web-conferencing)</i></p> <ul style="list-style-type: none"> ▶ Web-conferencing is easy to use. ▶ Web-conferencing is convenient for online learning. ▶ Web-conferencing is effective as a learning tool. ▶ The implementation of web-conferencing has been instrumental in online instruction. ▶ Web-conferencing tools are conducive to developing a productive learning environment for learners. ▶ Web-conferencing is an excellent tool for collaboration among learners. ▶ Web-conferencing allows interaction between instructors and learners. ▶ Web-conferencing helps improve online students' learning outcome. ▶ Web-conferencing is a good tool to use to elaborate discussion. ▶ Web-conferencing is a practical alternative to traditional face-to-face instruction. ▶ Web-conferencing is useful for sharing content with learners. ▶ Web-conferencing allows me to gain a better perception of learner's progress. ▶ As an instructor, web-conferencing is a beneficial tool to teach in an online learning environment. ▶ As an instructor, utilizing a real-time synchronous format for web-conferencing sessions enhances facilitation. ▶ Web-conferencing is helpful for teaching course content from different locations. ▶ Web-conferencing is a beneficial tool to bring guest speakers from different locations.
<p><i>Subscale II (Perception of web-conferencing as a tool for creating social presence and teaching presence)</i></p> <p>▶ Web-conferencing features such as hand Raise, Audio/Video/Webcam, Roll Call, and Breakout Virtual Sessions, give students a sense of "realness" of a physical presence of the instructor and other students in the online class.</p> <p>▶ The participant engagement web-conferencing features (e.g., Audio/Video/Webcam, Roll Call, Guest Speaker, Breakout Virtual Sessions, and Participant Panel) help form a sense of online community among online course participants.</p> <ul style="list-style-type: none"> ▶ Web-conferencing allows online students to form distinct impressions of other course participants. ▶ Web-conferencing allows online students to form a sense of belonging in the online course. ▶ Online collaboration using web-conferencing provides a more personal learning experience for online students. ▶ Web-conferencing is an excellent medium for social interaction. ▶ Interacting with learners through web-conferencing sessions is comfortable. ▶ Using web-conferencing personal profile to introduce myself to learners helped to create social presence. ▶ Utilizing web-conferencing with learners provides a sense of connectedness with learners. ▶ Discussions using audio/video/webcam tend to be more personal with learners. ▶ Web-conferencing allows online students to feel that their points of view are acknowledged. ▶ As an instructor, web-conferencing allowed me to feel like a 'real person' in the online learning environment. ▶ By seeing student reactions and facial expressions while web-conferencing, I was able to determine their comprehension of the instruction. ▶ Instructors create online social presence when they use web-conferencing for collaboration.
<p><i>Subscale III (Perception of barriers to use web-conferencing)</i></p> <ul style="list-style-type: none"> ▶ I lack relevant experience with using web-conferencing. ▶ I don't see the benefits of using web-conferencing for my online class. ▶ I lack knowledge/skills of integrating web-conferencing properly into my online class. ▶ Web-conferencing is challenging to navigate. ▶ It is difficult to provide feedback to learners while using Web-conferencing. ▶ Technical issues may occur when using web-conferencing thus inhibiting content delivery. ▶ There is a lack of technical support when experiencing difficulties using web-conferencing. ▶ It is problematic to find a common time for web-conferencing sessions that is beneficial for all learners. ▶ I feel using web-conferencing is time-consuming. ▶ It is difficult to facilitate student interactions while web-conferencing. ▶ The students do not have access to adequate bandwidth. ▶ I do not have adequate bandwidth. ▶ I get nervous when I have to teach via web-conferencing. ▶ Preparing for a class via web-conferencing is too time-consuming.

Measures and Data Analysis

The survey data were collected in spring 2019 using Survey Monkey. The mean item score for each subscale was calculated and this gave each instructor three perception scores: (1) *PerceptionScore 1* of perception of instructional benefits of web-conferencing, (2) *PerceptionScore 2* of perception of

web-conferencing as tool for creating social and teaching presences, and (3) *PerceptionScore 3* of perception of barriers to use web-conferencing. A binary logistic regression was modeled in SPSS 26.0 to analyze the data in this study. The three perception scores were the predictor variables in this model. The instructors' answers of using or not using web-conferencing in online instruction were the dependent variable (*WC_Adoption*) and were coded as "0" for "not using web-conferencing" (representing the reference or baseline category) and "1" for "using web-conferencing" (representing the target category).

RESULTS

Unlike standard ordinary least squares regression (OLS), logistic regression does not assume linearity of relationship between the raw values of the independent variables and raw values of the dependent variable and does not require normality and homoscedasticity assumptions to be met (Garson, 2009). In the binary logistic regression model fitted to this study, the predictors or independent variables were the three perception scores (i.e., *PerceptionScore1*, *PerceptionScore2*, and *PerceptionScore 3*), and the dependent variable was the binary variable of *WC_Adoption*. The data used for fitting the regression model were collected from 62 online college instructors. The binary variable divided these instructors into two groups: the group of instructors using web-conferencing ($n_1 = 36$) and the group of instructors not using web-conferencing ($n_2 = 26$). The descriptive statistics of the three perception scores for the two groups are reported in Table 3.

Table 3. Descriptive Statistics of the Perception Variables

Descriptive Statistics	Instructors Using Web-conferencing ($n_1 = 36$)			Instructors Not Using Web-conferencing ($n_1 = 26$)		
	PerceptionScore1	PerceptionScore2	PerceptionScore3	PerceptionScore1	PerceptionScore2	PerceptionScore3
Mean	4.934	4.667	2.958	3.796	3.821	3.937
Median	5.000	4.750	2.893	3.969	4.000	3.964
SD	0.756	0.951	0.806	1.048	0.990	0.673
Range	3.130	3.500	3.930	4.060	3.930	2.710
Minimum	2.880	2.500	1.430	1.190	1.860	2.790
Maximum	6.000	6.000	5.360	5.250	5.790	5.500

Full Model Results

The Omnibus Tests of Model Coefficients was conducted to compare the full model with all three perception variables to the null model without any predictors. The test result was significant ($\chi^2(5) = 29.637$, $p < .001$), indicating that the full model fits the data significantly better than a null model. The non-significant result ($p = .203$) of the Hosmer and Lemeshow Test is another indicator of good model fit. The results of the logistic regression analysis with all three perception variables are presented in Table 4.

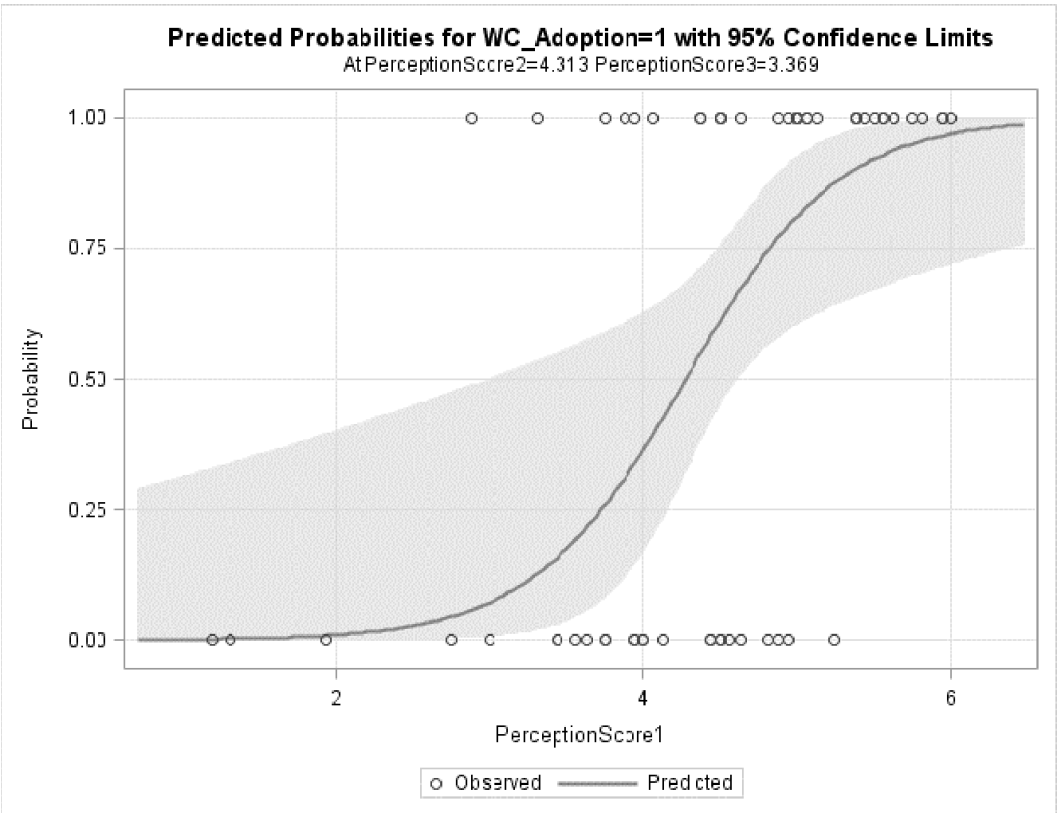
The slope for *PerceptionScore1* is positive and significant ($b = 1.998$, $\chi^2(1) = 5.745$, $p = .017$), indicating that perception of instructional benefits of web-conferencing is a positive and significant predictor of the probability of adopting web-conferencing. In ordinary linear regression, a slope coefficient indicates the amount of increase in the dependent variable with a unit increase in the independent variable. But in logistic regression, slope coefficients are in log-odds units, which are difficult to interpret. So, they are often converted to odds ratios (odds ratio = e^B with e being 2.71828)

Table 4. Full Logistic Regression Model Results

	B	S.E.	Wald	df		Sig.	Exp(B)	95% C.I. for EXP(B) Lower	95% C.I. for EXP(B) Upper
PerceptionScore1	1.998	.834	5.745	1		.017	7.376	1.439	37.799
PerceptionScore2	-.839	.643	1.699	1		.192	.432	.123	1.526
PerceptionScore3	-1.159	.508	5.211	1		.022	.314	.116	.849
Constant	-1.015	3.165	.103	1		.748	.362		

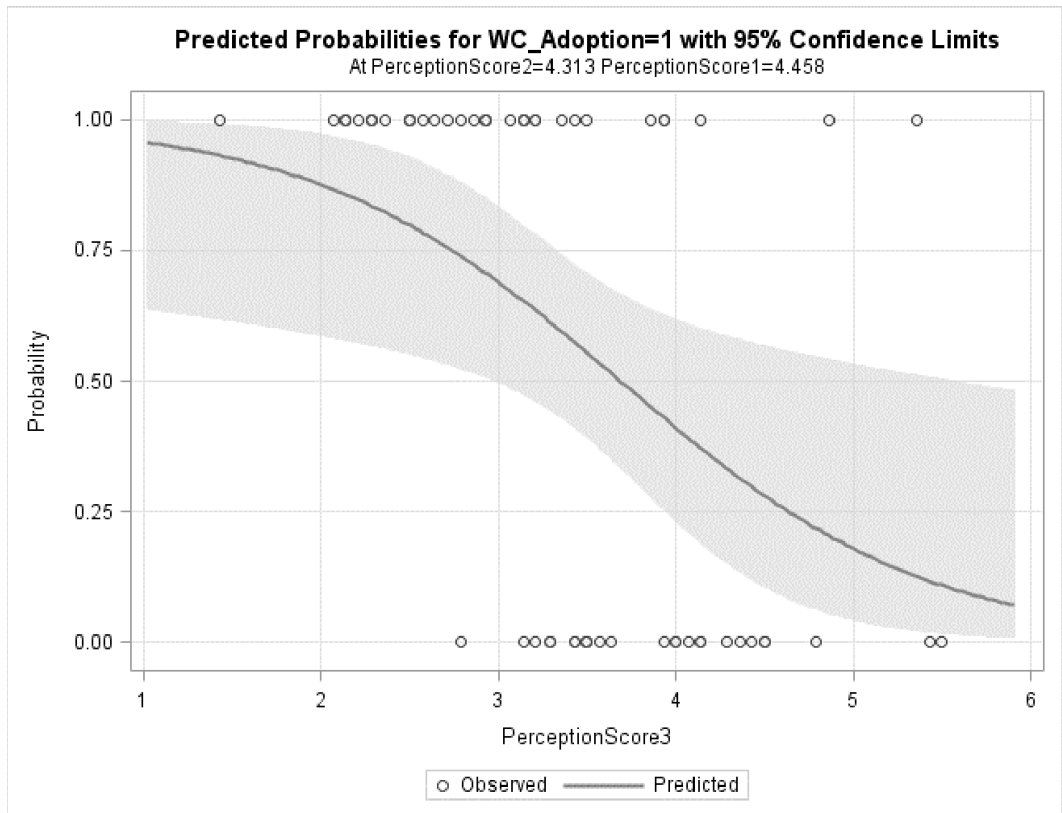
as shown in the column labeled “Exp(B)” in Table 4. The odds ratio for *PerceptionScore1* is 7.376, which means that, for one unit increase in an instructor’s perception of Instructional benefits of web-conferencing, the odds of adopting web-conferencing will increase by a factor of 7.376. Figure 2 is the estimated logistic curve created using SAS 9.4. This curve shows the probability of web-conferencing adoption (*WC_Adoption* = 1) as predicted by *PerceptionScore1*.

Figure 2. Estimated Logistic Curve for PerceptionScore1 in the Full Model



Perception of barriers to use web-conferencing is a negative and significant ($b = -1.159$, $\chi^2(1) = 5.211$, $p = .022$) predictor of the probability of adopting web-conferencing in online instruction. The odds ratio indicates that for one unit increase in an instructor's perception of barriers to use web-conferencing, the odds of adopting web-conferencing will decrease by a factor of .314. Figure 3 is the estimated logistic curve showing the probability of web-conferencing adoption ($WC_Adoption = 1$) as predicted by *PerceptionScore3*. The perception of web-conferencing as a tool for creating social presence and teaching presence is not significant ($b = -.839$, $\chi^2(1) = 1.699$, $p = .192$).

Figure 3. Estimated Logistic Curve for PerceptionScore3 in the Full Model



Reduced Model Results

A correlation matrix was calculated for *PerceptionScore1*, *PerceptionScore2*, and *PerceptionsScore3*. According to the traditional criterion that an absolute correlation coefficient larger than .7 among two or more predictors indicates the presence of multicollinearity (Pace, 2009), the correlation coefficient of .868 ($p < .001$) for *PerceptionScore1* and *PerceptionScore2* indicates possible multicollinearity between the perception of instructional benefits of web-conferencing and the perception of web-conferencing as a tool for creating social and teaching presences. The collinearity diagnostics from SPSS show a variance inflation factor (VIF) of 4.047 for *PerceptionScore1* and *PerceptionScore2*. This also indicates multicollinearity between the perception of instructional benefits of web-conferencing and the perception of web-conferencing as a tool for creating social and teaching presences, if a more stringent criterion is adopted where VIF should be lower than 3.3 (Diamantopoulos & Siguaw, 2006).

or VIF value exceeding 4.0 suggests a problem with multicollinearity (Hair et al., 2010). Due to the presence of multicollinearity, *PerceptionScore2* was dropped from the logistic model and the result with only *PerceptionScore1* and *PerceptionScore3* in the model was presented in Table 5.

Table 5. Results of Reduced Logistic Regression Models

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Reduced Model 1 with PerceptionScore1 and PerceptionScore3								
PerceptionScore1	1.167	.494	5.572	1	.018	3.212	1.219	8.466
PerceptionScore3	-1.171	.507	5.324	1	.021	.310	.115	.838
Constant	-.823	3.148	.068	1	.794	.439		
Reduced Model 2 with PerceptionScore2 and PerceptionScore3								
PerceptionScore2	.408	.363	1.260	1	.262	1.503	.738	3.064
PerceptionScore3	-1.517	.500	9.193	1	.002	.219	.082	.585
Constant	3.793	2.636	2.071	1	.150	44.374		
Reduced Model 3 with PerceptionScore2 and PerceptionScore1								
PerceptionScore2	-.887	.672	1.742	1	.187	.412	.110	1.538
PerceptionScore1	2.444	.811	9.088	1	.003	11.520	2.351	56.439
Constant	-6.792	2.048	10.993	1	.001	.001		
Reduced Model 4 with PerceptionScore1								
PerceptionScore1	1.599	.448	12.730	1	< .001	4.949	2.056	11.915
Constant	-6.798	2.027	11.245	1	.001	.001		
Reduced Model 5 with PerceptionScore2								
PerceptionScore2	.904	.311	8.423	1	.004	2.469	1.341	4.544
Constant	-3.529	1.352	6.818	1	.009	.029		
Reduced Model 6 with PerceptionScore3								
PerceptionScore3	-1.723	.471	13.363	1	< .001	.179	.071	.450
Constant	6.219	1.651	14.189	1	.000	502.147		

Also included in Table 4 are three models with each having one of the three perception scores. When alone in the model, each of three perception variables is a significant predictor of the probability of adopting web-conferencing in online instruction. For one unit increase in an instructor's perception of instructional benefits of web-conferencing, the odds of adopting web-conferencing will increase by a factor of 4.949. The odds will increase by a factor of 2.469 with one unit increase in perception of web-conferencing as a tool for creating social and teaching presences. For perception of barriers to use web-conferencing, one unit increase will result in the odds of adopting web-conferencing decreasing by a factor of .179.

As shown in Table 4, while *PerceptionScore2* is a significant predictor when it is alone in the model. It becomes insignificant whenever it is with another predictor variable in the model. It makes sense that *PerceptionScore2* is insignificant when being with *PerceptionScore1* in the model

due to the multicollinearity between these two predictor variables. The correlation coefficient for *PerceptionScore2* and *PerceptionScore3* is $-.571$ ($p < .001$) and the VIF value for them is 1.503. Although there seems no multicollinearity between these two predictor variables according to the criteria for multicollinearity mentioned earlier, *PerceptionScore2* becomes insignificant when *PerceptionScore3* is added into the model.

DISCUSSION

As discussed in the Background, the three perception scores (*PerceptionScore1*, *PerceptionScore2*, and *PerceptionsScore3*) reflect the perceived characteristics of web-conferencing as “relative advantage” and “complexity.” The data analysis results from the study indicated that each of the three perception scores, when alone in a logistic regression model, is a significant predictor of the odds of adopting web-conferencing in online instruction. The finding of *PerceptionScore1* and *PerceptionScore2* being significant positive predictors and *PerceptionScore3* being a significant negative predictor of the likelihood of adopting web-conferencing in online instruction provides empirical evidence supporting Rogers’ (2003) conceptualization of the relationship between one’s decision to adopt an innovation and their perceptions of the innovation’s “relative advantage” and “complexity.”

PerceptionScore2 (representing perception of web-conferencing as a tool for creating teaching and social presence) becomes insignificant when together with *PerceptionScore1* (representing perception of instructional benefits of web-conferencing) in the logistic regression model due to them being highly correlated. The multicollinearity between these two predictor variables may be explained by the fact that web-conferencing’s inherent affordance of synchronicity is central to its roles as both an instructional tool and as a tool for creating social and teaching presences in online learning environments (Beattie et al., 2017; Bower, 2011; Edmunds et al., 2021; Islam, 2019). With *PerceptionScore1* and *PerceptionScore2* related to the “relative advantage” characteristics of web-conferencing innovation, the multicollinearity actually revealed the interrelatedness of these two types of advantages. Perhaps instructors perceive the value of these two in similar ways. Future research could be done to determine if these dimensions could be coalesced.

Another piece of evidence from this study indicating the interrelatedness of the characteristics of this innovation is the result that *PerceptionScore3* renders *PerceptionScore2* insignificant when they are together in the model (see Reduced Model 2 in Table 5). It seems that online instructors’ perception of barriers of using web-conferencing has a negative confounding effect on their perception of web-conferencing as a tool for creating social and teaching presences. This negative confounding effect pulls the association between *PerceptionScore2* and the odds of adopting web-conferencing in online instruction towards the null hypothesis (LeMotte, 2021; Sibai, 2005). The role of web-conferencing as a tool for creating social and teaching presence relies heavily on its technological affordances of promoting live interaction and collaboration (Cornelius, 2014; Martin & Parker, 2014; Stover et al., 2014). However, the technological aspects of web-conferencing are where most of the barriers of using it in online instruction can be found (Cornelius, 2014; Kozar, 2016; Lewis et al., 2020). While this would help explain the negative confounding effect of *PerceptionScore3* on *PerceptionScore2*, it provides a good example of how an innovation’s perceived “complexity” can affect or be related to its perceived “relative advantage,” which may be a potential research topic for innovation adoption researchers.

CONCLUSION

The logistic regression analyses in this study revealed that college online instructors’ perception of instructional benefits of web-conferencing (*PerceptionScore1*), perception of web-conferencing as a tool for creating social presence and teaching presence (*PerceptionScore2*), and perception of barriers of using web-conferencing (*PerceptionScore3*) are significant predictors of the probability of adopting

web-conferencing in online instruction. The study quantified the change in the odds of adopting web-conferencing with one unit increase in *PerceptionScore1*, *PerceptionScore2*, or *PerceptionScore3*. The findings yielded in this study provided empirical evidence that supports Rogers' (2003) theory about how an innovation's perceived characteristics in "relative advantage" and "complexity" will affect the adoption decision of the innovation. Further, the findings serve to enrich the theory by shedding light on how these perceived characteristics may interact to affect adoption decision.

Practical implications of these findings are that the adoption of web-conferencing can be promoted by helping online instructors (1) learn more about web-conferencing and its affordances as an online instructional tool; (2) become more knowledgeable about the benefits and affordances of using web-conferencing to create social and teaching presence in online learning environments; and (3) overcome barriers of using web-conferencing in online instruction.

A limitation of this study was that it did not include online instructors' perceptions of "compatibility," "trialability," and "observability" of web-conferencing in its research scope. But the relationship or interrelatedness of the two characteristics (i.e., "relative advantage" and "complexity") of web-conferencing as revealed in this study highlights the need for future adoption research to fill the gap in our understanding of the mechanism of how the five characteristics of an innovation interact to affect adoption decision.

This study was conducted before the COVID-19 pandemic catapulted education to an online platform. During the pandemic, many educators were forced to choose web-conferencing as a substitution for face-to-face teaching. This change may generate enough information for college instructors to perceive the "trialability" and "observability" characteristics of web-conferencing, consequently making it possible for innovation adoption researchers to investigate how perceived "trialability" and "observability" will affect adoption of web-conferencing and how they will interact with perceived "relative advantage" and "complexity" to determine college online instructors' decision of adopting web-conferencing.

Logistic regression serves as a good statistical technique for approaching web-conferencing adoption or other innovation adoption from a binary perspective (adopting vs. not adopting). However, other quantitative and/or qualitative research methods should be adopted to capture the nuances along the adoption continuum from adopters (including innovators, early adopters, early majority, late majority, and laggards) (Rogers, 2003) to non-adopters that fall beyond the applicability scope of logistic regression. Additionally, it is envisioned that future research will include the perceived characteristics of "compatibility," "trialability," and "observability" in its investigation to provide educators with new insights into the adoption of web-conferencing or any other innovations in online teaching and learning.

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