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## Conference Paper

# Assessing Digital Divides in Higher Education During the Covid-19 Pandemic: Exploring an Evaluating E-learning System Success Model

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Assessing Digital Divides in Higher Education During the Covid-19 Pandemic: Exploring an

Evaluating E-learning System Success Model

Brett Payton, Laura Gomez Auriolos

### Abstract

The global transition to online classes in higher education during the COVID-19 pandemic gave researchers the opportunity to evaluate eLearning in ways never before possible. This study extends a model for Evaluating eLearning System Success (EESS) and uses an information systems approach to explore the issue of digital divides within higher education during the global push to online learning.

Preliminary findings suggest that instructor quality, learner quality, socioemotional support from university staff and classmates, as well as levels of stress all significantly contribute to evaluation of eLearning systems success by students, whereas technical system quality, information quality, service quality, educational system quality, support system, and feature use do not. This suggests a very different scenario presented by the transition to online classes during COVID-19 than is found in literature regarding eLearning system evaluation.

At the same time, socioeconomic status (SES) was found to be a statistically significant predictor for all factors contributing to eLearning evaluation, meaning the global push to online classes likely benefitted students of higher SES more than those of lower SES. This may have therefore contributed to digital divides within global higher education and have implication for future global inequality.

*Keywords:* eLearning, Higher Education, digital inequality, COVID-19 Pandemic

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The knowledge gap hypothesis states that mass media tends to disseminate information more rapidly and effectively for those with a higher socio-economic status than those with a lower socio-economic status, thus increasing gaps in knowledge and power (Moore, 1987) rather than reducing disparity (Tichenor et al., 1970). A meta-analysis of knowledge gap research over thirty-five years (Hwang & Jeong, 2009) showed that level of education has been shown to be strongly correlated with level of knowledge but that media publicity has not been shown to increase knowledge gaps generally over time. An important caveat is that some gaps do exist or widen more based on the knowledge topic i.e., science and health knowledge gaps are larger than social-political knowledge; settings i.e., gaps in knowledge increasing the less local and more international the setting is; and the type of knowledge i.e., large gaps in awareness but less in belief-knowledge (2009). These findings have implications for inequality in both education and mass media because education level is consistently correlated with socio-economic status, while, historically, mass media consumption is not.

An outgrowth of the knowledge gap hypothesis has been the concept of digital divides, which emphasizes the importance of looking at who exactly benefits from digital technologies, who does not, and why (Rogers, 2001). Ultimately, the goal is to illuminate disparities and develop solutions to reduce them. This is a multi-faceted issue, which includes unequal access, learning divides, content divides, and socio-economic divides. Mason and Hacker (2003) suggest communication theories such as structurization theory and diffusion of innovations offer deeper insight into digital divides and societal implications because information and communication technology is supposed to increase certain resources of the users. Social networking and

information processing are resources highly valued by the information society (Castells 2000; van Dijk 1999). E-learning systems should thus be at the forefront of discussions on both knowledge gaps and digital divides because of the combined purpose of information processing inherent in the technology and the instrumental nature of the technology in raising the level of education of users.

The focus on e-learning systems and inequality aligns with a variety of approaches to international development studies that emphasize the importance of both education and ICT in economic development, political development, cultural development and alternative development. Chabbott and Ramirez (2000) detail the commonly studied correlation between education and these various forms of development but note that the relationship runs both ways i.e., transformation of higher education from elite institutions to mass education models has also been shown to increase various development indicators. There is strong evidence educational attainment is highly correlated with both socio-economic inequality and digital divides (Cruz-Jesus et al., 2016). Therefore, digital divides regarding e-learning systems within higher education, specifically, have implications for global inequality.

Although e-learning is a highly-researched topic, it has rarely been studied as a form of mass education, similar to the way mass media has been studied regarding knowledge gaps. This is likely for a few reasons. First, e-learning had yet to reach what in diffusion of innovations theory is called critical mass, that is, a self-sustaining adoption of a technology without the need for change agents (Rogers, 2003), in higher education. Although certain features of eLearning systems have been adopted on a large scale in some universities and in some places in the world, transition to completely online classes within higher education globally had never happened, greatly limiting the impact of eLearning systems on university students around the globe.

Second, the factors which impact adoption and success have been difficult to measure in mixed environments, where eLearning is a supplement to face to face classes and in situations where use is largely determined by universities or individual teachers, rather than university students. Finally, the subfield of development, ICT for Development (ICT4D), which is focused on ICT use specifically for development is largely interested in research related to social sectors and NGO and non-profit development projects, rather than issues related to higher education. All this has left a gap in literature looking specifically at how eLearning system use in higher education may be affecting digital divides globally, especially as the mass education model for higher education continues to expand.

The obvious initial barrier to such research has been the relatively slow or sporadic adoption of eLearning systems within higher education around the world. The COV-19 pandemic has presented several opportunities in this regard. First, it represents the first completely mandatory adoption scenario within traditional university degree programs at an international scale. This is unique because online degree programs are generally offered to “non-traditional” students as part of “non-traditional” degree programs, thus confining results to those already predisposed to online learning or taking online classes out of necessity. This is the first time online learning can be assessed by “traditional students” attending “traditional” degree programs that were expecting and paying for an offline learning environment.

Price differences, as well as expectations, have been shown to be different for online versus offline learning and there is significant evidence that lower and middle-income countries have been much slower to adopt eLearning. These are important factors when considering discussion of digital divides within global higher education. Mandatory adoption at the global scale during the Covid-19 pandemic could mean that digital divides in global education are

compounding other issues with global inequality in educational opportunity and success for individuals, and development at the national level.

This study represents an effort to formulate a way to measure e-learning system success in the context of a global push to online learning in higher education during the Covid-19 pandemic. To do this, an applicable existing model is first extended and reexamined, given the unique context of a pandemic and widespread mandatory adoption. This model is then tested for model fitness using Structural Equation Modeling (SEM) from an initial sample (n=250) of university students from around the world. Next, preliminary analysis of this initial sample is used to probe which factors may be contributing most to difference in outcomes in e-learning success for students based on socio-economic status and home country.

## **Literature Review**

### **Digital Divides in Higher Education**

Online learning has been praised as a possible way of reducing existing inequalities in higher education by allowing greater access to quality education regardless of location; making higher education more affordable (Deming et al., 2015), changing expectations of students as consumers; increased cost savings for students telecommuting versus commuting; and greater flexibility of schedules, which allows certain barriers to be reduced for adult learners and students who simultaneously work jobs.

Nevertheless, online learning has yet to become the global norm for obtaining official degrees from accredited universities. In this way, online learning has yet to be included within indicators measuring educational attainment in digital divide studies. The issues with “techno-positivism” related to online learning in higher education have also been well documented (Njenga & Fourie, 2010). Online learning in traditional higher education degree programs has

mostly been implemented as value-added tools rather than a commitment to a full transition. Although there are increasing numbers of online degrees available, comparing the benefits of the same degrees offered offline and online on a large scale has not been possible. What is more, the digital divide within higher education at the country-level is also well documented. Universities in developing countries have generally been slower to adopt online learning in their degree programs and there is evidence of more barriers for teachers (Rasmitadila et al., 2020), greater barriers for students (Baticulon et al., 2021) and lagging internet adoption overall (Adnan & Anwar, 2020).

Which segments of students are negatively or positively affected by these changes has important implications. If findings pointing to digital divides within higher education hold true, the COV-19 pandemic may have intensified inequality both within countries and between countries. If, however, widespread mandatory adoption created an environment in which the benefits of online learning for traditional students of lower socio-economic status or from developing countries increased at a similar level as other students, it may have helped close digital divides within higher education globally and would mean it may have had a significant impact on reducing global inequality. This leads us to our first two research questions:

***RQ1a:*** *Did the mandatory adoption of online learning by universities around the world during the COV-19 pandemic have significantly different effects based on socio-economic status?*

***RQ1b:*** *Did the mandatory adoption of online learning by universities around the world during the COV-19 pandemic have significantly different effects on students from countries with different levels of economic development?*



## **Applicable Models for Evaluating eLearning Systems Success during a Pandemic**

### ***The Information Systems Approach***

Online learning is a generalized term that encompasses e-Learning, distance learning, online learning platforms, learning management systems, training management systems, asynchronous learning networks, etc. These terms all emphasize slightly different aspects of online learning as implementation of information systems that use the internet/intranet and some form of computer for the purpose of learning. At the same time, these terms are sometimes industry specific and may be used for adult education, training and all levels of formal education, from the perspectives of learners, teachers, admin staff, IT staff, and organizations. This represents an information systems approach to online learning that has largely been informed by the fields of information systems, organizational development and communications, using models which look at complex mechanisms involved in both adoption and various conceptualizations of success.

Other studies take an affordance approach to online learning, examining particular affordances related to specific technologies e.g., online discussion forum software (Xin & Feenberg, 2002), audience response systems (Blasco-Arcas et al., 2013) or mobile devices (Podder et al., 2016); aspects of time e.g., asynchronous versus synchronous learning; pedagogy, e.g., constructivism, gamification or pedagogical agents; or social aspects (McArdle et al., 2008) e.g., social networking during online learning (Russo & Koesten, 2005) or communities of practice (Hajisoteriou et al., 2018). These studies are mainly done from the perspectives of students as learners or teachers as educators within the field of education, and thus differ from an information systems approach in their focus and conceptualization of terms.

For this study, we are interested specifically in online classes offered at universities during the Covid-19 pandemic, as eLearning systems which are comprised of various online distance learning technologies to replace face-to-face classes offered at traditional brick-and-mortar universities. The goal is to explore mechanisms which have affected the success of such eLearning systems, as they were actually implemented, during a time of crises and forced adoption globally. These mechanisms and criteria for success have been thoroughly explored within the information systems approach and will therefore largely be drawn from there. However, there are a few important additions needed, which will be outlined later.

The main advantage of an information systems approach is that it allows researchers to explore larger trends in adoption, use and effects because it conceptualizes online learning as a single type of information system where different pedagogical approaches are employed within diverse socio-cultural situations which may utilize a large range of technologies implemented in various ways. In this way, it allows space for the diversity found within higher education. For online learning at universities around the world during the COV-19 pandemic, this is an especially useful approach because it provides a more generalized framework that focuses on how digital technologies are implemented in real world scenarios and the effects on users. This is a pertinent method for exploring possible digital divides in such a diverse setting as higher education.

The quality of education is an important but separate issue, one more rooted in pedagogical debates within the field of education. Entirely different constructs are used to assess desired learning outcomes. Information systems approaches are technology centric and traditionally used by organizations to analyze the value, advantages and disadvantages of technology implementation from the perspective of user attitudes and behaviors. Therefore, this

approach also provides a way for universities, as organizations, to better evaluate eLearning system implementation success overall, but specifically during mandatory adoption scenarios such as the COV-19 pandemic, from the perspective of students, as both learners and consumers.

### *Contributions to a Generalized IS Model for Evaluating eLearning Systems*

Standard diffusion-based models, such as the Technology Adoption Model (TAM) and the Unified Theory of Use and Acceptance of Technology (UTUAT) have been employed to understand adoption and use of e-learning (Abdullah & Ward, 2016), mobile learning (Chao, 2019) and Learning Management Systems (Sinclair & Aho, 2018). Venkatesh and Bala (2008) argue that complex models such as TAM 3 offer a comprehensive list of factors which should be considered during both pre-implementation and post-implementation phases of IT rollouts, which is what is ultimately needed to help with and understand the move from traditional face-to-face classes to online classes at universities during the pandemic.

Such models have been shown to be technology and context specific, requiring specialized extended models for application to online learning. Abdulah and Ward (2016) provide a comprehensive overview of TAM model studies related to e-Learning and provide a General Extended Technology Acceptance Model for E-Learning (GETAMEL). Online learning has mostly been studied within voluntary adoption scenarios, for the purpose of understanding why teachers or students choose to use online learning tools either within traditional classrooms, as part of blended learning environments, or enroll in online courses that are generally offered outside of traditional universities.

Teachers, students, and administrators around the world may still have little to no experience using a completely online educational environment. Previous experience is one of the biggest predictors of positive attitudes towards online learning (Abdullah & Ward, 2016),

suggesting that global attitudes towards online learning will be more positive for students already familiar with online learning and much less positive for less experienced. As was noted earlier, this might magnify a disparity in attitude between students coming from lower socio-economic backgrounds or from low or lower-middle income countries. Additionally, factors such as organizational support (Venkatesh & Bala, 2008), subjective norms, self-efficacy, enjoyment, and technology anxiety (Abdullah & Ward, 2016) have all been shown to be significant determinants of attitudes and use of online learning technologies.

Although the factors influencing attitudes and use are comprehensive in such models, there is an inherent issue with measuring success as intention to use or actual use when this is no longer a voluntary decision on the part of the user. Literature specific to online learning technology adoption generally assumes voluntary adoption scenarios because it has largely been a voluntary choice on the part of departments, teachers, and/or students as a value-added tool. Therefore, although these models are excellent at predicting intentions or use as a desired outcome, they are not necessarily applicable to mandatory adoption scenarios, meaning situations where admin, teachers and students are forced to use online learning as the only option, such as during the global COV-19 pandemic. What is more, it has been suggested that eLearning system use by students, as users of e-learning systems, is almost never actually voluntary and it usually dictated by either individual teachers or departmental policy (Eom et al., 2012).

A recent systematic literature review of the Information System Success (ISS) model found that e-Learning was the second most common type of information system the model was used for (Al-Kofahi et al., 2020). The updated version of this model includes Information Quality, System Quality, Service Quality as correlated with Intention to Use, Use, and User

Satisfaction, which in turn is correlated with Net Benefits (DeLone & McLean, 2003). DeLone and McLean explicitly say the association between intention to use, use, user satisfaction and net benefits are not necessarily causal and relationships may be complex. An additional important caveat is that some studies have found the ISS model to have limited predictive power in mandatory or quasi-voluntary scenarios. Extensions of the TAM model, such as Tam2 (Venkatesh & Davis, 2000) added level of voluntariness as a factor, specifically for this reason.

Nevertheless, the ISS model contributes a few important factors to a generalized IS model. Information quality, in the context of online learning refers to the actual content generated during classes (Mohammadi, 2015). This has been shown to be highly correlated with information system use and satisfaction in online learning (2015). In the same vein, service quality and system quality have been shown to consistently affect use and satisfaction (DeLone & McLean, 2003). However, in the context of online learning, these have had to be modified to better reflect online learning systems.

Finally, a comprehensive model for Evaluating eLearning System Success (EESS) was introduced and validated in 2020 (Al-Fraihat et al.). This represents an important contribution to developing an e-learning system specific model. For one, this model is useful for universities, as organizations which benefit from understanding important factors contributing to the success and benefits of proper eLearning system implementation. Second, the model is also useful as a generalized model for measuring eLearning system effects at a much larger scale than the individual university level. Largescale effects of eLearning technology implemented as a mass education technology has yielded little empirical academic research as of yet, although there is considerable industry-led research being conducted by industry leaders.

The EESS model combines all factors from typical models in an integrated conceptual framework (please see full model and adjustments for this study in Figure 1). This model will be used for this study because the comprehensiveness of factors as well as the focus on system success, rather than adoption factors. At the same time, learning in a time of national crises, such as during a pandemic, presents special challenges to both students and educators, which may affect both implementation and outcomes. This necessitates the need to consider additional factors which may severely impact the success of online learning in such situations.

### *Adjusting the EESS Model to the Covid-19 Pandemic Situation*

#### *Reconceptualizing Use*

Overall adoption of eLearning systems at both national levels and university levels became mandatory as universities around the globe closed their classroom doors to limit the spread of COV-19. However, actual implementation of online learning within this mandatory adoption scenario was likely very diverse. Many universities, especially ones in high income countries like the US, already implement learning management systems such as Canvas, and thus only required teachers and admin staff to use more of these system features, especially online video streaming of classes, more often than they might have before. On the other hand, some universities or teachers may have been using such systems and features for the first time. Universities may place the responsibility on teachers to implement online learning technologies for their classes without any university-level policies or standardized implementation.

While the pandemic catalyzed rapid adoption of online learning at both national levels and university levels, implementation as actual use of certain features is still more likely to have been based on class or department level decisions driven by administrators or teachers themselves. As previously stated, students themselves do not necessarily choose exactly how to

use online learning systems, even when overall use is mandatory. This highlights the need to look at more facets of actual use of online learning as features than is generally present in IS approaches in the literature. It is especially important to understand which e-learning features in systems are used and to what effect when eLearning systems are meant to be a complete substitution for traditional face-to-face classes and communication with teachers and administrative staff/university. Furthermore overall system use, as it is usually measured, has been shown to have no correlation, some correlation or strong correlation depending on the situation (Al-Fraihat et al., 2020). Feature use may play a part in the inconsistency of findings.

Since most prevalent E-learning systems used in higher education have robust sets of features as a standard, availability of features will not likely fluctuate much between e-learning systems. So rather than including feature lists as an indicator of system quality, feature use, as a separate construct, should yield more insight into how exactly use affects e-learning success. At the same time, feature use is not necessarily an indicator of success and might depend on the learning objectives, subject of the class, or teaching methodology. For the most part, studies usually focus on either one specific technology, such as Wikis, or on e-Learning as an entire information system (Abdullah & Ward, 2016). This study uses a full list of common features. The idea here is that general use of eLearning systems will not vary much in this mandatory adoption scenario, but actual use of features will likely vary a great deal and is worth exploring. This leads to the following research question:

RQ2: Does use of different features impact online learning success differently?

### *Psychological Stress as an element of Learner Quality*

Technology anxiety has consistently been shown to affect adoption and intention to use (Abdullah & Ward, 2016). The transition to online learning has also been shown to be a source of

heightened stress for medical students (Mohammad et al., 2020). However, the effects of other forms of stress have not been adequately studied in the eLearning literature. Stress, anxiety and depression were found to be elevated globally (Shah et al., 2021) and specifically in university students during the Covid-19 pandemic (Debowska et al., 2020; Husky et al., 2020; Padrón et al., 2021; Sun et al., 2021). Unfortunately, stress related to lower socio-economic status has also been shown to have increased for university students during Covid-19 in Bangladesh (Islam et al., 2020).

Negative effects of increased levels of stress in university students has been shown to cause things like reduced enthusiasm for learning in medical students (Ye et al., 2020) and affect academic experience overall (Dodd et al., 2021). However, literature could not be found as to the effects of overall stress and stress from a variety of different effects on e-learning success. As classes transitioned entirely online, the way in which stress related to academic experience, lower socio-economic status, and the pandemic may also have had a significant impact on the perceived satisfaction or benefits of e-learning for students. To fit into the conceptual model of the EESS model, this may be considered a dimension of learner quality, since it is an individual psychological state of the learner.

RQ3: Does level of stress (as a dimension of learn quality) significantly correlate with eLearning system success?

### *Social Support as an Expansion of Support System Quality*

Finally, Support System Quality as presented in Al-Fraihat et al's (2020) study is theoretically unclear as a construct. It includes, norms and encouragement from the university, as



well as supportive issues such as ethics, policies data protection and legal and copyright issues. It is not clear exactly how the listed supportive issues affect e-learning success, although it was empirically supported, as measured in at least one study (Al-Fraihat et al., 2020).

A great deal of empirical evidence has shown that encouragement from the university and norms predict use and satisfaction (2020). However, since use is mandatory, norms and popularity will have little to do with use in a mandatory adoption scenario. What is important in the model is the possible effects on eLearning system evaluation. Because this was a transition to completely online classes and included a transition to being a university student online, not just using some e-learning features for learning, social support may play an important role in evaluation.

The social elements of online learning in regard to social learning is well documented. However, the role of social support provided in a classroom and university environment has received less attention. For university students affected by pandemic restrictions, this may have played a role in eLearning system evaluation, if there were expectations to receive social support from university staff and classmates. Social support is often divided into instrumental support and socioemotional support (Ong & Ward, 2005). Support system quality is conceptually very similar to instrumental support provided as a service by universities. Therefore, socio-emotional support may be a natural extension of the support system quality construct.

The literature tends to ignore the role online systems can play in administration and support of students. The reason for this may be because admin and support are usually carried out outside of classroom time and not considered part of learning, but administration. However, in a time when university campuses are shut down, the use of online communication and services delivered online may play a crucial role in the success of students. This should include support to

use the online systems for learning, as well ways in which the university communicates policies, encourages community, offers physical and mental health services and carries out administrative duties. The transition to completely online attendance at universities expands eLearning systems from just learning-focused features to online education as a more comprehensive service that universities provide students. The inclusion of social support is a move in this direction but needs to be studied in greater depth.

Social support will be included specifically because it has implications regarding digital divides in higher education. Digital divides in higher education might not just be exacerbating inequalities in information service provision, but also in tertiary services provision that may also impact student success in a variety of ways. For students of lower socioeconomic status and from lower income countries, these aspects of universities may play an even more important part in their education, since they may be affected by a greater number of barriers to their education (Muilenburg & Berge, 2005) and a greater variety of sources of stress (Islam et al., 2020). Social support, specifically, has been shown to be a key protective factor for psychiatric symptoms for university students during the COV-19 pandemic (Sun et al., 2021). This leads us to our final research questions:

RQ4: Does socioemotional support (as an expansion of support system quality) significantly correlate with eLearning system success?

H1: The proposed model for Evaluating E-learning System Success (EESS) during the COVID-19 pandemic significantly predicts eLearning system success?

## Methods

### Measures

Measures for technical service quality, Information Quality, Service Quality, Educational System Quality, Instructor Quality, Learner Quality, and Support system use are taken from Al-Fraihat, Joy, Masa'deh, and Sincliar (2020). However, a few important additions were made. Three items from Abdullah and Ward (2016) were added to Information Quality with the potential of making a stronger measurement. The 2016 study found that these items were the most commonly used in studies of E-learning acceptance and were missing from the 2020 study. All questions were asked on a 7-point likert scale, with 1 being strongly disagree to 7 strongly agree. The three additional items included were: "Overall, the level of difficulty of the information was appropriate; overall, the information was easy to understand; and generally, the amount of information was appropriate." Since the instruments for the EESS model were all validated using CFA and SEM, items for each construct were combined to create a single-item measurement to be used for path analysis.

Additionally, support system quality was expanded from the construct and measurements used in the EESS model to include another dimension for social support, including a version of the perceived social support scale (Zimet et al., 1988) for the socioemotional aspects of the support system at a university. This included items aimed at measuring socioemotional support from university staff and classmates.

Learner Quality was expanded to include a dimension related to psychological stress. For psychological stress, a single-item measure was used from the Occupational Stress Questionnaire (Elo et al., 2003) and a list of sources of stress were asked that are thought to be applicable to university students during a pandemic. These included stress related to one's health or the health

of others; economic concerns; relationships; social distancing, quarantining or stores and public spaces being closed; violence or social unrest; accessing food or electricity; accessing affordable health care; disruptions to online learning; attending university classes; and having classes online rather than a classroom.

Feature use was measured using questions asking the respondent to identify how often they used various technological features on a 5-point scale, from 1 being never used to 5 being heavily used (several times a week). Typical features of learning management systems were included i.e., real-time online class sessions through video conferencing; discussion boards, email, group chats or social media; filesharing; online quizzes or polls; online assignments; and online notifications. This allows for the effects of individual feature use to be measured separately, but also for the average of all feature use to be used as a more accurate assessment of system use than a single or dual item measurement for use that is most commonly used in TAM models. However, because features were all listed separately, the averaged frequency of use of all features is really measuring the variety of system use along with the frequency, meaning a high score indicates that a large variety of features were being used often, while a low score would indicate either a small variety of features were used or that several features were used seldomly. Both of these would indicate less system use but in different ways.

Socio-economic status was measured with a single item which asked respondents to classify their families into lower/working class, lower-middle class, middle class, upper-middle class or upper class. Specific income brackets were not included because, since the survey was distributed internationally, the variation of income cutoffs between countries would make this difficult to calculate, university students likely would not accurately report the income of their entire families, and university students themselves have not necessarily entered the workforce

and thus real income level would not likely indicate social class. However, to further measure SES related to digital divides, respondents were asked to identify the highest level of education of their highest educated parent and whether they grew up in an urban, suburban or rural environment.

Country-level economic development status was measured with a question asking the students which country they are a citizen of and then recoding each country according to the World Bank's World Development Indicators for country GNI. This measurement categorizes countries into low income, lower-middle income, upper middle income, and high income.

### **Sample**

An initial online survey was conducted using MTURK. MTURK is commonly used for such research on attitudes and use of technology. It is especially useful for getting an international sample of university students, which was needed for this study. A total of 301 responses were received. A preliminary analysis of missing data and unengaged responses yielded 250 responses considered valid for further analysis. The demographic information for the sample is shown in Table 1. Further rounds of sampling will be used to gather a much larger and more representative sample in the future.

### **Preliminary Analysis and Results**

The final two research questions (RQ2, RQ4) ask about the explanatory power of psychological stress and socioemotional support from university staff and classmates in the evaluation of eLearning system success. To do this, stress and socioemotional support were included into a model in AMOS and a path analysis was conducted to determine which variables best contributed to the model.

First, the overall model fit, using a maximum likelihood model, was poor  $F(11, 78) = 83.585, p < .0001$ ), according to the standard model fit summary. With path analysis, a lower chi-square that is statistically insignificant indicates a good model-fit. However, this could be largely because of the complexity of the model (10 independent variables) and a small sample size ( $n=250$ ). Other ways of calculating goodness of fit suggest a better model fit. The Goodness of Fit Index (GFI) is .949, which is higher than .9 and indicates a good model fit. The AFGI and PFGI were much lower, .582 and .115 respectively, suggesting the number of parameters and number of paths explain the low model-fit with other standard measurements. Finally, the Normed Fixed Index (NFI=.977) and the Comparative Fit Index (CFI=.979) were both higher than the suggested cutoff of .95, which may be the best indicator of model fitness for the given model, due to these indicators comparing the default model to the independence model, rather than just the saturated model, especially appropriate for small sample sizes. In conclusion, the path model was deemed to be an overall good fit, although a larger sample size and combining some of the indicators into multidimensional factors may be a better way of accurately assessing goodness of fit for the model.

Results of the path model analysis are shown below in Table 2. Regarding stress, there was a statistically significant positive correlation with perceived usefulness  $r^2=.083, (p=.028)$  and a statistically significant negative correlation with satisfaction  $r^2=-.085, (p<.001)$ . For socioemotional support, there was a statistically significant positive relationship with satisfaction  $r^2=.199, (p=.006)$  and perceived usefulness  $r^2=.296, (p<.001)$ . Essentially, as overall stress levels went up, the level of satisfaction went down but perceived usefulness went up and the more socioemotional support a student felt from the university staff and classmates, the more they were satisfied with the eLearning systems and perceived them to be useful. In answer to RQ3

and RQ4, these results indicate the importance of both heightened levels of stress and greater socioemotional support during the transition to online classes at universities around the world during the Covid-19 pandemic.

For RQ2, system use was explored in two different ways. First, in the path model analysis, feature use was measured as the average frequency of use of each feature. As stated

Table 2

Maximum Likelihood Estimates:

Variables	Estimate	S.E.	Sig.
persat <--- tsqual	.044	.100	.664
persat <--- infqual	-.056	.110	.613
persat <--- serqual	.090	.065	.166
persat <--- edsqual	.041	.091	.653
persat <--- supsys	.070	.060	.246
persat <--- soemsup	.199	.073	.006
peruse <--- edsqual	.108	.089	.222
peruse <--- supsys	.016	.059	.792
peruse <--- soemsup	.296	.071	***
peruse <--- lnqual	.429	.065	***
peruse <--- insqual	.355	.090	***
peruse <--- featuse	-.130	.077	.094
peruse <--- stress1	.083	.038	.028
peruse <--- tsqual	-.088	.098	.369
peruse <--- infqual	-.046	.108	.671
peruse <--- serqual	-.057	.063	.364
persat <--- lnqual	.444	.067	***
persat <--- insqual	.352	.092	***
persat <--- featuse	-.120	.079	.131
persat <--- stress1	-.085	.039	<a href="#">.028</a>
bnfts <--- persat	.487	.032	***
bnfts <--- peruse	.350	.035	***

Note: \*\*\* <.001

before, this item is actually measuring overall system use as both frequency and variety of features used. Using this averaged indicator, overall system use did not have a statistically significant correlation with either satisfaction ( $p=.131$ ) or perceived ease of use ( $p=.094$ ).

Feature use was then probed to see if there was a difference in the impact according to specific features. To do this, a stepwise linear regression was run to see if greater frequency of use of certain features were more significantly positively correlated with greater satisfaction and perceived usefulness. For satisfaction, a model which included “real-time class sessions via video conferencing”, “discussion boards, email, group chats or social media”, and “take online quizzes or polls” yielded  $F(3,246)=14.361$ ,  $p<.001$ ,  $R^2$  of .149. For perceived usefulness, the same three features comprised the best model,  $F(3,246)=18.942$ ,  $p<.001$ ,  $R^2$  of .163. See table 3 for individual coefficients.

Therefore, for RQ2 although overall system use as the average of different feature uses was not significantly correlated with satisfaction and perceived usefulness, greater use of three individual features, namely real-time class sessions via video conferencing, discussion boards and online chatgroups, and online quizzes or polls, were all significantly correlated with both satisfaction and perceived usefulness.

The guiding research question RQ1 deals with the possible moderating role socioeconomic status or the economic status of an individual student’s home country has on eLearning system evaluation. In order to explore this question a few tests were used. First, a simple linear regression was run to see if either socioeconomic status or country-level level of economic development were positively correlated with satisfaction, perceived usefulness or benefits. While controlling for the demographics variables of age and gender, SES was significantly positively correlated with satisfaction  $F(3,246)=8.719$ ,  $p=.001$ ,  $\Delta R^2$  of .062, perceived usefulness  $F(3,246)=5.732$ ,  $p=.006$ ,  $\Delta R^2$  of .047, benefits  $F(3,246)=4.378$ ,  $p=.005$ ,  $\Delta R^2$  of .05. However, the country-level level of economic development was not correlated with any of these outcomes in a statistically significant way.



In order to probe which predictors are correlated with SES, several linear regression models were run. When controlling for the demographic variables of age and gender, technical system quality  $F(3,246)=5.923$ ,  $p=.001$ ,  $\Delta R^2$  of .060, information quality  $F(3,246)=4.833$ ,  $p=.003$ ,  $\Delta R^2$  of .051, Service Quality  $F(3,246)=4.322$ ,  $p=.005$ ,  $\Delta R^2$  of .045, educational system quality  $F(3,246)=3.456$ ,  $p=.017$ ,  $\Delta R^2$  of .032, support system quality  $F(3,246)=4.233$ ,  $p=.006$ ,  $\Delta R^2$  of .043, socioemotional support  $F(3,246)=8.791$ ,  $p<.001$ ,  $\Delta R^2$  of .094, learner quality  $F(3,246)=3.202$ ,  $p=.002$ ,  $\Delta R^2$  of .037, instructor quality  $F(3,246)=4.667$ ,  $p=.003$ ,  $\Delta R^2$  of .048, and stress  $F(3,246)=3.326$ ,  $p=.004$ ,  $\Delta R^2$  of .034.

Although SES only explains from about 3% to 6% of variance in each of these factors, the trends are clear. Socioeconomic status does seem to play a significant role in influencing the evaluation of eLearning systems around the world. However, it doesn't seem to matter which country the student comes from, meaning country-level divides within higher education might not have been as big of a problem as domestic inequality in the transition to online learning around the globe during the Covid-19 pandemic.

### **Discussion**

The EESS model did not perform as well as expected. However, the findings of this study highlight a few important things in evaluating e-learning systems during the transition to fully online classes during the COVID-19 pandemic around the world. The most important factors in determining positive evaluations of satisfaction were socioemotional support ( $r^2$  of .199,  $p=.006$ ), learner quality ( $r^2$  of .444,  $p<.001$ ), instructor quality ( $r^2$  of .352,  $p<.001$ ) and stress ( $r^2$  of -.085,  $p=.028$ ). For perceived usefulness, the most important predicting factors were socioemotional support ( $r^2$  of .296,  $p<.001$ ), learner quality ( $r^2$  of .429,  $p<.001$ ), instructor quality ( $r^2$  of .355,  $p<.001$ ), and stress ( $r^2$  of .083,  $p<.028$ ).

A few interesting conclusions may be drawn from these results but should be put into context first. First, this study represents an attempt to utilize a single student sample from around the world to test an EESS model that looks at a mandatory transition to fully online classes for traditional university students. Generally, eLearning models assess use of very specific features or specific eLearning platforms e.g., moodle, in situations that are voluntary for either the students or the instructors. Furthermore, the situation created by the pandemic heightened levels of stress for students and might explain the large predictive power of socio-emotional support and stress.

However, there is a noticeable lack of explanatory power for technical system quality, suggesting the technical systems utilized for eLearning are all quite standardized and of decent quality, thus not affecting the evaluation of the eLearning systems by students. It's possible information quality, educational system quality, service quality and support system quality are not statistically significant predictors of satisfaction, or perceived usefulness because variations in these are attributed to either the instructors or the university rather than the eLearning system. At the same time, instructor quality was highly correlated with both satisfaction and perceived usefulness.

These findings all point to the importance of instructors in transitioning to fully online classes. Similarly, the largest predictor of satisfaction and perceived usefulness being learner quality suggests efforts to create good attitudes towards eLearning and foster self-efficacy will continue to be important as traditional degree programs continue to migrate online. The findings also highlight the importance of socioemotional support for traditional students. This is worth exploring in more depth and has not been touched upon by any of the reviewed literature. University students may either need or expect socioemotional support from university staff and

classmates as part of their formal education. The social aspects of online learning that are not directly related to information processing are worthy of further exploration. Just as students might enjoy and benefit from attending university in ways not specifically related to learning, the use of eLearning systems to help fulfill some of these needs should be considered.

Finally, preliminary findings show that socioeconomic status is an important factor in evaluating eLearning systems success, meaning the transition to online learning during the COVID-19 pandemic has likely benefitted those of higher socioeconomic status significantly more than those of lower socioeconomic status. Although there is promise of eLearning to help close gaps in educational success, this has possibly yet to manifest on a large scale within higher education. This study only dealt with possible digital divides within higher education in terms of different levels of success of eLearning systems according to SES for existing students.

The educational divides and digital divides around the world are much greater if measured by who actually has access to higher education and digital technologies needed for eLearning in the first place. Although there is an increasingly mass higher-education model developing around the world, if attention is not also paid to how socioeconomic status affects eLearning success, inequality will continue to grow as a result of digital exclusion within higher education. However, one interesting finding was that the level of economic development of a student's home country did not necessarily play a role in evaluating eLearning system success. This could mean that country-level inequality within global higher education may not necessarily be noticeable at the student level. However, much more country-level analysis would be needed to make any significant conclusions in this regard in terms of the educational attainment between countries and the state of higher education in each country. This is well beyond the scope of this study to attempt to draw such conclusions.

There are several other shortcomings of this study in its current form. For one, additional samples are needed to make it closer to a representative sample. The current sample only provides for a preliminary analysis. Second, more robust statistical analysis will be utilized in future versions of the transcript.

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## Tables

Table 1

## Sample Demographics

Characteristic		Frequency	Percent
Gender	Male	176	70.4
	Female	74	29.6
Age	16-20	19	7.6
	21-25	77	30.8
	26-30	57	22.8
	31-35	49	19.6
	36+	48	19.2
Social Class	Lower/Working	6	2.4
	Lower-middle	33	13.2
	Middle	155	62
	Upper Middle	47	18.8
	Upper	9	3.6
Background	Urban	134	53.6
	Suburban	73	29.2
	Rural	41	16.4
Country GNI	Low Income	2	.8
	Lower-middle	25	10
	Upper-middle	31	12.4
	High Income	192	76.8
Year of Study	Year 1	4	1.6
	Year 2	26	10.4
	Year 3	42	16.8
	Year 4	96	38.4
	Master's	64	25.6
	PhD+	18	7.2

*Note:*

Table 2

Maximum Likelihood Estimates:

Variables		Estimate	S.E.	Sig.
persat	<--- tsqual	.044	.100	.664
persat	<--- infqual	-.056	.110	.613
persat	<--- serqual	.090	.065	.166
persat	<--- edsqual	.041	.091	.653
persat	<--- supsys	.070	.060	.246
persat	<--- soemsup	.199	.073	.006
peruse	<--- edsqual	.108	.089	.222
peruse	<--- supsys	.016	.059	.792
peruse	<--- soemsup	.296	.071	***
peruse	<--- lnqual	.429	.065	***
peruse	<--- insqual	.355	.090	***
peruse	<--- featuse	-.130	.077	.094
peruse	<--- stress1	.083	.038	.028
peruse	<--- tsqual	-.088	.098	.369
peruse	<--- infqual	-.046	.108	.671
peruse	<--- serqual	-.057	.063	.364
persat	<--- lnqual	.444	.067	***
persat	<--- insqual	.352	.092	***
persat	<--- featuse	-.120	.079	.131
persat	<--- stress1	-.085	.039	<a href="#">.028</a>
bnfts	<--- persat	.487	.032	***
bnfts	<--- peruse	.350	.035	***

Note: \*\*\* <.001

Figure 1: Multidimensional Conceptual Model for Evaluating Elearning System Success (EESS)



Figure 1. Taken from Al-Fraihat, Joy, Masa'deh, and Sinliar (2020).

Figure 2: Extended Model for Evaluating E-Learning System Success (EESS) During Mandatory Adoption Due to Crises Situations

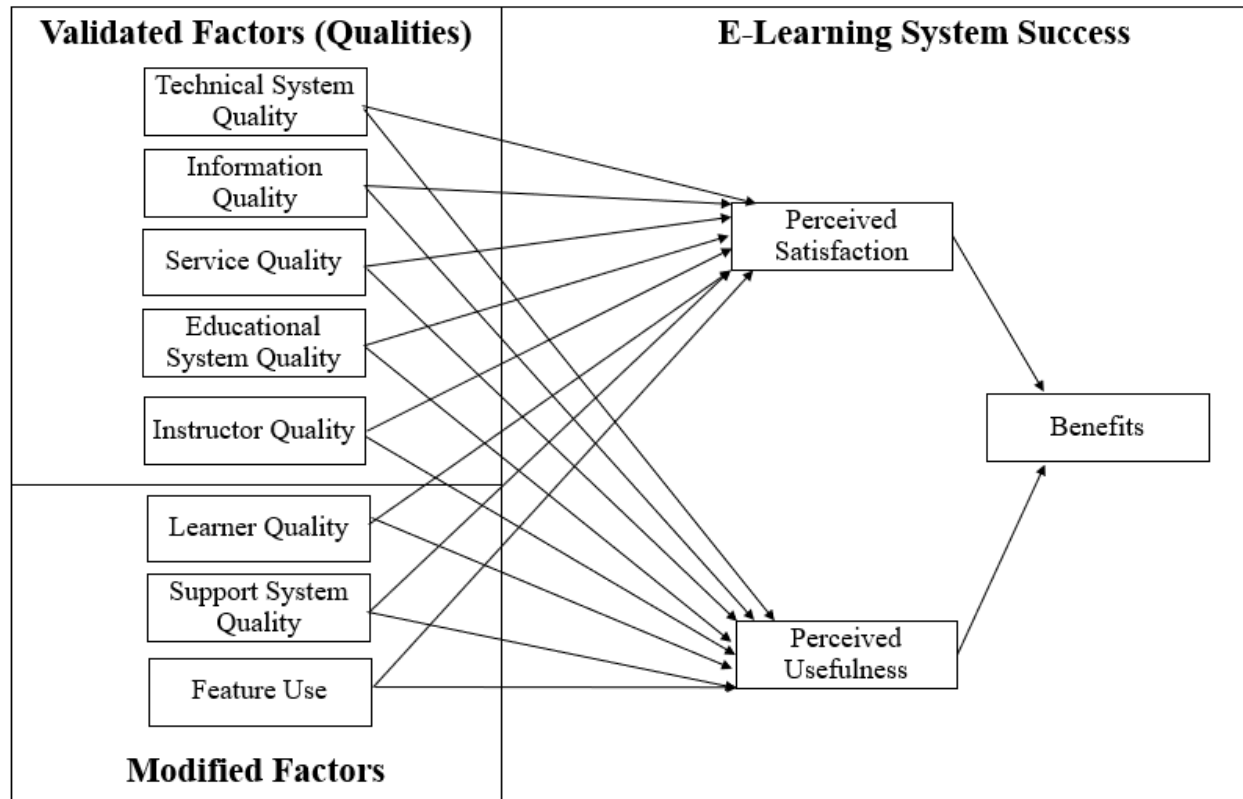


Figure 1. Derived from the EESS model proposed by Al-Fraihat, Joy, Masa'deh, and Sincliar (2020). This model moves “use” from a dependent variable to a predictive factor (independent variable) and changes the construct from a measurement of general system use to a measurement of specific feature use. The multidimensional construct, “Learner Quality” is expanded to include psychological stress as an important dimension during a crises. Finally, “Support System” is reconceptualized to include socioemotional support as an important element of education as a service model.