Predicting undergraduates’ future preferred mode of learning during the closure of institutions of higher learning and its implications

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Abstract
E-learning was abruptly adopted as a strategic response to the sudden closure of institutions of learning induced by the COVID-19 pandemic. In contrast to the conventional voluntary adoption of e-learning, this study aims to explore a new trail by drawing challenges of e-learning eclectically from recent literature to develop an alternative theoretical model of future preferred mode of learning against the background of the sudden closure of institutions of higher learning induced by the COVID-19 pandemic. The theoretical model was validated via an empirical study based on the responses obtained from 352 Malaysian undergraduates. Results from the multinomial regression revealed that the model was significant \((p\text{-value}<0.01)\). Moreover, Information and Communication Technology infrastructure positively predicted whereas bottom 40% household income category and disadvantages of e-learning negatively predicted undergraduates’ future preference for blended learning (relative to 100% conventional classroom learning). Being male and possessing discipline for e-learning positively predicted whereas living in semi-urban area and disadvantages of e-learning negatively predicted undergraduates’ future preference for 100% e-learning (relative to 100% conventional classroom learning). This study adds to the body of knowledge by way of an alternative theoretical model of undergraduates’ future preferred mode of learning, which may facilitate future meta analysis on similarities and differences in challenges related to e-learning during the closure of institutions of higher learning across different countries. This study concludes with some reflective thoughts in terms of theory, practice and policy about one important lesson learned from this unprecedented closure of institutions of higher learning, which is readiness for blended learning to deal with future unexpected crises.

Keywords  E-learning · Future preferred mode of learning · Blended learning · Undergraduates · Closure of institutions of higher learning · Malaysia
Introduction

Public places closure is a primary nonpharmaceutical intervention at the population level to reduce the transmission of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which caused the Coronavirus disease 2019 (COVID-19). Consequently, many institutions of learning were closed suddenly and routine learning schedule was disrupted (Zayapragassarazan, 2020). The scale and duration of closure of institutions of learning is unprecedented in history (UNESCO, 2020c).

Interrupted learning deprives learners of opportunities for learning, growth and development (Almaiah et al., 2020). Moreover, extended interruption of study causes suspension of learning time, loss of knowledge and skills gained (Reimers & Schleicher, 2020) due to decay, forgetting and lack of practices. The sudden closure of institutions of learning creates adverse consequences especially for vulnerable and marginalized learners. In sum, the sudden closure of institutions of learning carry high social and economic costs (UNESCO, 2020a).

E-learning was abruptly adopted as a strategic response to the sudden closure of institutions of learning induced by the COVID-19 pandemic (Crawford et al., 2020; UNESCO, 2020c; Zhou et al., 2020). The Malaysian Qualifications Agency (MQA) instructed all institutions of higher learning (IHL) in Malaysia to switch to e-learning (Malay Mail, 2020; MQA, 2020) to protect educational opportunities of undergraduates (Reimers & Schleicher, 2020). Hence, there is continuity of teaching-learning activities using the online mode (Zayapragassarazan, 2020).

After this sudden and disruptive change – rather than planned and progressive implementation – in the mode of delivery for higher education, what is the future outlook for e-learning from the perspectives of undergraduates? Will undergraduates abandon e-learning once their IHL are re-open or they prefer 100% e-learning or combination of conventional classroom learning and e-learning (i.e., blended learning)? The fight against the COVID-19 pandemic is characterised by new variants of SARS-CoV-2 and new surges, meaning that e-learning is likely to continue for some time. In addition, natural disasters and other crises are expected to happen more frequently in the future, seriously disrupting delivery of higher education again. Consequently, a future crisis response plan for education system facing major emergencies should be in place right now.

Presently, there is limited understanding of the relationships among challenges of e-learning with undergraduates’ future preferred mode of learning during the closure of IHL. At the same time, the lack of demographics and socioeconomic status disaggregated data hamper identification of differential implications of the COVID-19 pandemic (World Health Organization, 2020). As such, there is an urgent need to better understand the potentially differential impacts of the COVID-19 pandemic due to demographics and socioeconomic status to inform national strategic plans for COVID-19 pandemic preparedness (World Health Organization, 2020), including addressing inequities related to e-learning. This study aims to explore a new trail by drawing challenges of e-learning eclectically from recent literature to develop an alternative theoretical model of future preferred mode of learning against the background of the sudden closure of IHL induced by the COVID-19 pandemic.

Malaysia is a developing country. Due to uneven economic and infrastructure development across different parts of the country, not all learners have Information and Communication Technology (ICT) equipment and Internet access for e-learning. Prior to the sudden
closure of IHL in Malaysia, conventional classroom learning was the dominant mode of learning, albeit many IHL practised partial e-learning (i.e., using email for communications and learning management system to deliver learning materials). For existing undergraduates, none has had any experience of 100% e-learning for all courses. This study offers another perspective on how Malaysian undergraduates view the challenges arising from a sudden and involuntary switch to e-learning. Lastly, it is critical for various stakeholders to have a deeper understanding of the contextual challenges of e-learning faced by undergraduates in order to effectively and efficiently mitigate these challenges.

Literature review

E-learning during the closure of institutions of learning

The outbreak of the COVID-19 pandemic and the subsequent sudden closure of institutions of learning created a different theoretical context in which to research future preferred mode of learning of learners. The sudden and involuntary adoption of e-learning during the closure of institutions of learning is not a planned behavior nor acceptance of e-learning technology. Thus, behavioural and technology acceptance theories, such as the Theory of Planned Behavior, the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology, whether in its original or modified form, are unlikely to be appropriate to examine contextual challenges of e-learning during the closure of institutions of learning.

The unprecedented scale, sudden and involuntary adoption of e-learning during the closure of institutions of learning posed enormous human and technical challenges (Choong, 2020; Crawford et al., 2020; Reimers & Schleicher, 2020; UNESCO, 2020a, 2020c). Nevertheless, failure to adopt e-learning is not acceptable irrespective of whether learners are ready to embrace e-learning. A review of the recent literature suggests the following challenges associated with e-learning, especially during the closure of institutions of learning.

ICT infrastructure for e-learning

During the closure of institutions of learning, teaching and learning are carried out completely online. As such, ICT equipment (hardware such as desk top computer, laptop, tablet or smart phone plus software) and access to Internet are paramount pre-requisites for e-learning (Abbasi et al., 2020; Almaiah et al., 2020; Choong, 2020; Wang et al., 2020). However, there are inequities of access to ICT equipment and Internet for e-learning, known as digital divide (Almaiah et al., 2020), leading to a loss in educational opportunities (Choong, 2020; Wang et al., 2020; World Health Organization, 2020; Zhou et al., 2020) for learners from lower household income category (Crawford et al., 2020) or learners residing in remote or rural areas (Almaiah et al., 2020). Moreover, e-learning can be based on a variety of software and learning management systems. Thus, raising serious technical challenges and technophobia of e-learning (Choong, 2020; Wang et al., 2020).
Technical training, technical support and resources for e-learning

Ideally, learners should attend online workshops on e-learning tools, techniques and guidance for self-directed e-learning (Reimers & Schleicher, 2020; Zhou et al., 2020) prior to e-learning classes. Although learners may be known as the digital generation, they may lack digital skills related to e-learning (UNESCO, 2020c). Another critical challenge in switching to e-learning is resistance to change as learners prefer conventional classroom learning (Almaiah et al., 2020). Training programs and technical support can alleviate resistance to change. Furthermore, e-learning can fail as a result of lack of technical support – unavailability of technical staff and lack of support to perform various e-learning activities, such as installation, operation, maintenance, network administration and security (Almaiah et al., 2020; UNESCO, 2020b, Zhou et al., 2020). Lastly, sufficient e-learning resources should be made available to support e-learning (Almaiah et al., 2020; Zhou et al., 2020).

Discipline for e-learning

There are vast differences among learners in terms of discipline, resilience, motivation and skills to learn online independently (Reimers & Schleicher, 2020; UNESCO, 2020c). Factors for effective e-learning identified in the extant literature include motivation (Huang et al., 2020; Reimers & Schleicher, 2020; UNESCO, 2020b), independent learning (Huang et al., 2020; Reimers & Schleicher, 2020), self-direction/self-regulation/self-organization skills (Huang et al., 2020; UNESCO 2020c), good study habits (Zayapragassarazan, 2020) and good study skills (UNESCO, 2020c).

Perceived advantages of e-learning

E-learning can be carried out anywhere and anytime (24/7) as long as there is ICT equipment and access to Internet, breaking the limitations of study space and time (Zhou et al., 2020), offering flexibility (Abbasi et al., 2020; Zayapragassarazan, 2020; Zhou et al., 2020) and better control over learning environment (Abbasi et al., 2020).

E-learning is a “learner-centric” education model (Zayapragassarazan, 2020; Zhou et al., 2020), meaning that the emphasis is on learners (Reimers & Schleicher, 2020; UNESCO, 2020c; Zhou et al., 2020). This “learner-centric” education model offers rich learning choices and allows learners to take more responsibilities for their own learning (Zayapragassarazan, 2020) in terms of goal setting, self-monitoring and making adjustments for e-learning (Huang et al., 2020), leading to greater self-awareness, improved learning effectiveness and efficiency (Almaiah et al., 2020; Reimers & Schleicher, 2020), more knowledgeable learner and enhanced higher-order thinking skills, such as questioning, creativity and problem solving (UNESCO, 2020b).

Perceived disadvantages of e-learning

The sudden and involuntary adoption of e-learning may induce learners to feel overloaded and confused (UNESCO, 2020b). Besides, disruptions resulting from the COVID-19 pandemic impose mental and financial distress on learners (Choong, 2020; UNESCO, 2020a). Learners with deficiencies in motivation and discipline for e-learning will most likely expe-
Tertiary Education and Management (2022) 28:301–316

Experience stress and depression, and without strong social support, will be susceptible to burnout and eventually give up e-learning or drop out from study (Choong, 2020; UNESCO, 2020a).

The sudden closure of institutions of learning, notwithstanding e-learning, reduces learner-lecturer interaction (Abbas et al., 2020; Choong, 2020), creates a physical and psychological separation and distance (UNESCO, 2020c), a sense of disengagement (UNESCO, 2020c) and social isolation (Abbas et al., 2020; UNESCO, 2020a).

Learning outcomes

The education priorities in response to the sudden closure of institutions of learning are to ensure the continuity of academic learning for learners (Reimers & Schleicher, 2020) as well as assessing learning outcomes (UNESCO, 2020c). In other words, learning outcomes, whether using conventional classroom learning or e-learning, must always be achieved, albeit not at the same level resulting from challenges encountered with the sudden and involuntary adoption of e-learning. Achieving learning outcomes enhanced learners’ future preference for e-learning (Looi et al., 2022). Given the context of this study – e-learning in Malaysian IHL – it is natural to adopt the five clusters of learning outcomes developed by the Malaysian Qualifications Agency (MQF, 2017), namely, knowledge and understanding, cognitive skills, functional work skills (practical, interpersonal, communication, digital, numeracy, leadership, autonomy and responsibility), personal and entrepreneurial skills, ethics and professionalism.

Demographic and socioeconomic factors

The COVID-19 pandemic has differential impacts on individuals, contingent upon their demographics and socioeconomic status (Choong, 2020; Yeung & Yau, 2022; World Health Organization, 2020). In addition to the digital divide, some learners may not have a conducive environment at home for e-learning or may be distracted by family responsibilities (Yeung & Yau, 2022). Additionally, sex differences influence e-learning preference (Ong & Lai, 2006; Yoo et al., 2015). In some societies, parents give priority for their male children over female children regarding learning (Khlaif et al., 2021). Consequently, these learners are likely to suffer a higher risk of being left behind in e-learning.

Moderating or mediating effect

A literature review of e-learning research published between 2020 and 2022 found no conceptual nor empirical evidence for moderating or mediating effect of any particular challenge on the relationships between challenges and future preferred mode of learning. This lack of evidence is potentially due to the theory development of challenges associated with e-learning during the closure of institutions of learning is still at an exploratory stage. In addition to the direct relationships between gender, household income and location of residence with future preferred mode of learning, these variables may also moderate the relationships between challenges and future preferred mode of learning.

In sum, building on the recent literature on e-learning during the closure of institutions of learning, the research model for the present study is depicted in Fig. 1.
Methods

Given that e-learning during the sudden closure of institutions of higher learning is not well understood yet, an exploratory qualitative study (Eisenhardt, 1989; Schwab, 2005) was conducted using an unstructured reflective essay to elicit initial information on e-learning experiences from 30 business undergraduates. The challenges mentioned by the undergraduates mainly corroborated with recent literature on e-learning during the sudden closure of institutions of learning. In other words, the triangulation of constructs using different methods. Building on this foundation, a subsequent quantitative study was conducted to empirically validate the research model.

Participants

This study was approved by the Research Ethics Committee of Xiamen University Malaysia (REC-2005.02). This study selects a narrowly defined sample (Davidsson, 2005), that is, full time undergraduates majoring in economics or business (for example, accounting, international business, finance, management, marketing, etc.) from one private and one public university in Malaysia. These undergraduates normally attend conventional classroom learning prior to the outbreak of the COVID-19 pandemic.
Measurement

Multi-item questions were used to ensure no priming and there was no overlapping among questions for different constructs (Spector & Brannick, 2011). Ex ante procedural remedies in design and administration of the questionnaire were employed to reduce common method variance (Chang et al., 2010). At the beginning of the questionnaire, participants were assured anonymity and confidentiality of their responses, that there are no correct or incorrect answers and they should answer as honestly as possible. Moreover, there are no questions that would provoke defensiveness or threaten esteem.

The questionnaire is in English and consists of two parts. Part A collected data on gender, household income (bottom 40% (B40) with monthly household income of below RM4,850; middle 40% (M40) with monthly household income of between RM4,850 and RM10,959; top 20% (T20) with monthly household income of RM10,960 or higher) and location of residence (rural, semi-urban or urban area). Control variables are extraneous variables not related to the theories and hypotheses being examined (Atinc et al., 2012; Carlson & Wu, 2012; Spector & Brannick, 2011). This study utilised quasi-experimental design (Becker, 2005; Bernerth & Aguinis, 2016) to eliminate the extraneous effects of level of study, major/specialisation and experience of 100% e-learning by holding them constant across samples (Atinc et al., 2012; Becker, 2005; Bernerth & Aguinis, 2016).

Part B collected data on challenges and future preferred mode of learning. The challenge of ICT infrastructure was measured by five items (sample item: I have access to a laptop, personal computer, tablet or smart phone for e-learning). The challenge of training, support and resources was measured by six items (sample item: I attended online workshops to make the best out of e-learning). The challenge of discipline for e-learning was measured by six items (sample item: I maintained good learning habits, including hours of self-learning before and during e-learning). The challenge of perceived advantages of e-learning was measured by six items (sample item: I think e-learning is an undergraduate-centric education model). The challenge of perceived disadvantages of e-learning was measured by six items (sample item: I feel social isolation using e-learning). The challenge of learning outcomes was measured by eight items (sample item: Using e-learning, I am able to effectively learn subject knowledge). The response scale for all items were Likert type ranging from strongly disagree (1), disagree (2), neutral (3), agree (4) to strongly agree (5). Future preferred mode of learning was measured by three nominal categories (100% e-learning, 100% conventional classroom learning and blended learning).

Data collection procedures

The survey was conducted from July 2020 to August 2020, that is, when all IHL were closed and practised 100% e-learning. The link to the self-administered questionnaire hosted on the Google Forms was distributed to undergraduates by emails. Participation in this survey was voluntary. This study followed standard survey approaches to minimise response biases, that is, no social pressure to influence responses and no payoff or cost for particular responses.
At the end of the data collection period, data in Excel format were downloaded from the Google Forms. Unqualified participants were deleted, resulting in 352 valid responses. Next, responses were recoded into numeric data and transferred into the Statistical Package for the Social Sciences (SPSS) version 26. The preliminary analysis examined normality assumption, checked constructs’ reliability and validity, and tested common method bias for variance attributable to the measurement instrument.

Using the multinominal regression in the main analysis, future preference was entered as the dependent variable and the reference category was 100% conventional classroom learning. Gender, household income and location of residence were entered as factors. All challenges were entered as co-variates.

Results

The data were checked for normality using normal Q–Q plot and results suggested that there was no serious violation. Furthermore, there is no serious threat of outliers in the data. Cross-tabulation of gender, household income and location of residence is presented in Table 1. More than 59% of undergraduates preferred blended learning in the future (Table 2). The means, standard deviations, reliability and correlations were presented in Table 3.
The results of factor analysis were satisfactory with Kaiser-Meyer-Olkin measure of sampling adequacy above 0.5 and Bartlett’s test of sphericity significant. In exploratory factor analysis (EFA), using principal component analysis and varimax rotation method, seven components were extracted – consistent with a priori theorising – accounting for 62% of total variance explained. Thus, the ex post statistical remedy of Harman one factor analysis indicated that variance in the data is not largely attributed to a single factor (i.e., absence of common method bias). All items were correctly loaded onto their respective factors, demonstrating good convergent and discriminant validity, except thinking skills, which was originally theorised as an item under advantages of e-learning. This item was excluded from subsequent analysis.

In the multinomial regression, the model is significant ($p$-value < 0.01). Pseudo R-square ranges from 0.295 to 0.504, indicating a reasonable fit of the data to the research model. The Likelihood ratio tests (Table 4) suggest that, overall, gender, household income, location of residence, ICT infrastructure, discipline for e-learning, disadvantages of e-learning and future preference are significant predictors of the research model. The table also indicates that the interaction effect of gender and household income at the level of residence and TSR is significant.

| Table 3 | Means, standard deviations, reliability and correlations |
|---------|--------------------------------------------------------|
|         | Mean | SD | α | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. ICT infrastructure | 3.95 | 0.74 | 0.83 | 1 |   |   |   |   |   |   |
| 2. TSR | 3.38 | 0.75 | 0.86 | 0.45** | 1 |   |   |   |   |   |
| 3. Discipline | 3.30 | 0.88 | 0.92 | 0.39** | 0.52** | 1 |   |   |   |   |
| 4. Advantages | 3.53 | 0.81 | 0.87 | 0.42** | 0.51** | 0.66** | 1 |   |   |   |
| 5. Disadvantages | 3.34 | 0.81 | 0.84 | −0.22** | −0.23** | −0.25** | −0.31** | 1 |   |   |
| 6. Learning outcomes | 3.12 | 0.84 | 0.93 | 0.26** | 0.47** | 0.58** | 0.70** | −0.32** | 1 |   |
| 7. Future preference | 2.71 | 1.04 | 0.90 | 0.29** | 0.35** | 0.46** | 0.53** | −0.54** | 0.58** | 1 |

Notes: ** Correlation is significant at the 0.01 level (2-tailed)
SD denotes standard deviation. α denotes Cronbach’s alpha. TSR denotes training, support and resources

| Table 4 | Likelihood ratio tests |
|---------|------------------------|
| Effect | Model fitting criteria | Likelihood ratio tests |
|        |                       | -2 log likelihood of reduced model | Chi-square | df | Sig. |
| Intercept | 471.737 | 0.000 | 0 |   |
| Gender | 479.114 | 7.378 | 2 | 0.025* |
| Household income | 485.714 | 13.977 | 4 | 0.007** |
| Location of residence | 485.247 | 13.510 | 4 | 0.009** |
| ICT infrastructure | 479.225 | 7.488 | 2 | 0.024* |
| TSR | 471.737a | 0.000 | 0 |   |
| Discipline | 482.218 | 10.481 | 2 | 0.005** |
| Advantages | 474.727 | 2.990 | 2 | 0.224 |
| Disadvantages | 517.172 | 45.435 | 2 | 0.000** |
| Learning outcomes | 473.626 | 1.889 | 2 | 0.389 |
| Gender * household income * location of residence * TSR | 532.779 | 61.042 | 34 | 0.003** |

Notes: * significant at the 0.05 level, ** significant at the 0.01 level
TSR denotes training, support and resources

The results of factor analysis were satisfactory with Kaiser-Meyer-Olkin measure of sampling adequacy above 0.5 and Bartlett’s test of sphericity significant. In exploratory factor analysis (EFA), using principal component analysis and varimax rotation method, seven components were extracted – consistent with a priori theorising – accounting for 62% of total variance explained. Thus, the ex post statistical remedy of Harman one factor analysis indicated that variance in the data is not largely attributed to a single factor (i.e., absence of common method bias). All items were correctly loaded onto their respective factors, demonstrating good convergent and discriminant validity, except thinking skills, which was originally theorised as an item under advantages of e-learning. This item was excluded from subsequent analysis.

In the multinomial regression, the model is significant ($p$-value < 0.01). Pseudo R-square ranges from 0.295 to 0.504, indicating a reasonable fit of the data to the research model. The Likelihood ratio tests (Table 4) suggest that, overall, gender, household income, location of residence, ICT infrastructure, discipline for e-learning, disadvantages of e-learning and future preference are significant predictors of the research model.
interaction of gender * household income * location of residence * training, support and resources affect future preferred mode of learning.

Reading from Table 5 top half, undergraduates who preferred blended learning (compare to 100% conventional classroom learning) in the future have access to ICT infrastructure and for every unit increase in ICT infrastructure, their future preference for blended learning will double (\(\exp(B) = 1.889\)). Undergraduates from B40 household income category and undergraduates who perceived disadvantages of e-learning do not prefer blended learning (compare to 100% conventional classroom learning) in the future. For every unit increase in perceived disadvantages of e-learning, their future preference for blended learning will reduce by about 0.4 (\(\exp(B) = 0.389\)). For interaction effects, male undergraduates from B40 household income category staying in semi-urban area with training, support and resources preferred blended learning (compare to 100% conventional classroom learning) in the future. Male undergraduates from T20 household income category staying in rural area with training, support and resources also preferred blended learning (compare to 100% conventional classroom learning) in the future.

Reading from Table 5 bottom half, male undergraduates and undergraduates with discipline for e-learning preferred 100% e-learning (relative to 100% conventional classroom learning) in the future. For every unit increase in discipline for e-learning, undergraduates’ future preference for 100% e-learning will triple (\(\exp(B) = 2.900\)). However, undergraduates from semi-urban area as well as undergraduates who perceived disadvantages of e-learning shun 100% e-learning (relative to 100% conventional classroom learning) in the future. However, the negative impact of disadvantages of e-learning is small (\(\exp(B) = 0.113\)). For interaction effects, female undergraduates from T20 household income category staying in semi-urban area with training, support and resources also preferred 100% e-learning (compare to 100% conventional classroom learning) in the future.

Lastly, the correct classification for blended learning, 100% conventional classroom learning and 100% e-learning was 83.7%, 47.7% and 44.6%, respectively. The overall percentage of correct classification was 68.5% (Table 6).
Discussion

The COVID-19 pandemic has forced IHL in Malaysia to adopt a sudden paradigm shift to e-learning. Thus far, the migration to e-learning and maintaining it for more than two years seem to be an effective educational response to the COVID-19 pandemic, albeit vulnerable and marginalized undergraduates suffered from e-learning. The foci of educational response during the sudden closure of institutions of learning are to ensure learning continuity, education access and quality of education (UNESCO, 2020d). However, not all IHL were equally well prepared to provide e-learning during their sudden closure. Some IHL were more prepared for e-learning as they had implemented e-learning or blended learning prior to their sudden closure (Crawford et al., 2020). Moreover, due to the necessity for speed of transition to e-learning, the process will not be perfect from the start but IHL should iteratively improve by addressing associated challenges (UNESCO, 2020c). For undergraduates, after more than two years of e-learning, they should be getting acquainted with it. This study found that more than 59% of undergraduates surveyed preferred blended learning in the future and it is easy to understand their vantage point. By preferring blended learning in the future, they are indirectly telling IHL that they want the high touch of conventional classroom learning as well as the high tech of e-learning. To state it differently, undergraduates surveyed want the best of both worlds! In the era of Industry Revolution (IR) 4.0, many industries have widely embraced technologies to stay competitive and the tertiary education industry should be no exception. IHL can provide an excellent education experience of blended learning with high touch and high tech. The high touch aspect of blended learning can be provided via conventional classroom whereas the high tech aspect can exploit digital innovation to enhance the teaching and learning process in higher education to meet the expectations of digital generation undergraduates. This valuable insight will inspire market-oriented IHL to increase their competitive advantages by offering more blended learning to attract new undergraduates as well as retain existing undergraduates.

The results from the multinomial regression analysis suggested that the research model (except advantages of e-learning and learning outcomes) is significant in predicting undergraduates’ future preferred mode of learning, particularly the positive effect of interaction among gender, household income, location of residence and training, support and resources. A plausible explanation for the insignificance of advantages of e-learning and learning outcomes in predicting future preferred mode of learning could be that data were collected
during the first semester of 100% e-learning, where the priority is continuation of education, rather than advantages of e-learning and achieving all learning outcomes.

This study found that ICT infrastructure is a paramount factor in determining undergraduates’ future preference for blended learning (compare to 100% conventional classroom learning). If Malaysia intends to boost digital education post COVID-19 pandemic (particularly blended learning), there should be rapid and substantial investments to improve ICT infrastructure (i.e., hardware, software and Internet) by the government, IHL as well as parents.

Consistent with theory, undergraduates who perceived disadvantages associated with e-learning (e.g., feeling social isolation, lack of interaction with lecturers and peers, feeling overloaded, confused or feeling stress) do not prefer blended learning nor 100% e-learning (compare to 100% conventional classroom learning) in the future. Fortunately, the negative impact is small (Exp(B) ranging from 0.113 to 0.389). Hence, the perceived disadvantages of e-learning are surmountable with counselling and assistance from counsellors and/or lecturers.

This study identified undergraduates from B40 household income category shun blended learning (compare to 100% conventional classroom learning) in the future. Notwithstanding, male undergraduates from B40 household income category staying in semi-urban area with training, support and resources preferred blended learning (compare to 100% conventional classroom learning) in the future. However, the results did not show whether there was any difference in future preference between B40 male undergraduates and B40 female undergraduates or among B40 undergraduates from different location of residence. This is a potential avenue for future research.

Male undergraduates preferred 100% e-learning (relative to 100% conventional classroom learning) in the future and reported a significantly higher confidence than female undergraduates to overcome technophobia of e-learning (p-value = 0.046). The extant literature suggests that male learners are more likely to view computer as an inherently interesting machine (Hancock et al., 2002; Margolis & Fisher, 2002). On the other hand, female learners are more likely to view computer as a tool (Margolis & Fisher, 2002), are less confident in their information technology abilities, do not feel comfortable in using technology and accessing the Internet (OECD, 2018). This gender digital divide probably explain why female undergraduates do not prefer 100% e-learning. This finding implies that future 100% e-learning should take cognizance of this gender digital divide and provide more encouragement and support to female undergraduates to overcome their technophobia. Promoting gender equality in computing augurs well for female undergraduates in view of the growing importance of computing in the business world.

Undergraduates with discipline for e-learning preferred 100% e-learning (relative to 100% conventional classroom learning) in the future, underlining the importance of discipline for e-learning. The implication is, if 100% e-learning is practiced in the future, whether under normal circumstance or during a crisis, discipline for e-learning must be maintained. Although e-learning offers the flexibility of 24/7 learning, discipline for e-learning can be maintained, for example, via fixed schedule synchronous lectures or tutorials with attendance closely monitored.

The prediction ability of the research model ranges from good in predicting blended learning (83.7%) to moderate in predicting 100% conventional classroom learning (47.7%) and 100% e-learning (44.6%).
There are several limitations related to this study. First, given the limited body of knowledge on the challenges associated with e-learning during the sudden closure of institutions of learning, this study is considered exploratory. Second, findings are not generalisable to other contexts or countries as responses were obtained from Malaysian undergraduates. Third, challenges of e-learning may evolve over time. Hence, future replication studies may arrive at different results. Consequently, a lot of research is still needed to better understand contextual challenges and consequences of e-learning during the sudden closure of institutions of higher learning. Two examples include: how to achieve better learning outcomes using e-learning in the future, especially during a crisis? What are the cross-country similarities and differences in terms of challenges and consequences of e-learning during the sudden closure of institutions of higher learning?

**Conclusion**

E-learning was abruptly adopted as a strategic response to the sudden closure of institutions of learning induced by the COVID-19 pandemic. In contrast to the conventional voluntary adoption of e-learning, this study explored a new trail by drawing challenges of e-learning eclectically from recent literature to develop an alternative theoretical model of future preferred mode of learning against the background of the sudden closure of institutions of higher learning induced by the COVID-19 pandemic and validated the theoretical model via an empirical study based on the responses obtained from 352 Malaysian undergraduates. This study adds to the body of knowledge by way of an alternative theoretical model of undergraduates’ future preferred mode of learning, which may facilitate future meta analysis on similarities and differences in challenges related to e-learning during the sudden closure of institutions of higher learning across different countries.

This study concludes with some reflective thoughts about one important lesson learned from this unprecedented pandemic, which is e-learning readiness to deal with future unexpected crises. As the uncertainty surrounding the COVID-19 pandemic continues and the world adjusts to a new normal in learning, e-learning becomes a crucial element in higher education. Undergraduates want assurance that their education can continue no matter the circumstances. Besides, it is possible that after accustomed to e-learning, undergraduates may acquire new behaviours and habits. Hence, they may demand more and better e-learning experiences in the near future. The implication for practice is that IHL need to be better prepared in terms of education responses (i.e., Plan B) to effectively overcome future unexpected crises (e.g., pandemic, epidemic, natural disaster, et cetera) that may disrupt education delivery as well as meeting market demand. This anticipation and preparation for e-learning – whether in the form of 100% e-learning or blended learning – can be a competitive advantage to attract and retain digital generation undergraduates. In sum, integrating e-learning is an inevitable trend for all IHL. IHL also need to maintain up-to-date database to identify digital divide in education and increase support – especially for vulnerable and marginalized undergraduates – to achieve an equitable and inclusive education without undermining the quality of e-learning. Post COVID-19 pandemic, e-learning should be maintained in all IHL. For example, in every semester, at least one course/subject should be delivered via 100% e-learning or blended learning, so that undergraduates and lecturers are always well prepared to switch to e-learning during future crises (Looi, 2022).
Blended learning is “a mixed learning paradigm that integrates e-learning with traditional learning theories and practices, materialized in a flexible, multimodal and multilinear redesign that promotes self-regulation and collaborativeness” (Fernandes et al., 2016, p. 11). Blended learning can offset limitations inherent in conventional classroom learning and e-learning to improve undergraduates’ learning experiences and achieve greater learning effectiveness. It is expected that post COVID-19 pandemic, e-learning, whether in the form of 100% e-learning or blended learning, will be the new norm in higher education (Cheong et al., 2021; Looi, 2021). Therefore, IHL should take blended learning more seriously now so that the challenges associated with sudden switch to e-learning during future crises will be greatly mitigated. At present, educational institutions in some countries flexibly switch between conventional classroom learning and e-learning (i.e., practicing blended learning), depending on the severity of the COVID-19 pandemic.

Governments need not wait until the COVID-19 pandemic is finally over to start formulating adaptive, coherent, effective and equitable education responses to future crises that will severely disrupt education delivery again. Policy makers should seriously and quickly embrace digital education transformation and to effectively educate undergraduates, instead of treating e-learning as a one-off crisis response plan (Zhou et al., 2020). UNESCO (2020c) recommends comprehensive distance learning strategies guided by both short term goal (e.g., rapid responses for continuation of education) and long-term goals (e.g., building flexible, effective and equitable education provision systems). Given that ICT infrastructure has a close to 200% positive effect on future preference for blended learning, e-learning need to be supported by good ICT infrastructure. As such, the national ICT development policies and strategies should take into account the national e-learning policy. Finally, given that discipline for e-learning has a close to three hundred percent positive effect on future preference for 100% e-learning, policy-makers should issue a standard operating procedures or at least some guidance to maintain discipline for self-directed learning (Reimers & Schleicher, 2020).

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