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Achieving Learning Outcomes of Emergency Remote Learning to Sustain Higher Education during Crises: An Empirical Study of Malaysian Undergraduates

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Abstract: The sudden switch to emergency remote learning during the COVID-19 pandemic posed many challenges for learners, but it also provided the opportunity to research these challenges. This study empirically examines the relationships of the contextual challenges of emergency remote learning with future preference for e-learning, as well as moderating effects of learning outcomes on future preference for e-learning of undergraduates during the closure of Higher Education Institutions. Participants were drawn from two universities in Malaysia practising emergency remote learning during the survey period. Underpinned by the literature, the challenges of emergency remote learning and future preference for e-learning were operationalised into items reflective of each factor. In total, 352 valid responses were collected via a self-administered questionnaire hosted on Google Forms, and responses were analysed with Eviews statistical software. In this study, the significant challenges associated with future preference for e-learning, in descending order, were disadvantages (negative), learning outcomes, and advantages. Additionally, the interaction between learning outcomes and disadvantages has a positive relationship, reversing the original negative relationship of disadvantages with future preference for e-learning. Sustainability of higher education in times of crisis is critical. This study provides valuable insights concerning the importance of achieving learning outcomes in order to support sustainable higher education using emergency remote learning during similar future crises.

Keywords: e-learning; emergency remote learning; hybrid learning; emergency remote learning challenges; e-learning future preference; sustainability

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1. Introduction

The fourth goal of the United Nations Sustainable Development Goals—quality education—contends that education enables individuals to achieve increased socioeconomic mobility and to escape poverty [1]. The outbreak of the Coronavirus disease 2019 (COVID-19) at the end of 2019 created a sudden and unprecedented educational disruption in terms of the scale and duration of closure of education institutions [2]. Discontinuity of education during a crisis has dire consequences. In the immediate term, the closure of educational institutions disrupted learning and upended lives. Far-reaching consequences may include jeopardising hard-won gains in global education achieved over many years [1], as well as affecting multiple generations that will struggle to recover from a massive gap in knowledge and skills [3]. Therefore, continuity and sustainability of education in times of crisis are important [3].

Prior to the outbreak of the COVID-19 pandemic, education was one of the least digitized and most people-intensive economic activities [4]. The current crisis exposed the

vulnerability of Higher Education Institutions (HEI) due to inadequate crisis preparedness [3]. HEI were severely disrupted by the COVID-19 pandemic, resulting in a sudden transition to emergency remote teaching [3,5], also known as education in emergencies [6], to ensure continuity of education during closures of HEI. In this study, emergency remote learning (ERL) was adapted, given that this study is from learners' perspectives. Notwithstanding, learners suddenly and involuntarily switched from conventional classroom learning to ERL without any prior e-learning experience, proper training, or mental preparation. The sudden switch during a crisis posed many challenges for learners, but it also provided the opportunity to research these challenges [3]. It is likely that challenges associated with ERL during the COVID-19 pandemic are different from challenges experienced during normal times, such as perceived ease of use, perceived usefulness, satisfaction, and trust in e-learning. A better understanding of learners' challenges and their preference is essential to increase the effectiveness of ERL and the sustainability of higher education during crises.

The purpose of this study is threefold; first, to empirically examine the relationships between the contextual challenges of ERL (i.e., information and communication technology (ICT) infrastructure, training, support and resources, discipline, advantages, disadvantages, and learning outcomes) and future preference for e-learning of undergraduates during the closure of HEI; second, to examine the moderating effects of learning outcomes on the relationships between the five contextual challenges (i.e., ICT infrastructure, training, support and resources, discipline, advantages, and disadvantages) and future preference for e-learning of undergraduates; and third, to provide recommendations to surmount challenges encountered by undergraduates using ERL during the COVID-19 pandemic and future crises, culminating in improved sustainability of HEI.

2. Literature Review

Similar to other information technology projects, effective e-learning requires careful planning, installation, testing and fine tuning, training, and support. However, due to the sudden shift from conventional face-to-face learning to ERL, careful planning was not implemented [5]. Hence, various studies endeavoured to address challenges associated with ERL during the closure of education institutions from different perspectives, such as those of learners, instructors, HEI, and policy makers [2,7–13]. Moreover, recent studies on ERL during the closure of educational institutions have tended to focus on narrative and generalised challenges. It is crucial to empirically identify contextual challenges of ERL from the perspective of learners, given the urgency of mitigating its negative impacts.

2.1. ICT Infrastructure for Emergency Remote Learning

During the closure of educational institutions, teaching and learning were carried out completely online. As such, equipment (hardware such as desktop computers, laptops, tablets, or smart phones, plus software) and reliable internet (in terms of coverage and speed) were paramount prerequisites for ERL. Moreover, ERL can be based on a variety of information and communication technology platforms and software and learning management systems, raising serious technical challenges with the sudden switch to ERL [3,14], as well as technophobia associated with ERL [15]. In addition, information technology literacy affects learners' online learning effectiveness [16]. Thus, this study hypothesises that:

Hypothesis 1 (H1): *ICT infrastructure is positively related to learners' future preference for e-learning.*

2.2. Training, Support and Resources for Emergency Remote Learning

Ideally, learners should receive guidance for ERL, as well as technical training on ERL tools and techniques [3,17]. Although learners may be known as the digital generation, they may lack digital skills related to ERL [2].

ERL can fail as a result of a lack of technical support, for example, unavailability of technical staff to support installation, operation, maintenance, network administration, and security [3,7]. Another critical challenge in switching to ERL is resistance to change, as learners prefer conventional learning methods [7]. Training programmes and technical support can alleviate resistance to change. Furthermore, sufficient ERL resources must be made available [18]. Thus, this study hypothesises that:

Hypothesis 2 (H2): *Training, support and resources are positively related to learners' future preference for e-learning.*

2.3. Discipline for Emergency Remote Learning

There is heterogeneity among learners in terms of resilience, motivation, and skills to learn online independently [2,17]. Successful ERL requires learners to be motivated [6] and to foster good study habits [19] and good study skills [2]. Motivation and discipline were found to predict experienced learners' performance in e-learning [20].

ERL is a "learner-centric" education model [18,19], meaning that the emphasis is on the learner, for example, self-direction, self-discipline, self-organisation, and self-regulated (autonomous) learning ability [2,17,18,21]. Thus, this study hypothesises that:

Hypothesis 3 (H3): *Discipline is positively related to learners' future preference for e-learning.*

2.4. Actual or Perceived Advantages of Emergency Remote Learning

ERL can be carried out anywhere and anytime (24/7), as long as there is access to the Internet, overcoming the limitations of place and time [18] offers learners flexibility in terms of what is learned, how it is learned, and where it is learned [19,22,23]; and gives learners more control over their learning environment [22]. Thus, learners can progress at their own pace.

The "learner-centric" education model offers rich learning choices and opportunities for learners to take more responsibility for their own learning [19,21], leading to greater self-awareness [21], improving learning effectiveness and efficiency [7], becoming more knowledgeable [21], and enhancing higher-order thinking skills, such as questioning, creativity, and problem solving [6]. As such, this study hypothesises that:

Hypothesis 4 (H4): *Advantages of ERL are positively related to learners' future preference for e-learning.*

2.5. Actual or Perceived Disadvantages of Emergency Remote Learning

The sudden and full adoption of ERL may induce learners to feel overwhelmed, overloaded, and confused [3,6]. Learners with deficiencies in motivation and discipline will most likely experience stress and depression, and without strong social support, will be susceptible to burnout and eventually give up ERL or drop out [24]. In addition, the flexibility of e-learning can create potential confusion and information overload [23].

The closure of educational institutions, notwithstanding ERL, reduces learner–instructor interaction [22] while creating a physical and psychological separation and distance [2], a sense of disengagement [2], and social isolation [22,24], negatively impacting learners' socialisation skills. As such, this study hypothesises that:

Hypothesis 5 (H5): *Disadvantages of ERL are negatively related to learners' future preference for e-learning.*

2.6. Learning Outcomes

The educational priorities in response to the COVID-19 pandemic are to ensure the continuity of academic learning for learners and to support learners lacking independent

(i.e., ERL) study skills [17]. Notwithstanding, ERL during the closure of educational institutions does not negate the importance of assessing learning outcomes [2]. Irrespective of the mode of learning, learning outcomes must always be achieved, albeit not at the same level as with conventional learning due to the challenges associated with the sudden and full switch to ERL.

Given the context of this study, which is ERL in Malaysian HEI, this study adopts the five clusters of learning outcomes of the Malaysian Qualifications Agency [25], namely: knowledge and understanding; cognitive skills; functional work skills (practical, interpersonal, communication, digital, numeracy, leadership, autonomy, and responsibility); personal and entrepreneurial skills; and ethics and professionalism. This study hypothesises that:

Hypothesis 6 (H6): *Learning outcomes are positively related to learners' future preference for e-learning.*

Furthermore, the accomplishment of learning outcomes may indicate that learners have mitigated the challenges associated with ERL and become accustomed to ERL [3], resulting in greater future preference for e-learning. Therefore, this study further hypothesises that:

Hypothesis 7 (H7): *Learning outcomes positively moderate the effects of ICT infrastructure, training, support and resources, discipline, advantages, and disadvantages on learners' future preference for e-learning.*

2.7. Income, Geographical Location, Sex and Emergency Remote Learning

Extant literature suggests that learners from poor families (economically disadvantaged learners) and those living in remote or rural areas (geographically disadvantaged learners) suffer from inequitable access to equipment and the Internet when participating in ERL [7,26]. Recent empirical findings suggest that household income level affects learners' ERL effectiveness [16]. This digital divide [7] leads to a loss of educational opportunities [12,18,27]. Additionally, the literature suggests sex differences influence e-learning preference [28,29]. As such, future research should consider sex when developing and testing e-learning theories [28]. Therefore, this study hypothesises that:

Hypothesis 8a (H8a): *Economically disadvantaged learners have lower future preference for e-learning.*

Hypothesis 8b (H8b): *Geographicallydisadvantaged learners have lower future preference for e-learning.*

Hypothesis 8c (H8c): *Femalelearners have lower future preference for e-learning.*

3. Materials and Methods

To empirically examine the relationships between the contextual challenges of ERL and future preference for e-learning, this study adopted a post-positivism quantitative cross-sectional survey method.

3.1. Participants

This study was approved by the Research Ethics Committee of Xiamen University Malaysia, Malaysia (REC-2005.02). Undergraduates who normally attended conventional classroom learning prior to the closure of HEI were drawn from one private and one public university in Malaysia.

3.2. Instruments

3.2.1. Control Variables

This study targeted undergraduates majoring in economics or business who were using ERL for all courses for the first time during the closure of HEI.

3.2.2. Income and Geographical Location Variables

Household incomes were measured with three options: (1) bottom 40% (B40), with household income of below RM 4850 (EUR 1010) per month; (2) middle 40% (M40), with household income between RM 4850 (EUR 1010) and RM 10,959 (EUR 2280) per month; and (3) top 20% (T20), with household income of RM 10,960 (EUR 2280) or higher per month [30]. Residential location was measured with three options: (1) rural areas, (2) semi-urban areas, and (3) urban areas.

3.2.3. Development of Questionnaire

This study used multi-items to measure factors [31], i.e., using several items representing different aspects of the factor to obtain a more comprehensive perspective [32,33]. Underpinned by the literature, the independent variables of the challenges of ERL (i.e., ICT infrastructure, training, support and resources, discipline, actual or perceived advantages, actual or perceived disadvantages, and learning outcomes) and the dependent variable of future preference for e-learning were operationalised into items reflective of each factor.

Factor operationalisation involves specifying what each factor means and precisely how they will be measured—in other words, reducing factors into items [34]. The procedures to operationalise or develop multi-item measures for factors followed the recommendations in the measure development literature [35–37]. The aims are to develop a set of items that focus directly and unambiguously on the research topic [31], as well as achieving reliability and validity properties [35,38]. There exist slight variations in the processes described in the measure development literature; therefore, they are synthesised below.

Step one searched for the definitions of factors from the literature. Step two generated an initial list of items and scales. Step three sought expert judgement on the face validity of the items. Step four purified the measures. At this stage, issues such as common method biases, five types of faulty questions, and item wording were addressed. The output from this stage was the first draft of the questionnaire. Step five was a pilot test using a sample of 30 undergraduates. Statistical analysis generated correlations, Cronbach's alphas, and factor analysis statistics for further improvement of the items in each factor. Step six refined the items and generated the final questionnaire.

The ICT infrastructure factor was measured by five items (sample item: "I have access to a laptop, personal computer, tablet, or smart phone for ERL"). The training, support and resources factor was measured by six items (sample item: "I attended online workshops to make the best out of ERL"). The discipline factor was measured by six items (sample item: "I maintained good learning habits, including hours of self-learning, before and during ERL"). The actual or perceived advantages factor was measured by six items (sample item: "I think ERL is an undergraduate-centric education model"). The actual or perceived disadvantages factor was measured by six items (sample item: "I feel socially isolated using ERL"). The learning outcomes factor was measured by eight items (sample item: "Using ERL, I am able to effectively learn the subject knowledge"). The future preference for e-learning factor was measured by four items (sample item: I prefer e-learning in future semesters).

Participants' responses for all items were recorded using the Likert scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

3.3. Data-Collection Procedures

This study was carried out in the second half of the year 2020. The study timing was appropriate to capture challenges associated with ERL and future preference for e-learning of Malaysian undergraduates because all HEI in Malaysia were closed due to cordon sanitaire preventive measures to contain the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The link to the self-administered online questionnaire hosted on Google Forms was distributed to undergraduates via email. An online questionnaire was a safe and feasible approach to collect data during the COVID-19 pandemic [39].

Participation in this survey was voluntary, and participants consented online before answering the questionnaire. All participants were briefed on the purposes of the study, assured of the anonymity of their responses, that all data would be used for academic purposes only, and that there were no known risks associated with the study. The study followed standard survey approaches to minimize response biases [40], e.g., there was no social pressure to influence responses, no questions that would provoke defensiveness or threaten esteem, and no payoff or cost for particular responses. A total of 352 valid responses were received.

3.4. Data Analysis

The psychometric properties of ICT infrastructure, training, support and resources, discipline, advantages, disadvantages, learning outcomes, and future preference for e-learning were checked. The goalpost method of minimum and maximum scores transformed responses into indices ranging from 0 to 1 for each factor using the following formula:

$$\frac{\left(\sum_{s=1}^{j} X_{is}\right) - \left(\sum_{s=1}^{j} Xmin_{is}\right)}{\left(\sum_{s=1}^{j} Xmax_{is}\right) - \left(\sum_{s=1}^{j} Xmin_{is}\right)}$$

where X_{is}, $Xmin_{is}$, and $Xmax_{is}$ are the actual, minimum, and maximum score, respectively, given by the i-th respondent for the s-th item from a list of a total of j items measuring each factor.

All valid responses were analysed with Eviews version 12 statistical software to generate descriptive and inferential statistics. This study specified a linear model to examine the relationships between the contextual challenges (i.e., ICT infrastructure, training, support and resources, discipline, advantages, disadvantages, and learning outcomes) and future preference for e-learning of undergraduates. One-way analysis of variance (ANOVA) and mean pairwise comparison analysis examined whether there were differences between/among the groups within income, geographical location, and sex variables.

To solve the endogeneity bias triggered by a reciprocal relationship, the two-stage least-squares method (2SLS) was used, whereby the independent variables were assumed to be weakly exogenous and thus instrumented. The Wald statistic tested the null hypothesis of no difference in the coefficients of the main model (Model 1, without interaction) and sub-models (Models 1.1 to 1.5, with interaction). The Sargan statistic tested the validity of instruments used in the first stage of 2SLS estimation. The Durbin–Wu–Hausman statistic tested the endogeneity problem. The mean-of-variance inflation factor (VIF) checked the multi-collinearity problem. The Breusch–Pagan statistic tested the heteroscedasticity problem, with the null hypothesis of no heteroskedasticity. Ramsey's regression-specification error test (RESET) tested the specification error in the linear model. The root mean square error (RMSE) statistic compared the forecasting errors of different models. A lower RMSE is better than a higher RMSE.

Lastly, this study specified two-way interaction models between the five challenges and learning outcomes on future preference for e-learning.

4. Results

4.1. Metric Quality Assessment

The Cronbach's alphas for all factors were above 0.7, indicating the reliability of factors. In exploratory factor analysis, all items loaded correctly onto their theorised factors, indicating the discriminant validity of factors. Additionally, Harman's single-factor criteria [41] suggested the absence of common method variance, as the first factor extracted in exploratory factor analysis for all items explained less than 50 percent of the variance in the items.

4.2. Descriptive Statistics, ANOVA, and Two-Stage Least Squares

Table 1 presents income, geographical location, and sex characteristics of the surveyed participants.

Table 1. Income, geographical location, and sex characteristics of participants.

	Category	Frequency	Percent
University	Public	101	28.7
	Private	251	71.3
Household income	Bottom	76	21.6
	Middle	178	50.6
	Top	98	27.8
Residential location	Rural area	47	13.4
	Semi-urban area	171	48.5
	Urban area	134	38.1
Sex	Male	130	36.9
	Female	222	63.1

Overall, undergraduates surveyed expressed the highest level of agreement with the availability of ICT infrastructure and the advantages of ERL (Table 2). Training, support and resources differed statistically based on sex; the availability of ICT infrastructure differed statistically based on residential location and household income (Table 3). Specifically, the availability of ICT infrastructure differed statistically between urban and rural areas as well as between semi-urban and rural areas (Table 4). In terms of income, there were significant differences in terms of ICT infrastructure between undergraduates from the T20 and M40 groups, between undergraduates from the T20 and B40 groups, as well as between undergraduates from the M40 and B40 groups. However, there were no significant differences in future preference for e-learning across income, geographical location, and sex.

Table 2. Descriptive statistics.

	Mean	Standard Deviation	Min	Max
Future preference index	0.428	0.259	0	1
Learning outcomes index	0.530	0.209	0	1
ICT infrastructure index	0.708	0.205	0	1
Training, support and resources index	0.595	0.187	0	1
Discipline index	0.574	0.221	0	1
Advantages index	0.632	0.202	0	1
Disadvantages index	0.586	0.203	0	1

Table 3. Analysis of Variance (ANOVA).

	Gender	Location	Household Income
Future preference	0.048	0.197	0.029
Learning outcomes	0.085	0.022	0.172
ICT infrastructure	0.017	0.283 *	0.666 **
Training, support and resources	0.137 *	0.070	0.164
Discipline	0.029	0.191	0.012
Advantages	0.006	0.032	0.027
Disadvantages	0.034	0.083	0.086

Note: ** and * denote significance level at 1% and 5%, respectively.

Table 4. Mean pairwise comparison.

	Sex	Location			Household Income		
	Male vs. Female	Urban vs. Semi-Urban	Urban vs. Rural	Semi-Urban vs. Rural	T20 vs. M40	T20 vs. B40	M40 vs. B40
Future preference	−0.024	0.017	−0.056	−0.073	−0.002	0.020	0.023
Learning outcomes	−0.032	0.007	−0.017	−0.024	−0.051	−0.022	0.029
ICT infrastructure	−0.014	0.028	0.090 **	0.062 *	0.049 *	0.124 **	0.076 **
Training, support and resources	−0.041 *	0.028	0.000	−0.028	−0.001	0.052	0.053 *
Discipline	−0.019	0.044	−0.009	−0.053	0.005	0.017	0.011
Advantages	−0.009	0.018	−0.003	−0.021	−0.018	−0.002	0.016
Disadvantages	−0.020	−0.027	−0.041	−0.014	−0.005	−0.041	−0.036

Note: ** and * denote significance level at 1% and 5%, respectively.

4.3. Two-Way Interaction between Challenges and Learning Outcomes

In Table 5, Model 1 (without interaction effect) of 2SLS estimation, the significant challenges for future preference for e-learning, in descending order, were disadvantages (negative), learning outcomes, and advantages. The interactions between learning outcomes and challenges (from Model 1.1 to Model 1.5) were significant (p-value < 0.01). Importantly, the interaction between learning outcomes and disadvantages was positively correlated with future preference for e-learning, reversing the original negative correlation of disadvantages with future preference for e-learning.

The R^2 from the 2SLS was more than 0.86 for all models, indicating high levels of variance explained. The p-values for the Wald χ^2 statistic were less than 0.05 for all sub-models, implying that addition of two-way interaction terms contributed to the modelling. The p-values for the Sargan statistic were greater than 0.05 for all models, indicating the validity of instruments used in the first-stage estimation of 2SLS. The p-values for the Durbin–Wu–Hausman statistic were greater than 0.05 for all models, suggesting the absence of endogeneity. The means for variance inflation factor (VIF) were not significantly greater than 1 for all models, suggesting the absence of multicollinearity. The p-values for the Breusch–Pagan statistic were greater than 0.05 for all models, suggesting absence of heteroscedasticity. The Ramsey's RESET statistic suggested no specification error in all models. Lastly, the RMSE was less than 0.2 for all models, indicating a good measure of accuracy. In sum, given these statistical tests, the results from 2SLS estimations are trustworthy.

Table 5. Two-stage least squares with two-way interaction between challenges and learning outcomes [a].

	Model 1	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5
Learning outcomes (LO)	0.378 **	-	-	-	-	-
ICT infrastructure (INFRA)	0.062	−0.219 **	0.054	0.021	0.022	0.064
Training, support, and resources (TSR)	−0.024	−0.006	−0.350 **	0.003	−0.004	−0.023
Discipline (DISC)	0.118	0108	0.125 *	−0.199	0.134 *	0.143 *
Advantages (ADV)	0.165 *	0.181 *	0.220 **	0.269 **	0.008	0.185 *
Disadvantages (DISADV)	−0.480 **	−0.482 **	−0.498 **	−0.498 **	−0.508 **	−0.787 **
INFRA × LO	-	0.478 **	-	-	-	-
TSR × LO	-	-	0.550 **	-	-	-
DISC × LO	-	-	-	0.512 **	-	-
ADV × LO	-	-	-	-	0.484 **	-
DISADV × LO	-	-	-	-	-	0.462 **
Constant	0.306 **	0.507 **	0.494 **	0.478 **	0.484 **	0.519 **
R^2	0.866	0.866	0.865	0.863	0.864	0.863
Wald χ^2 (*p*-value)	-	0.000	0.000	0.000	0.000	0.000
Sargan (*p*-value)	0.345	0.935	0.291	0.156	0.159	0.270
Durbin–Wu–Hausman (*p*-value)	0.815	0.312	0.267	0.083	0.436	0.113
Mean of variance inflation factor	1.83	2.09	2.28	2.43	2.43	1.98
Breusch–Pagan (*p*-value)	0.335	0.345	0.331	0.188	0.236	0.098
Ramsey's RESET (*p*-value)	0.363	0.395	0.501	0.419	0.434	0.059
RMSE	0.183	0.183	0.184	0.185	0.184	0.185
No. of observations	352	352	352	352	352	352

Notes: [a] dependent variable is future preference for e-learning. ** and * denote significance level at 1% and 5%, respectively.

5. Discussion

This study examined the relationships between contextual challenges and future preference for e-learning of undergraduates during the closure of HEI. The outbreak of the COVID-19 pandemic and the subsequent closure of HEI created a completely different theoretical context in which to research future preference for e-learning. Although the extant literature discussed various challenges associated with ERL, not all challenges are salient in all contexts. As demonstrated by the present study, it is critical for various stakeholders to have a deeper understanding of the contextual challenges faced by undergraduates in order to effectively and efficiently mitigate these challenges. A one-size-fits-all solution should be avoided in view of the heterogenous contexts of different HEI.

This study found that the significant challenges associated with future preference for e-learning, in descending order, were disadvantages (negative) (H_5), learning outcomes (H_6), and advantages (H_4). Existing volitional behavioural models would predict that future preference for e-learning would be a function of advantages (benefits). In contrast, the involuntary adoption of ERL resulted in disadvantages being most strongly associated (negatively) with future preference for e-learning. Thus, this study extends the existing literature on e-learning through the new lens of the involuntary adoption of ERL. The results suggest the importance of overcoming the actual or perceived disadvantages of ERL. Thus, stakeholders in HEI should constantly monitor and promptly address actual or perceived disadvantages of ERL of undergraduates [42].

In this study, disadvantages were operationalised into social isolation; lack of interactions; feeling overloaded, confused or stressed; and wanting to give up. These mainly psychological disadvantages of ERL can be overcome by shifts in thinking [43]. It is critical to realise that during the current crisis, it is not ERL vs. face-to-face learning; rather, it is ERL vs. interrupted learning. Put differently, ERL is the only mode of learning available

during the closure of HEI. The high social and economic costs of interrupted learning [24] include lost opportunities for learning, growth, and development; suspension of learning time; and loss of gained knowledge and skills [7,17]. These losses can translate into a lost generation. As such, a new mentality is needed in order for undergraduates to accept all the trials (i.e., disadvantages) that they are facing with an open heart and instead adapt to ERL.

Taken together, the significant results of disadvantages, learning outcomes, and advantages augur well for future preference for e-learning. As undergraduates become accustomed to ERL, they will overcome the disadvantages associated with e-learning. Additionally, achieving learning outcomes, coupled with the advantages associated with ERL, will incentivise undergraduates to prefer e-learning in the future.

Contrary to the literature, ICT infrastructure (H_1), training, support and resources (H_2), and discipline (H_3) were found to be insignificant in the present study. A plausible explanation is that the two represented institutions already practiced partial e-learning in the form of using email and/or social media for communication, as well as learning management systems to deliver learning contents prior to the closure. Hence, undergraduates did not face significant challenges when migrating to ERL. The insignificant differences in future preference for e-learning according to income (H_{8a}) and geographical location (H_{8b}) can be attributed to the background of the participants in this study (Table 1), as approximately 78% and 86% of respondents originated from medium or high-income families and resided in semi-urban or urban areas, respectively. The insignificant difference in future preference for e-learning according to sex (H_{8c}) suggests the absence of a gender-based digital divide in the context of the present study.

The interactions between learning outcomes and challenges (i.e., ICT infrastructure, training, support and resources, discipline, advantages, and disadvantages) were significant (H_7). Given the achievement of learning outcomes, the challenges of ICT infrastructure, training, support and resources, discipline, advantages, and disadvantages can positively influence future preference for e-learning. In particular, learning outcomes and disadvantages were positively correlated, reversing the original negative relationship of disadvantages with future preference for e-learning. Stated differently, despite the disadvantages of ERL, undergraduates who achieved learning outcomes prefer e-learning in the future. Therefore, to ensure achievement of learning outcomes, it may be necessary to assess undergraduates on a regular basis instead of at the end of the semester only. Instructors may need to be more creative to devise various assessments at regular intervals to monitor the achievements of learning outcomes.

The implications of the findings will be discussed at the level of the learner and HEI. After being forced to study online, many undergraduates have become accustomed to this new way of learning [3]. The psychological barriers associated with ERL have been significantly reduced [44] and, over time, undergraduates may evolve from resisting to favouring e-learning. In particular, when they return to campus to resume traditional face-to-face learning after several tumultuous semesters, they may begin to miss the advantages of e-learning and may request hybrid learning that offers the best of both worlds. Hybrid learning, also known as 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" [45]. Hybrid learning can offset limitations inherent in face-to-face learning and e-learning, thus improving undergraduates' learning experiences and achieving better learning effectiveness. Therefore, it is highly likely that post-pandemic, a new normal of hybrid learning will emerge in HEI [3]. E-learning, underpinned by the learner-centric philosophy, augments learners' lifelong learning capabilities. E-learning also develops undergraduates' digital capabilities to keep pace with technological advances and to prosper in the 21st century digital economy [4].

The contextual challenges encountered by undergraduates, coupled with their future expectation for hybrid learning, led to the second implication. The COVID-19 pandemic

forced HEI to accelerate digitally enhanced learning. Now is a critical time to evaluate outcomes and revisit the strategies and policies of e-learning through a fresh lens. To suit the learning needs of digital generations of learners, HEI should adopt a more digitally driven business model [4] by offering digitally enhanced learning, using technology such as mobile applications, cloud computing, machine learning, artificial intelligence (AI), virtual reality (VR), augmented reality (AR), Internet of Things (IoT), big data, etc. This technology-driven strategy can enhance sustainability in higher education and develop the 21st century digital skills of learners. However, the downside of this technology-driven strategy is the costly investment required in technology and digital skills training for instructors and learners.

6. Conclusions

This study made two theoretical contributions to the emerging literature on ERL during the COVID-19 pandemic. First, this study identified salient challenges related to ERL in the context of involuntary adoption of e-learning and discussed recommendations to surmount the disadvantages of ERL. Second, this study contends that despite various challenges associated with ERL during the COVID-19 pandemic, it is crucial to ensure that undergraduates achieve learning outcomes and surmount challenges to positively influence their future preference for e-learning. This finding provides valuable insight concerning the importance of achieving learning outcomes to support sustainable higher education using ERL during similar future crises.

The COVID-19 pandemic has caused tremendous disruptions on a global scale, forcing us to work and learn in new ways, to accelerate the adoption of digital technology, and to change our mindsets [3]. The COVID-19 pandemic has hastened higher education's overdue technological transformation [4]. Leaders of HEI must learn from this crisis to transform higher education and start planning for a more resilient future higher education model. The lessons learned must be used to build forward-thinking and resilient HEI by adopting a digital-transformation strategy capable of improving learning experiences and learning outcomes during the current pandemic and future crises—in other words, educational planning in crises [5]. These digital capabilities are essential to the sustainability of HEI.

There are several limitations inherent in this study. First, the survey was carried out in July 2020, when undergraduates were using ERL for the first time. Hence, future replication studies may produce different results. Second, new challenges may have emerged over time. Third, this study should be replicated using undergraduates from other courses that require access to equipment and laboratories, such as science, medicine, and engineering. Lastly, the findings have limited generalisability to other contexts. More research should be performed in order to understand the contextual challenges of ERL.

Finally, scholars have called for future research on the transformative effects of the COVID-19 pandemic on education [3]. For instance, one unexpected positive life event arising from this pandemic is that learners may become better at self-regulation. This may cultivate their self-direction values, which is essential for entrepreneurship and intrapreneurship (i.e., entrepreneurial mindsets and behaviours) [46–48]. Moreover, the challenging experiences (i.e., adversity) of ERL may facilitate learners' positive adaptation of resilience for future challenges [49].

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