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A Study On Lab Class Delivery with E-Learning Systems Improvements and Familiarity Among Gender During COVID-19

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Abstract

COVID-19 pandemic has changed the way we interact, purchase, socialize, transact, work and also learn. Higher education sector has resort to electronic learning (e-learning) to substitute the traditional face-to-face class delivery. The substitution is inevitable and crucial to ensure smooth continuation of students' education. As a result, campus can resume operations at distance and help stand the survival of the institution. Considering the new approach which need to be adapted, the process of teaching and learning have never been the same for both the instructors and students. The e-learning systems utilized by institution should offer fundamental features and provide necessary functions for virtual lab class delivery. This aspect is considerably important to ensure lab lesson deliver virtually is effective and student's orientation is adequate. The aim of this study is to examine the association between lab class delivery with e-learning systems improvement. Additionally, association between gender and familiarity with e-learning systems was also assessed. The study population are students studying in higher education institutions at undergraduate and postgraduate levels. The undergraduate and postgraduate students were randomly sampled from local institutions in Malaysia as well as institutions located in several other countries. This is a quantitative study and self-administered questionnaires were used to collect information from a final sample of 293 students. MS Excel application was used as the tool to develop the quantitative analysis. The results suggested that no significant association between lab class delivery with e-learning systems improvement and both male and female students seem acquainted with the e-learning systems. This study offers additional basic understanding for institutions on the suitability of e-learning systems for virtual lab class delivery and familiarity on the e-learning systems as viewed by students from both gender.

***Keywords*:** *E-learning systems, lab class, familiarity, gender.*

1. Introduction

COVID-19 is a highly infectious disease caused by the newly discovered breed of coronavirus. This type of virus is known to cause respiratory infections in human beings. The COVID-19 virus affects people differently. Most of the infected people develop mild to moderate illness and usually recover even without hospitalization. The common symptoms of this disease are fever, tiredness, dry cough, sore throat, headache, conjunctivitis, loss of taste or smell, and discoloration of fingers or toes (World Health Organization, 2020). This new breed of virus was completely unknown to the world before December 2019. It was realized when an outbreak of a pneumonia from an unidentified cause emerged in Wuhan, China. The first COVID-19 case in Malaysia was discovered on 24th January, 2020 (World Health Organization, 2020). The pandemic caused by COVID-19 has impacted almost all aspects and activities in our daily lives, including in the teaching and learning process.

Consequently, the global higher educational sector has pivoted to e-learning systems to substitute the present face-to-face classes. E-learning systems are systems that are used for online learning purposes or to support the face-to-face classes with lecture materials, submissions, collaborations, and activities. E-learning systems require Internet connection to function. In the context of this study, these e-learning systems are the one used to fully replace the face-to-face classes. Some examples of e-learning systems include Moodle, TalentLMS, SkyPrep, Edmodo, Mindflash, Blackboard, Canvas, ISpring, Litmos, Docebo and many more (Software Testing Help, 2020).

Among the main advantage of e-learning is it allows the linking of various learning resources in several varying formats. It serves as a very efficient way of delivering online courses. Due to its flexibility and convenience, the learning resources are accessible at anytime from anywhere. Regardless of the study mode, both part time and full time students can take advantage of e-learning. Further, e-learning promotes an independent and active learning. It allows one to train themselves independently and conveniently on a day to day basis at their own pace and availability. With e-learning's discussion boards and forums, one is able to interact with study companions online and also clarify doubts if any. Students can revisit recorded lecture, audio or chats for revision or for clarification purposes. On the other hand, among the main disadvantage of e-learning includes the issue of security on data collected and exchanged on the e-learning video conferencing platform. Another issue is on the authenticity and plagiarism of student's submission for online assessments. This is because, anyone can complete an assessment on behalf, as long as the login credentials such as username and password are correct. Assessments that are computer-marked have a tendency of being only on knowledge based and not practicality based (Clover, 2017). Considering the new norm that have to be adopted due to COVID-19 pandemic, teaching and learning have never been the same for the instructors and students. Instructors must quickly become proficient at how to use and operate the e-learning systems. In the same way, students must be familiar with the e-learning systems utilized by their institutions. For students, it is vital for them to develop a rapid understanding on the tools, features and functions available in the e-learning systems. This is to ensure a smooth and manageable transition from face-to-face mode to fully online approach while attending to the teaching and learning process. Higher education institutions should put efforts and provide the support that encourages instructor's competency in using the e-learning systems, motivating the students and ensuring effective utilization (Maphosa, 2021). Thus, the full replacement to e-learning systems must be unified with ample familiarization by the instructors as well as students. Eventually, the expected learning outcomes should be accomplished similar to when teaching and learning process is conducted in face-to-face mode.

2. Lab Class Delivery with E-Learning Systems

Apart from lecture and tutorial, certain courses and subjects require students to attend lab session. Normally, class delivery in lab session between instructor and students involves additional practical activities and learning materials. Practical activities are essential instrument in lab session. The practical activities are designed to effectively achieve the learning outcomes of the related module in the course. While the additional learning materials include lab manual, lab exercise and lab report. In view of the additional practical activities and learning materials, the e-learning systems utilized to support the fully online lab session must be suitable and fitting. This is considerably challenging to ensure the most appropriate e-learning systems are used for the fully online lab session. The technologies including the software, hardware and communications network facilitated the e-learning systems must be assessed and selected appropriately. It is wise to explore and understand the key problems in e-learning solutions related to remote distributed technology and signal processing in communications network (Liu et al., 2019). In remote distributed network environment, the client terminal needs to establish connection with the e-learning systems server and communicate with each other through mutually agreed communications protocols, to exchange data and information during the virtual lab session.

Virtual experiments conducted online can be divided into four main categories (Lin et al., 2018); separate experiment, one-on-one guided experiment, one-to-many guided experiment and collaborative experiment. Separate, one-on-one guided and one-to-many guided are type of virtual experiments which are typically involve lab students practice lab exercise individually based on the lab manual instructions. On the other hand, collaborative experiment is based on experimental operation through collaboration of multiple group members to complete the synergy of an experiment (Lin et al., 2018). In collaborative environment, experimental data sharing technology is necessary. The technology enables each participant to intercept and receives the distributed input events from the other participants who run the same application software in their individual devices. Conducting experiment in a collaborative environment may also presents some challenges. It can be very challenging for a lab instructor to deal with a large number of students working in group settings. Additionally, lab instructor may find it difficult to promptly respond and guide the individual needs of the participating students (Esposito et al., 2021).

Server side of virtual lab which consists modules of application server, database server and web server is fundamental in the implementation of a virtual lab environment. The integration of software systems, hardware systems, and communications network through cloud computing technology accelerates the efficient use of a virtual lab resources. Through the Internet, lab instructors can post lab learning materials on the cloud and students can access the learning materials through their usual login details on the e-learning platform. Esposito et al. (2021) extended the list of technical tools and technologies potential for further integration including gamification, actuators and controllers, smart devices, smart sensors and haptics. As recommended by Lin et al. (2018), it is essential to build a set of virtual lab environment that is integrated, categorized, and personalized to different course offerings. Considering the integration approach, the security of user data and distributed input events are to be managed properly. The security mechanism applies user authentication mode, implemented on the web server module. Permission settings for different users are enforced and only authorized users can access the lab learning materials like the lab manuals for experiments. Pfeiffer et al. (2020) suggested that lab-based education is essential especially in scientific subjects. This suggestion is therefore relevant and practical to subjects within the science, technology, engineering and mathematics (STEM) domain. Subjects such as biology, physics, chemistry, nuclear research and fuel research are some of the examples. The lab environment provides training in observation and offers a consistent level of technical and practical knowledge (Esposito et al., 2021). In this regard, effective use of e-learning systems for the lab session is imperative. Besides, the software systems, hardware systems and communications network must be integrated and incorporated effectively.

3. Familiarity with E-Learning Systems

Beyond the features and functionalities of the e-learning systems, another important factor is the familiarity among students on using the e-learning systems itself. During virtual lab session, students must be oriented with the features, tools and techniques. Elements such as graphical user interface (GUI), menus, toolbars, and working space are among the fundamental features important for students to be familiar with. Villa & Paula-Irene (2020) reported that students struggle with issues online including how to take assessments in a new format and settings. While Copeland et al. (2020) informed that among the typical sources of frustration in STEM lesson is from the difficulty of self-regulating work and struggle of navigating unclear instructions in the online environment. In online learning, self-regulating work is crucial and students who failed to regulate might face trouble to follow the virtual lab delivery. Consequently, it may lead to a lower students' performance which may potentially extent to stress, frustration and mental health issues especially during this unprecedented period of COVID-19 crisis. The total and sudden utilization of e-learning systems during COVID-19 crisis may have some negative effects on students' side, as a result of some hindrances which may likely hamper the overall students' learning process (Al-Kumaim et al., 2021). Virtual learning has become a new routine, however it poses serious challenges (Alsoud & Harasis, 2021). Furthermore, students' favor more on face to face learning as compared to online learning. For instance, in the study conducted by Copeland et al. (2020), it was found that less than 50% from the total 121 respondents perceived remote learning is effective. Perception wise, it can considerably be

challenging to instill the desired level of confidence among students towards the use of e-learning systems in the virtual lab delivery.

In relation, Al-Kumaim et al. (2021), suggested that obstacles for students could be from issues such as unfamiliarity with some information technologies platforms, limited Internet access or insufficient experience to deal with some e-learning systems in terms of the interactivity and engagement. Also, the same study described that students reported unfamiliarity with the online learning environment and new normal study practice. To balance and neutralized the obstacles, it is vital to ensure students have sufficient knowledge and understanding about using the e-learning systems, supporting their virtual lab class delivery. In this regard, it is essential to assess and evaluate option of having a mixed approach of synchronous and asynchronous experiments in the virtual lab session. In the synchronous approach, students attend the lab session virtually while lab instructor teaches. Through this method, students can interact with instructors directly in real time settings. Students learn together in live settings, allowing greater collaboration and sense of community (Alsoud & Harasis, 2021). An effective synchronous approach would require a stable and robust e-learning systems. While in the asynchronous approach, students learn and work on lab experiments independently. Lab materials are uploaded and made available by instructors for the students to refer during the self-study. Asynchronous approach could be superior than synchronous as it allows students flexibility in time and learning resources to follow up, recap and reinforce the knowledge they acquired (Al-Kumaim et al., 2021). Ideally, it would be appropriate for lab instructors to integrate both the synchronous and asynchronous approaches when designing their virtual lab instructional delivery. In doing so, the different categories of virtual experiments must also be assessed and take into consideration when designing. Primarily, students must be oriented, adapted and confidence when they use the e-learning systems while carrying out their virtual experimental tasks.

4. Methodology

This study had employed quantitative research methodology. Quantitative research methodology can be either descriptive or experimental. In this study, the researchers have utilized both approaches to learn the relationship between lab class delivery mode with e-learning systems improvement. Additionally, the relationship between gender with the familiarity of e-learning systems was also assessed. Self-administered questionnaire was developed and sent to target respondents via online survey. Google Form application was used to prepare the online survey and responses from respondents were gathered and recorded in the same application. Online survey was adopted considering the COVID-19 pandemic situation as the large society are forced to stay at home and obey the movement control order (MCO). Moreover, the speed of data collection through online survey is generally fast and quick (Alsoud & Harasis, 2021). The online survey was distributed via online communications medium such as email as well as through social media platforms including WhatsApp and Facebook. It is advantageous to distribute online survey and collect responses through social media platforms because online users are heavily dependent on their social media platforms. They checked, followed, shared and commented on online contents published on the social media platforms. As a result, data collection can be accelerated in a meaningful manner.

For the target population, a simple random sampling method was used. The target population includes undergraduate and postgraduate students who are active students currently pursuing their study in either public or private higher education institutions. The locality of the target population extends from higher education institutions located in Malaysia to higher education institutions located in other countries including Australia, Bangladesh, Canada, Nigeria and the United States of America (USA). The distribution of the online survey to overseas students studying abroad was made possible through the existing network and connections among the researchers of this study. In this view, the widespread coverage may help in the generalization of the data collection. Besides Google Form application, MS Excel application was also utilized to facilitate the analysis of the experimental quantitative method, the chi-square test. From the online survey, a total of 301 responses were collected. Eight data sets were removed as part of the data preparation process primarily due to missing, incomplete or having null values. Accordingly, 293 cleaned data sets were compiled and analyzed. Pre-processing of data

preparation is crucial to ensure the finalized data sets are usable, practical and fit for the subsequent experimental analysis.

5. Results

One of the fundamental response obtained in this study is on the perceived quality of the e-learning systems utilized by the students during the COVID-19 pandemic phase. The result has indicated that students in various higher education institutions were fairly satisfied with the quality of the e-learning systems. This is reflected by more than 80% of the respondents who responded that the e-learning systems used and utilized by their institutions is between good and excellent. The complete overview of the respondent's feedback on the quality of their e-learning systems is provided in Figure 1.

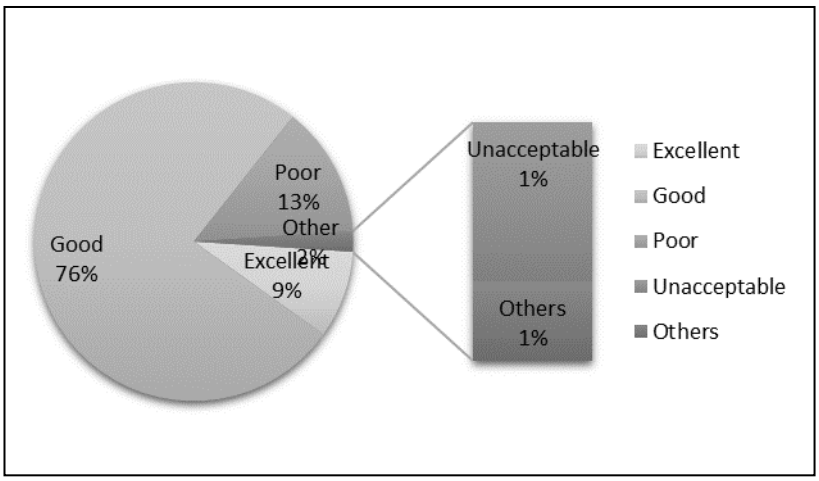

Figure 1: Evaluation of respondents on the quality of e-learning systems utilized by their institutions

There are various e-learning systems available and largely, students are satisfied with the quality of the features offered and functionalities provided. In this view, we may deduce that the e-learning systems are generally user-friendly and ease to be used by the students. Relative to virtual lab class delivery, we may also presume that the same e-learning systems are appropriate for the purpose of virtual experiment activities. Furthermore, the positive result on the perceived quality of the e-learning systems by the respondents was evaluated using another measure through chi-square test. Specifically, the relationship between lab class delivery mode with e-learning systems improvement was assessed. The categorical variables collected were summarized as a series of counts that are arranged in a tabular format known as a contingency table (Singhal & Rana, 2015). Basically, as shown in Table 1, the data collection method and approach of this study has conformed to the fundamental assumptions underlying a chi-square test.

Table 1: Assumptions underlying the chi-square test relative to this study

	Fundamental Assumptions	Relatives
1	The data are randomly drawn from a population.	The data were drawn from a random population in various higher education institutions in and outside Malaysia, including both the public and private institutions.
2	The values in the cells are considered adequate when expected counts are not less than 5 and there are no cells with zero.	The data preparation process or also known as data wrangling was adopted (Hoang, 2017). This process is to get the data sets ready for use in business intelligence and analytics applications.
3	The sample size is sufficiently large with minimum sample size varies from 20 to 50.	The cleaned data sets are more than 50 sets.
4	The variables under consideration must be	There are no items that were counted twice.

mutually exclusive. It means that each variable must only be counted once in a particular category and should not be allowed to appear in other category.

The null and alternative hypothesis for the first chi-square test are:

H_0: There is no association between lab class delivery mode with e-learning systems improvement.
H_a: There is an association between lab class delivery mode with e-learning systems improvement.

In principle, the null hypothesis attempts to identify if there is any significant association between lab class delivery mode (i.e. virtual lab and face-to-face) with e-learning systems improvement. In the aspect of the improvement, it may be prompted by different challenges faced by students when utilizing the e-learning systems. Students evaluate the current situation during pandemic with their earlier personal experiences gained before the pandemic. The contingency table for the chi-square test was set up as a 2 x 2 table. The general formula for calculating the expected counts from observed count for a particular cell is ((corresponding row total * corresponding column total) / Total no. of students). To obtain the degrees of freedom (df), the standard rule of (number of rows − 1) × (number of columns − 1), excluding the rows and column containing the Total, was applied. Hence, the calculation for df is (2−1) × (2−1) = 1. The hypothetical data for calculating the chi-square test for testing the association between lab class delivery mode with e-learning systems improvement is provided in Table 2.

Table 2: Hypothetical data containing observed and expected values for calculating the chi-square test

Observed			
Are you okay with e-learning systems for your lab class (virtual) or face-to-face is better?	Do you agree that your e-learning systems need improvement?		
Row Labels	No	Yes	Total
E-learning systems	8	59	67
Face-to-face	20	206	226
Total	28	265	293
Expected			
Are you okay with e-learning systems for your lab class (virtual) or face-to-face is better?	Do you agree that your e-learning systems need improvement?		
Row Labels	No	Yes	Total
E-learning systems	6	61	67
Face-to-face	22	204	226
Total	28	265	293
p value	0.45		

The chi-square value for this test is derived as 0.5712. For the hypothesis test, 5% level of significance was observed which is equivalent to alpha level of significance at 0.05. From the derived chi-square value, the corresponding p value of 0.45 is then referenced and compared with the probability level (alpha) value in the chi-square distribution table. The excerpts from the chi-square distribution table are shown in Table 3. The value of χ^2 (0.5712) lies between 0.455 and 2.706 where the corresponding probability is between the 0.5 and 0.10 probability levels. This means that the p value is below 0.05. Since it is below the accepted significance level of 0.05 (i.e., $p < 0.05$), the null hypothesis cannot be rejected, or in other words the null hypothesis is accepted and conclude that there is no significant association between lab class delivery mode with e-learning systems improvement.

Table 3: Excerpts from chi-square distribution table

	Probability level (alpha)					
df	0.50	0.10	0.05	0.02	0.01	0.001
1	0.455	2.706	3.841	5.412	6.635	10.827
2	1.386	4.605	5.991	7.824	9.210	13.815
3	2.366	6.251	7.815	9.837	11.345	16.268
4	3.357	7.779	9.488	11.668	13.277	18.465
5	4.351	9.236	11.070	13.388	15.086	20.517

Additionally, a second chi-square test was conducted in this study which relates to self-efficacy or familiarity with the e-learning systems. It is wise to put efforts and develop new understanding for any significant association between male and female students with their self-familiarity on the e-learning systems utilized during the COVID-19 pandemic phase.

The null and alternative hypothesis for the second chi-square test are:

H_0: There is no association between gender with familiarity of e-learning systems.
H_a: There is an association between gender with familiarity of e-learning systems.

The contingency table for the second chi-square was set up as a 2 x 4 table. The calculation for df is $(2-1) \times (4-1) = 3$. The hypothetical data for calculating the chi-square for testing the association between gender with familiarity of e-learning systems is provided in Table 4.

Table 4: Hypothetical data containing observed and expected values for calculating the chi-square test

Observed			
How acquainted are you with the e-learning systems you used?	Gender		
Row Labels	Female	Male	Total
Not familiar	21	15	36
Quite familiar	41	27	68
Familiar	95	39	134
Very familiar	41	14	55
Total	198	95	293
Expected			
How acquainted are you with the e-learning systems you used?	Gender		Gender
Row Labels	Female	Female	Total
Not familiar	24	12	36
Quite familiar	46	22	68
Familiar	91	43	134
Very familiar	37	18	55
Total	198	95	293
p value	0.18		

The chi-square value for this test is derived as 4.9425. For the hypothesis test, 5% level of significance was again observed which is equivalent to alpha level of significance at 0.05. From the derived chi-square value, the corresponding p value of 0.18 is then referenced and compared with the probability level (alpha) value in the chi-square distribution table, as shown in Table 3. The value of χ^2 (4.9425) lies between 2.366 and 6.251 where the corresponding probability is between the 0.5 and 0.10 probability levels. This means that the p value is below 0.05. Since it is below the accepted significance level of 0.05 (i.e., $p < 0.05$), the null hypothesis is not significant or in other words we accept the null hypothesis and conclude that there is no significant association between gender with familiarity of e-learning systems.

6. Discussions

This study provides some new understandings on the adoption of e-learning systems during the phase of COVID-19 pandemic. In terms of the basic quality of the e-learning systems, it is fair to perceive that the service delivery is satisfactory, including for virtual lab class. Observing on this aspect, higher education institutions should continue to maintain the current service delivery featured by the e-learning system utilized by the institutions. Line management of the institutions should also consider to regularly assess the e-learning technological trends. Keeping up-to-date with the latest offerings is important to remain competitive in the education sector. Stable, reliable and dependable e-learning systems are important as at present and perhaps moving forward, the whole world are moving towards a new norm in conducting teaching and learning delivery at distance. In particular, it is even decisive for the private institutions as their business and revenue models are predominantly rely on tuition and fees to stay afloat (Choong, 2020). Usually, lab class delivery is perceived to be best carry out in face-to-face delivery mode. From this study, it is learned that this is not the ultimate case. The association analysis reveals that there is no significant relationship between lab class delivery mode with e-learning systems improvement. In view of this, during the COVID-19 pandemic, it appears that students are not encountering much difficulty or constraints when attending virtual lab class via the e-learning systems utilized by their institutions. In relation, this further indicates that the lab class delivery is suitable and appropriate to be conducted via online through the e-learning systems.

Students' self-efficacy and general familiarity on the e-learning systems are relatively important as well. Being familiar and highly oriented on how to use and operate the e-learning systems will greatly facilitate interest and makes the learning process more beneficial. Through this study, it is learned that there is no distinct association between gender and familiarity with the e-learning systems. This appeals that both male and female students were largely acquainted with the e-learning systems during the pandemic phase. For higher education institutions, this can be a positive sign especially during new enrolment periods that may take place concurrently during the movement control order (MCO) phase. Higher education institutions can be more confident that their new students, male or female could instantly ready to go on board with the online learning using their selected e-learning systems. As current students' population is a hyper connected generations, this new information is not a major surprise. Current generations are closely linked with mobile technologies and Internet connectivity. Thus, institutions can put central focus more on the primary on-boarding arrangements, orientation and necessities, than developing extensive training plan on the e-learning systems for the newly enrolled students.

7. Conclusions and Recommendations

This study primarily contributes in a direction where new information is gained about students' view on lab class delivery mode and their perceived familiarization with e-learning systems, during the COVID-19 pandemic. Therefore, the findings may offer new perspectives for higher education institutions' policy makers to review and utilize it for ensuring and sustaining the successful usage of e-learning systems in conducting the online teaching and learning delivery. The findings of this study are based on empirical evidence and endorses more avenues for future study in accelerating the understanding and analysis on lab class delivery mode and students' familiarization with the utilized e-learning systems. Furthermore, the established findings from this study is largely appropriate for higher education institutions across geographical regions. As a whole, higher education institutions' policy makers, system designers and application developers can obtain benefit on a tangible overview about the current functionalities of e-learning systems. The understanding may aid as broad guidelines to manage future distribution and delivery of e-learning systems to the students. In order to response to the hypothesis, this study employed a quantitative analysis approach using chi-square test with MS Excel application. The survey was conducted with students across regions including from Malaysia, Australia, Bangladesh, Canada, Nigeria and the United States of America (USA). In view of the above, future study can leverage on the current findings. The lab class delivery mode can be further narrow down in focus into several clustered themes for example, lab class for pure science courses, lab class for information technology (IT) courses, lab class for language courses, and lab class for accounting courses. Other types of statistical analysis could also be employed to provide an extended

understanding or insights for the associated dependent and independent variables. In line with the scope of this study, another future opportunity is in the scope of geographical area where future study can put special emphasis on a specific country or region.

References

Abidah, A., Hidaayatullaah, H. N., Simamora, R. M., Fehabutar, D., & Mutakinati, L. (2020). The Impact of Covid-19 to Indonesian Education and Its Relation to the Philosophy of "Merdeka Belajar." Studies in Philosophy of Science and Education, 1(1), 38–49. https://doi.org/10.46627/sipose.v1i1.9

Aboagye, E., Yawson, J. A., & Appiah, K. N. (2020). COVID-19 and E-Learning: the Challenges of Students in Tertiary Institutions. Social Education Research, 109–115. https://doi.org/10.37256/ser.122020422

Al-Kumaim, N. H., Mohammed, F., Gazem, N. A., Fazea, Y., Alhazmi, A. K., & Dakkak, O. (2021). Exploring the Impact of Transformation to Fully Online Learning During COVID-19 on Malaysian University Students' Academic Life and Performance. *International Journal of Interactive Mobile Technologies (IJIM)*, 15(05), *140*. https://doi.org/10.3991/ijim.v15i05.20203

Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. Education and Information Technologies, 25. https://doi.org/10.1007/s10639-020-10219-y

Alsoud, A. R., & Harasis, A. A. (2021). The Impact of COVID-19 Pandemic on Student's E-Learning Experience in Jordan. *Journal of Theoretical and Applied Electronic Commerce Research*, 16(5), *1404–1414*. https://doi.org/10.3390/jtaer16050079

Ating, R. (2020, June 30). Challenges to Learning and Teaching in Malaysia in the Time of Covid-19. SHAPE-SEA. https://shapesea.com/op-ed/covid-19/challenges-to-learning-and-teaching-in-malaysia-in-the-time-of-covid-19/

Choong, J. (2020, May 9). Study shows Covid-19 could devastate private universities as students' delay studies to brace for looming recession | Malay Mail. www.malaymail.com. https://www.malaymail.com/news/malaysia/2020/05/09/study-shows-covid-19-could-devastate-private-universities-as-students-delay/1864519#.Xy7XmhgOtwU.email

Clover, I. (2017, February 17). Advantages And Disadvantages Of eLearning. ELearning Industry; eLearning Industry. https://elearningindustry.com/advantages-and-disadvantages-of-elearning

Copeland, W. E., McGinnis, E., Bai, Y., Adams, Z., Nardone, H., Devadanam, V., Rettew, J., & Hudziak, J. J. (2020). Impact of COVID on College Student Mental Health and Wellness. *Journal of the American Academy of Child & Adolescent Psychiatry*, 60(1). https://doi.org/10.1016/j.jaac.2020.08.466

Daily Times. (2020, April 15). Online teaching and challenges of COVID-19 for inclusion of PWDs in higher education. Daily Times. https://dailytimes.com.pk/595888/online-teaching-and-challenges-of-covid-19-for-inclusion-of-pwds-in-higher-education/

Esposito, G., Mezzogori, D., Reverberi, D., Romagnoli, G., Ustenko, M., & Zammori, F. (2021). Non-Traditional Labs and Lab Network Initiatives: A Review. *International Journal of Online and Biomedical Engineering (IJOE)*, 17(05), *4*. https://doi.org/10.3991/ijoe.v17i05.20991

Favale, T., Soro, F., Trevisan, M., Drago, I., & Mellia, M. (2020). Campus traffic and e-Learning during COVID-19 pandemic. Computer Networks, 176, 107290. https://doi.org/10.1016/j.comnet.2020.107290

Gonzalez, T., de la Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID-19 confinement on students' performance in higher education. PLOS ONE, 15(10), e0239490. https://doi.org/10.1371/journal.pone.0239490

Hoang, N. (2017, March 16). Data Preparation Processing: Steps and Meaning. Trifacta. https://www.trifacta.com/data-preparation-process/

Kapasia, N., Paul, P., Roy, A., Saha, J., Zaveri, A., Mallick, R., Barman, B., Das, P., & Chouhan, P. (2020). Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India. Children and Youth Services Review, 116, 105194. https://doi.org/10.1016/j.childyouth.2020.105194

Lin, Y., Wang, S., Wu, Q., & Chen, L. (2018). Key Technologies and Solutions of Remote Distributed Virtual Laboratory for E-Learning and E-Education. Mobile Networks and Applications, 24(1), 18–24. https://doi.org/10.1007/s11036-018-1130-z

Liu, S., Li, Z., Zhang, Y., & Cheng, X. (2019). Introduction of Key Problems in Long-Distance Learning and Training. Mobile Networks and Applications, 24(1), 1–4. https://doi.org/10.1007/s11036-018-1136-6

Maphosa, V. (2021). Factors Influencing Student's Perceptions Towards E-Learning Adoption During COVID-19 Pandemic: A Developing Country Context. *European Journal of Interactive Multimedia and Education*, *2*(2), e02109. https://doi.org/10.30935/ejimed/11000

Pfeiffer, A., Lukarov, V., Romagnoli, G., Uckelmann, D., & Schroeder, U. (2020). Experiential Learning in Labs and Multimodal Learning Analytics. Adoption of Data Analytics in Higher Education Learning and Teaching, 349–373. https://doi.org/10.1007/978-3-030-47392-1_18

Radha, R., Mahalakshmi, K., Sathish Kumar, Dr. V., & Saravanakumar, Dr. AR. (2020). E-Learning during Lockdown of Covid-19 Pandemic: A Global Perspective. *International Journal of Control and Automation*, 13(4), *1088–1099*.

Singhal, R., & Rana, R. (2015). Chi-square test and its application in hypothesis testing. *Journal of the Practice of Cardiovascular Sciences*, 1(1), *69*. https://doi.org/10.4103/2395-5414.157577

Software Testing Help. (2020). 15 Best Learning Management Systems (LMS of the Year 2020). www.softwaretestinghelp.com. https://www.softwaretestinghelp.com/learning-management-system/

Strielkowski, W. (2020). COVID-19 Pandemic and the Digital Revolution in Academia and Higher Education. https://doi.org/10.20944/preprints202004.0290.v1

The Straits Times. (2020, June 15). Forum: Covid-19 has widened digital divide. The Straits Times. https://www.straitstimes.com/forum/covid-19-has-widened-digital-divide

Villa, & Paula-Irene. (2020). What the crisis tells us about the challenges and actual problems of our universities and higher education system. Elephantinthelab.org. https://doi.org/10.5281/zenodo.3813167

World Health Organization. (2020). Coronavirus disease (COVID-19) in Malaysia. www.who.int. https://www.who.int/malaysia/emergencies/coronavirus-disease-(covid-19)-in-malaysia