EDUCATIONAL TECHNOLOGY EVOLVEMENT DURING THE COVID-19 PANDEMIC: A LITERATURE REVIEW

Hamim Hamdani [a*)], Ermaya Suradinata [a)], Layla Kurniawati [a)], Wangsih [a)]

[a)] *Institute of Home Affairs Governance, Sumedang, Indonesia*

[*)]*Corresponding Author: hamdan12051966@gmail.com*

Article history: *received 02 December 2023; revised 16 January 2023; accepted 02 February 2023* *DOI: https://doi.org/10.33751/jssah.v4i1.9952*

Abstract. The COVID-19 pandemic has become a global problem that has impacts on various government sectors. The education sector included the fields of science and technology, is one of the main pillars that must be maintained and improved under any circumstances. This study was conducted to determine the evolvement of educational technology during the COVID-19 pandemic. Articles related to educational technology have been collected through data-based Mendeley, using the keyword "Education Technology". The articles were filtered through several stages, as follows; a number of 163,616 articles were screened by related title, which then 33,228 articles were obtained after bering filtered by year 2020-2022. Then 23,747 articles were identified after being filtered to document type, journal (Education and Information technologies) obtained 197 articles, which then filtered by access type (open access) acquired 84 articles, and eventually 20 articles were eligible by inclusion and exclusion criteria that focused on the topic of educational technology during the COVID-19 pandemic. The findings of the article analysis were: 1) Educational technology during the COVID-19 pandemic, 2) Types of educational technology, and 3) Factors that influence the application of educational technology, and 4) Impact of educational technology. Educational technology is significantly important for continuity of learning process during the COVID-19 pandemic.

Keywords: education, technology, COVID-19

I. INTRODUCTION

Corona Virus Disease 2019 (COVID-19) has become a crucial issue since the end of 2019. In 2022, there were 532 million cases with 6.3 million deaths globally (Our World in Data, 2022). At the end of 2019, BBC News Indonesia reported that the first virus was discovered in Wuhan city, China, confirming more than 178 million cases with 3.9 million deaths. It spread rapidly and became a pandemic all over the world. In January 2022, there were ten countries with the highest cases and much deaths in the world (USA, Brazil, India, Rusia, Mexico, Peru, United Kingdom, Italia, Indonesia, and Columbia) (Worldometers, 2022). The COVID-19 virus has impacts on various sectors. The government in various countries has responded to take appropriate policies and steps to handle this case. The main policy has been carried out in various countries, including Indonesia, is to limit social activities or quarantine. In the early 2020, the Indonesian government issued Government Regulation Number 21 of 2020 concerning Large-Scale Social Restrictions in the Context of Accelerating the Handling of COVID-19 (PP Nomor 21 Tahun 2020, n.d.). This enforcement was based on government's various considerations including; the increasing number of COVID-19 cases and deaths, and the impacts to political, economic, social, cultural, defense and security, education, and health and welfare aspects of the Indonesian. The education sector is one of the main pillars in a country that affected by the COVID-19. Developed and developing country governments are still trying in various ways to keep the learning process continues during the pandemic. Therefore, an online learning method (online) was arranged using the internet and technology to allows individual or group interaction through cyberspace (online). Research conducted by (Matzavela & Alepis, 2021) stated that the learning process using a cell phone or smartphone has been used during the COVID-19 pandemic. The findings also reported some constraints in its features. Learning by using mobile phones or computers/laptops should be supported by certain applications that support online learning, such as; Zoom applications, Whatsapp, Google meet, and so on (Turnbull et al., 2021).

Education in the COVID-19 Pandemic Era relies on the technological assistance. Based on the results of a survey by the Badan Pusat Statistik (Central Statistics Agency), the development of Indonesia's information and communication technology in 2016 was ranked 111th out of 176 countries. According to data from the International Telecommunication Union (ITU) in the Southeast Asia region, Indonesia was sequentially below the countries of Singapore, Malaysia, Brunei Darussalam, the Philippines and Vietnam (Reily, 2017). Technology was created to assist works or activities. Many technological innovations has been evolve during the COVID-19 pandemic, especially in the field of education. However, not all of these technologies can be directly implemented in society. This may be influenced by several factors. In addition, the authors interested to conduct a literature review regarding the impact of educational technology on the online learning process (online).

II. RESEARCH METHODS

Literature review is a comprehensive summary of previous research on a certain topic. This study surveys scientific articles, books, and other sources that are relevant to a particular research field. Literature review is conducting a survey of books, scientific articles, and other sources with a particular problem, research field, or theory, which then provides a description, summary and critical evaluation in relation to the investigated research problem (Fink, 2014). Literature review uses a systematic approach as a method to analyze data in a simplified approach. The articles used are research results of literature reviews, qualitative and quantitative studies with Abstracts, Introduction, Methods, Results, and Discussion. The article selection of this study used the available database on the "Mendeley" e-resource. The keywords in finding articles were typed in English, namely "Education Technology". The articles were filtered through several stages, as follows; a number of 163,616 articles were screened by related title, which then 33,228 articles were obtained after being filtered by year 2020-2022. Then 23,747 articles were identified after being filtered to document type, journal (Education and Information technologies) obtained 197 articles, then filtered by access type (open access) acquired 84 articles, and eventually 20 articles were eligible by inclusion and exclusion criteria that focused on the topic of educational technology during the COVID-19 pandemic. These stages were conducted to maintain the quality of literature reviews based on ethical considerations such as: avoiding duplication of the publications, avoiding plagiarism, transparency, and ensuring accuracy.

III. RESULTS AND DISCUSSION

Analysis matrix was implemented to execute a summary of the literature review on educational technology during the COVID-19 pandemic. The summary results show that regarding online learning, government policies in various countries have received support from the community, especially from students (Singh et al., 2021). The results of this systematic review analysis showed that the impact of the lockdown policy on education prompted several countries to promote online learning during a pandemic (Abu Talib et al., 2021). The online learning process was supported by applications that facilitate teachers and students to learn and also see each other privately. The application used were Zoom, Youtube, Moodle, Facebook, Blackboard, Microsoft, skype, Whatsapp, google class room, tweeter, and Google Docs (Turnbull et al., 2021). In addition, technological innovations were designed to facilitate the student on an academic examination process. Online Proctored Examination (OPE) application was accepted and had a positive effect (Raman et al., 2021). Furthermore, the learning method based on the IS DeLone and McLean models obtained quite significant results in the online learning process (Alzahrani & Seth, 2021). The factors that influenced the educational technology implementation in the learning process were the possession of basic computer skills, the technological convenience, the technological utility (Jiang et al., 2021), digital devices mastery and the training for teachers about E-Learning programs(Kovacs et al., 2021), lack of resources and sufficient internet access, affordable and reliable technology, as well as socio-economic status (Cahyadi et al., 2022). Apart from having a positive impact on the learning process, educational technology also had others impact on students and educational institutions, such as; derivation of learning outcome and sense of belonging degradation of students to their university (Morgan et al., 2022), practical learning could not be carried out optimally through online larning, feelings of boredom with prolonged online methods, and decreased satisfaction of social interaction.

This literature review analyzed 20 articles related to educational technology during the COVID-19 period. Therefore, the author also explained about some related terms such as; Science, technology, education, and the COVID-19 pandemic. As mentioned in Law Number 11 year of 2019, these terms were explained in the general provisions chapter. Science is a collection of information that is explored, organized, and developed systematically using scientific methodologies to explain and/or prove natural phenomena, and/or social phenomena based on belief in God Almighty. Furthermore, technology is defined as a way, method or process of applying and utilizing various scientific disciplines that are useful in fulfilling needs, continuity, and improving the quality of human life. Education is a conscious and planned effort to create a learning atmosphere and learning process so that the students can actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation and state. Meanwhile, according to the Ministry of Health, corona virus is a large family of viruses that cause disease in humans and animals. In humans, it usually causes respiratory tract infections, ranging from the common cold to serious diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) (Kemenkes RI, 2020).

By identifying 20 eligible articles, four main findings were obtained related to educational technology during the COVID-19 pandemic. The first finding was regarding support for implementing online methods in the learning process during the co-19 pandemic. All countries listed in articles were Indonesia, Saudi Arabia, United Arab Emirates, China, Australia, Switzerland, Greece, India, Iran Israel, Poland, America, Ghana and Zimbabwe. Those countries supported and provided policies regarding the implementation of online learning. The second finding was about educational technology types that were often used in the learning process as well as new methods used to support learning activities and evaluations during a pandemic such as; Zoom, Youtube, Moodle, Facebook, Blackboard, Microsoft, Skype, Whatsapp, google class room, tweeter, and Google Docs applications. In addition, there was also the OPE method designed for the online student examination process, the IS DeLone and McLean methods, mobile phones or smartphones, virtual laboratories, the development of the Emergency Teaching Evaluation (ERT) method, and the development of the Unfied

Theory of Acceptance and Use of Technology (UTAUT) model. The third finding was about the factors that influenced the application of educational technology such as; computer skills, the technological convenience, the technological utility, digital devices mastery and the training for teachers about E-Learning programs, lack of resources and sufficient internet access, affordable and reliable technology, as well as socio-economic status. The fourth finding showed that aside from having a positive impact, online learning also has impact on several things such as; derivation of learning outcome and sense of belonging degradation of students to their university, practical learning could not be carried out optimally through online larning, feelings of boredom with prolonged online methods, and decreased satisfaction of social interaction.

Educational Technology During the COVID-19 Pandemic

The COVID-19 pandemic has led to dramatic impact on various aspects of human life worldwide. Aspects of government, social, health, education and other aspects that are assembled require an adjustment to continue running in a balanced way. For nearly three years, besides the health aspect, the education aspect has also received special attention. Quarantine or self-isolate at home policies has become issue. In other words, learning activities cannot be carried out as usual, especially for conventional or face-to-face learning. For this reason, governments in various countries continue to innovate in education technology so that the education can still be carried out by distance or online learning. Technology is defined as consisting of hardware and software (knowledge to produce and use technological hardware) (Kiraz, 2019). Meanwhile, education is defined as a conscious effort to achieve something that is culturally inherited from generation to generation. Education creates today's generation as the role model for the previous generations in teaching activities. Until now, education has no limitations to explain the meaning of education itself because of it is complex nature for human. Its complex nature is often called as the science of education. Science education is a continuation of education. Educational science is more related to educational theory which prioritizes scientific thinking. Education and science education have a relationship in terms of practice and theory. Thus, in human life, both collaborate with each other (Rahman et al., 2022). Technology is a tool created to achieve a goal (Dron, 2022). Educational technology talks about technology or tools used in education or learning. According to Dron (2022) explains that educational technology, or learning technology, can be tentatively defined as technology that, intentionally or not, includes pedagogy among the regulated technologies. While some educational technologies are designed and sold for this purpose – learning management systems, textbooks, electronic whiteboards, courses, etc. – almost any technology (from factories to word processing), when combined with appropriate pedagogy and other technologies, is used to support or generate learning activities. Neither students nor designers need to be aware of it. For example, the toy cars creator may not find them educate the child, and the child who plays them may not plan to learn from them, but the imaginative games they play can support strong learning processes.

Types of Educational Technology During the COVID-19 Pandemic

Based on the results of previous studies, there were several technologies used in education (learning), namely: zoom meeting, youtube, moodle, facebook, blackboard, Microsoft, skype, whatsapp, google classroom, titter and google docs (Turnbull et al., 2021). This paper discussed the three most popular applications from the results of the study. One of the most popular applications was Zoom Meeting. Many educational institutions, businesses, government health and so on used the zoom meeting application as a learning application or delivery of information online. This application can be applied easily by users, besides that this application can be downloaded and installed for free. Some Zoom meetings are paid and some are free. For the free version, users will only be given 40 minutes of time which will automatically turn off after the time runs out. However, for the paid version there is no time limit, meaning that users can communicate without interruption, unless there are problems with the internet network. This application is also often used at national and international seminar events. Apart from the Zoom Meeting application, the second popular application is YouTube. People can find anything they are looking for through youtube. This application is general in nature, not only educational content that can be watched but also other content such as entertainment, sports, government, health and so on. Youtube in the academic field is usually used to upload learning content, cannot be used as a direct online face-to-face medium, usually it can only be watched. As for usually the students are assigned to analyze a learning video in accordance with the topics taught in lectures. Or students are given the task of making a learning video or tutorial and then uploading it on YouTube.

Furthermore, the third application is the modle application. This application is in the form of a web-based which is often used as an effective online learning media. In some countries this application may be popular, but in Indonesia the academic community is not very familiar with this application. Because they find it easier to use zoom meetings or even other e-learning programs. This moodle application is very useful to be implemented as a Learning Management System (LMS). It has many advantages, such as being accessible for free, having complete features, network and security features that can be set individually, and so on However, the drawbacks of Moodle are 1) users must have a deeper understanding of Moodle, 2) an expert is required to act as an administrator, and 3) it requires pretty good hardware and a fairly high cost.

Factors that Influence the Application of Educational Technology

Educational technology is indeed very helpful in the learning process, but there are several important factors that influenced the implementation or application of these technologies in learning. Several factors that can influence the application of educational technology are school readiness including academic maintenance and social welfare (Williams & Corwith, 2021), post-COVID-19 strategies to promote e-learning (Adarkwah, 2021), adequate internet connection, level of difficulty of technology applications, economic

conditions and the support of school IT expert staff (Cahyadi et al., 2022).

School readiness is one of the main factors that can influence the application of technology in the educational environment. If schools are not ready, then the learning process using technology will be constrained and even cannot be carried out properly. Educational institutions should prioritize prior preparation, such as; synchronizing the educational curriculum, providing good and quality supporting facilities and infrastructure, adequate internet network and training for staff or teaching staff related to the applications to be used. Economic and social factors also influence its application, because in general the poor are constrained to prepare online learning support facilities such as; cellphones, laptops, and internet data packages. In addition, educational institutions tend to use applications that are easy to apply as learning media, low cost and accessible for free. This characteristic could likely be reached by the lower middle class, so that the learning process using technology can be enjoyed and used together easily and efficiently.

The Impact of Educational Technology on Online Learning

Educational technology in online learning certainly has positive and negative impacts.

IV. CONCLUSIONS

During the COVID-19 pandemic, the most often used application in online learning is the Zoom Meeting application. Possession of basic computer skill, insufficient internet connection access, technological convenience, application usability, e-learning training, and socio-economics influenced online learning activities. However, the shortcomings of online learning were derivation of learning outcome and students' sense of belonging at university, ineffective practical learning, and lastly the students' boredom feeling of prolonged online methods.

REFERENCES

[1] Abu Talib, M., Bettayeb, A. M., & Omer, R. I. (2021). Analytical study on the impact of technology in higher education during the age of COVID-19: Systematic literature review. *Education and Information Technologies*, *26*(6), 6719–6746. https://doi.org/10.1007/s10639-021-10507-1

[2] Adarkwah, M. A. (2021). "I'm not against online teaching, but what about us?": ICT in Ghana post Covid-19. *Education and Information Technologies*, *26*(2), 1665–1685. https://doi.org/10.1007/s10639-020-10331-z

[3] Alzahrani, L., & Seth, K. P. (2021). Factors influencing students' satisfaction with continuous use of learning management systems during the COVID-19 pandemic: An empirical study. *Education and Information Technologies*, *26*(6), 6787–6805. https://doi.org/10.1007/s10639-021-10492-5

[4] Bamoallem, B., & Altarteer, S. (2022). Remote emergency learning during COVID-19 and its impact on university students perception of blended learning in KSA. *Education and Information Technologies*, *27*(1), 157–179. https://doi.org/10.1007/s10639-021-10660-7

[5] Cahyadi, A., Hendryadi, Widyastuti, S., & Suryani. (2022). COVID-19, emergency remote teaching evaluation: The case of Indonesia. *Education and Information Technologies*, *27*(2), 2165–2179. https://doi.org/10.1007/s10639-021-10680-3

[6] Dron, J. (2022). Educational technology: What it is and how it works. In *AI and Society* (Vol. 37, Issue 1). https://doi.org/10.1007/s00146-021-01195-z

[7] Ezra, O., Cohen, A., Bronshtein, A., Gabbay, H., & Baruth, O. (2021). Equity factors during the COVID-19 pandemic: Difficulties in emergency remote teaching (ert) through online learning. *Education and Information Technologies*, *26*(6), 7657–7681. https://doi.org/10.1007/s10639-021-10632-x

[8] Fink, A. (2014). *Conducting Research Literature Reviews: From the Internet to Paper. Fourth edition.* (4th ed.). SAGE. https://libguides.usc.edu/writingguide/literaturereview

[9] Jiang, H., Islam, A. Y. M. A., Gu, X., & Spector, J. M. (2021). Online learning satisfaction in higher education during the COVID-19 pandemic: A regional comparison between Eastern and Western Chinese universities. *Education and Information Technologies*, *26*(6), 6747–6769. https://doi.org/10.1007/s10639-021-10519-x

[10] Karimian, Z., Farrokhi, M. R., Moghadami, M., Zarifsanaiey, N., Mehrabi, M., Khojasteh, L., & Salehi, N. (2022). Medical education and COVID-19 pandemic: A crisis management model towards an evolutionary pathway. *Education and Information Technologies*, *27*(3), 3299–3320. https://doi.org/10.1007/s10639-021-10697-8

[11] Kemenkes RI. (2020). *Coronavirus*.

[12] Khan, S., Kambris, M. E. K., & Alfalahi, H. (2022). Perspectives of University Students and Faculty on remote education experiences during COVID-19- a qualitative study. *Education and Information Technologies*, *27*(3), 4141–4169. https://doi.org/10.1007/s10639-021-10784-w

[13] Kiraz, G. (2019). Chapter Twenty Eight. *Comparative Edition of the Syriac Gospels*, 1–6. https://doi.org/10.31826/9781463209643-010

[14] Kovacs, H., Pulfrey, C., & Monnier, E. C. (2021). Surviving but not thriving: Comparing primary, vocational and higher education teachers' experiences during the COVID-19 lockdown. *Education and Information Technologies*, *26*(6), 7543–7567. https://doi.org/10.1007/s10639-021-10616-x

[15] Marchlik, P., Wichrowska, K., & Zubala, E. (2021). The use of ICT by ESL teachers working with young learners during the early COVID-19 pandemic in Poland. *Education and Information Technologies*, *26*(6), 7107–7131. https://doi.org/10.1007/s10639-

021-10556-6

[16] Matzavela, V., & Alepis, E. (2021). M-learning in the COVID-19 era: Physical vs digital class. *Education and Information Technologies*, *26*(6), 7183–7203. https://doi.org/10.1007/s10639-021-10572-6

[17] Morgan, C., Tsai, M. C., Hsu, C. E., Chow, H. W., Guo, H. R., & Lee, M. H. (2022). Qualitative impact assessment of COVID-19 on the pedagogical, technological and social experiences of higher education students in Taiwan. *Education and Information Technologies*, *0123456789*. https://doi.org/10.1007/s10639-022-10896-x

[18] Our World in Data. (2022). *COVID-19 Data Explorer*. https://ourworldindata.org/explorers/coronavirus-data-explorer?tab=map&facet=none&Metric=Confirmed+deaths&Interval=7-day+rolling+average&Relative+to+Population=true&Color+by+test+positivity=false&country=USA~ITA~CAN~DEU~GBR~FRA~JPN

[19] PP Nomor 21 Tahun 2020, Pub. L. No. PP Nomor 21 Tahun 2020. https://peraturan.bpk.go.id/Home/Details/135059/pp-no-21-tahun-2020

[20] Punjani, K. K., & Mahadevan, K. (2022). Transitioning to online learning in higher education: Influence of Awareness of COVID-19 and Self-Efficacy on Perceived Net Benefits and Intention. *Education and Information Technologies*, *27*(1), 291–320. https://doi.org/10.1007/s10639-021-10665-2

[21] Radhamani, R., Kumar, D., Nizar, N., Achuthan, K., Nair, B., & Diwakar, S. (2021). What virtual laboratory usage tells us about laboratory skill education pre- and post-COVID-19: Focus on usage, behavior, intention and adoption. *Education and Information Technologies*, *26*(6), 7477–7495. https://doi.org/10.1007/s10639-021-10583-3

[22] Rahman, A., Munandar, S. A., Fitriani, A., Karlina, Y., & Yumriani. (2022). Pengertian Pendidikan, Ilmu Pendidikan dan Unsur-Unsur Pendidikan. *Al Urwatul Wutsqa: Kajian Pendidikan Islam*, *2*(1), 1–8.

[23] Raman, R., Sairam, B., Veena, G., Vachharajani, H., & Nedungadi, P. (2021). Adoption of online proctored examinations by university students during COVID-19: Innovation diffusion study. *Education and Information Technologies*, *26*(6), 7339–7358. https://doi.org/10.1007/s10639-021-10581-5

[24] Reily, M. (2017). *Teknologi Informasi di Indonesia Peringkat 111 dari 176 Negara Michael Reily*. https://katadata.co.id/pingitaria/digital/5e9a5623497a3/teknologi-informasi-di-indonesia-peringkat-111-dari-176-negara

[25] Singh, M., Adebayo, S. O., Saini, M., & Singh, J. (2021). Indian government E-learning initiatives in response to COVID-19 crisis: A case study on online learning in Indian higher education system. In *Education and Information Technologies* (Vol. 26, Issue 6). Springer US. https://doi.org/10.1007/s10639-021-10585-1

[26] Turnbull, D., Chugh, R., & Luck, J. (2021). Transitioning to E-Learning during the COVID-19 pandemic: How have Higher Education Institutions responded to the challenge? *Education and Information Technologies*, *26*(5), 6401–6419. https://doi.org/10.1007/s10639-021-10633-w

[27] Williams, K. M., & Corwith, A. (2021). Beyond Bricks and Mortar: The efficacy of online learning and community-building at College Park Academy during the COVID-19 pandemic. *Education and Information Technologies*, *26*(5), 5055–5076. https://doi.org/10.1007/s10639-021-10516-0

[28] Worldometers. (2022). *Reported Cases and Deaths by Country or Territory*. https://www.worldometers.info/coronavirus/

[29] Zhou, M., Dzingirai, C., Hove, K., Chitata, T., & Mugandani, R. (2022). Adoption, use and enhancement of virtual learning during COVID-19. *Education and Information Technologies*, *0123456789*. https://doi.org/10.1007/s10639-022-10985-x