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Sustainability of Technology Use in Higher Education in Indonesia Post the COVID-19 Pandemic: Analysis of Scientific Evidence

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Keywords

Sustainability, Technology, Higher Education, Evidence Analysis

Abstract

We carried out this study to analyze several scientific pieces of evidence on the sustainability of the use of technology in the context of post-pandemic higher education learning. We got several kinds of literature in the form of scientific evidence from several publications released between 2010 and 2020, which we obtained electronically with keyword-based searches such as "technology uses," "sustainability Education," higher education" post-Covid-19," and technology in learning." To get answers to the questions of this study, we analyzed the data under another phenomenon approach which involved data coding techniques, data evaluation, data interpretation, and valid and reliable conclusions. Based on existing data and discussion of the results, we can conclude that the analysis of scientific evidence shows that the continued use of technology in teaching in higher education is an effort made to harmonize learning in the 21st century, which prioritizes technology adoption to accelerate learning outcomes in tertiary institutions. This result will be a helpful insight into the following studies.

Introduction

The world is changing, and each country's agenda continues to be proclaimed for sustainable development. Indonesia marked an important moment in the effort to join the global community to create a sustainable future (Marshall & Farahbakhsh, 2013). The linked international community's "Sustainable Development Goals" (SDGs) give a basic framework for organizations and communities to address them individually and collectively. According to Law No. 32 of 2009 on Environmental Protection and Management, sustainable development is an intentional and planned effort that incorporates environmental, social, and economic components into a development strategy to preserve environmental integrity and safety (Asrun et al., 2020). An example of sustainable development carried out by several regions in Indonesia is the existence of natural tourism. This development is necessary to provide entertainment as well as increase investment in every region in Indonesia. The

scientific community predicted and recorded responses to this goal, which have been widely adopted across the industry (Harrison et al., 2020). Indeed, a search of major academic databases for education for sustainable development yields "Development Index Chances" for all learners, also known as formal and informal learning. These opportunities allow students to gain the information, skills, attitudes, and values required to contribute to a more sustainable future. To reimagine the role of higher education in sustainable development, it is critical to transform the techniques and procedures through which knowledge is created, and the training students get. This will make pupils more socially responsible, critical, and environmentally conscious (Dharamsi et al., 2010).

Long-term development and higher education require sustainability in the education system and its administration (Yarime et al., 2012). This sustainability may be defined as correctly implementing quality higher education without significant limitations or a specific decline in production. The number of higher education providers in the context of education delivery systems and techniques that support the continual progression of knowledge and skills is sometimes referred to as continuity of education. The global HR sector's sustainable development is the UN's overall sustainability model (Khalili et al., 2015). The yearly PISA report demonstrates the growth of sustainable development in education, which is defined as educational progress that satisfies the requirements of the present without affecting future generations' capacity to meet their own needs. Education can help increase human resources who can make quality decisions for life in an advanced and dignified world environment, which will benefit future generations and sustainable human resources. Higher education institutions have developed individual medium and long-term strategic plans in recent years that are aligned with their response to the "Sustainable Development Goals." In a world that is becoming increasingly complex, this tertiary education and HR development plan highlights the importance of building a financially, socially, and environmentally sustainable organization (Purcell & Lumbreras, 2021). Due to its essential role in equipping future leaders with the necessary knowledge and skills to design and sustain their career paths, higher education is receiving increasing attention. Universities are expected to be able to improve quality through technology-oriented teaching in teaching even though the pandemic response policy has passed (Orhan & Beyhan, 2020).

The impact of the Covid-19 outbreak is still being felt in the higher education system because lecturers and students are used to impressive technology-assisted learning systems, even though the results could be adequate (Alghamdi et al., 2021). Many lecturers are familiar with the application of technology-based teaching systems. Likewise, students with sufficient skills to continue learning remotely have problems focusing their minds and adjusting patterns to the methods they acquired during the pandemic. Lectures during the pandemic teach students an attitude of discipline and responsibility; online learning makes students maintain good behavior with friends

and teachers. In addition, online learning can maintain a responsible attitude when asked to do assignments the teacher (Izquierdo et al., 2021).

Changes in higher education, on the other hand, have recognized that the function of higher education is critical to the sustainability of education. Because of the efficiency and service provided by professors and students, many universities desire to continue offering distance learning. In keeping with that, they have made a commitment to further their studies at the university level. The University of Bay Atlantic, for example, has made a commitment to researching sustainability as part of its academic program (Salvioni et al., 2017).

> "Increased interaction and class engagement are substantial technology impacts on education. Furthermore, improved general comprehension, practical learning, time management, and blended learning approaches are just a few ways technology has influenced student learning" *(*Williamson et al., 2010).
>
> Likewise, the vision and mission of the University of Westminster:
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> "The university community is dedicated to incorporating the United Nations' 17 SDGs into our teaching, research, and operations, exemplifying our values of responsibility, progress, and compassion, founded on the SDG Accord and the London Higher Sustainability Pledge" (Bebbington & Unerman, 2018).

Before Covid-19 hit universities, technology governance had respondents to institutional challenges to the sustainability of lectures through divestment in the procurement of technology-based facilities, building ITC buildings for sustainability, and implementing teaching based on technological innovation (Watermeye et al., 2021). The United Nations Global Compact program regarding higher education sustainability gives a complete image of institutions fully committed to achieving sustainable development goals. On December 4, 2014, the United Nations General Assembly accepted the framework for the post-2015 global development agenda based on the Open Working Group on Sustainable Development Goals, which will serve as global development targets and goals until 2030. At the Rio+20 Summit in 2012, 192 countries agreed on an SDGs framework, taking into account many factors, including being action-oriented, attainable, and universal. This spurred the original discussion on the SDGs (Hák et al., 2016). Academic institutions signed on as signatories between 2003 and 2018. Even though the Global Compact is more extensive than the SDGs, changes in the number of signatories between 2020 and 2021 demonstrate institutional priorities over the previous two years. During the epidemic, core business continuity (education and research) had to take precedence over social good and value-added efforts. This makes progress toward sustainability in higher education and including a sustainable curriculum extremely difficult.

The onset of a pandemic has had a considerable influence on the continuation of higher education, particularly in terms of transferring educational results from in-class learning techniques to distant learning with the use of digital apps to facilitate

activities throughout the pandemic response (Rapanta et al., 2021). Because the security factor for academics has become a top priority, changes to the system level are achieved by using technology. Universities must depart from the academic mission they had before the pandemic to empower academics with technical characteristics to achieve the mandated continuity of lectures (Bartusevičienė et al., 2021). This means that human resources, lecturers, and leaders can respond with strategies to achieve the sustainability of learning objectives from traditional to technology-intensive ways. Most scientific results regarding the sustainability of higher education in the context of pandemic reactions to technology use published in 2020 and 2021 are the outcome of university preparedness to study with technology. After the pandemic, the academic community will continue to use the same online lecture approach done during the pandemic response. Unknowingly, the pandemic has triggered society to change conventional behavior into a techno-cultural learning approach. Pre-pandemic research on sustainability has continued since 2020, but mainly from Sustainability 2022 (Pandit & Agrawal, 2022).

We undertook this study to understand the post-pandemic technology-based learning sustainability literature better. This is related to how universities respond to the pandemic and embrace the academic community to empower themselves in a technology-based lecture approach model with innovative reasons and the efficiency of technology. In Part 1, we provide an introduction and problems, and then in Part 2, we provide an overview of the analytical review techniques used in this work (Kirkwood & Price, 2014). Section 3 also discusses the findings of a study of several scientific data for and against continuing education using technology. Section 4 discusses the significance and tangible research findings for future sustainability research and practice in higher education (Kozinets & Gambetti, 2020).

Research Method

We can describe the steps for carrying out the study to analyze scientific evidence on the sustainability of the use of technology in higher education teaching in Indonesia after the pandemic response period (Sá & Serpa, 2020). Many studies have raised the issue of the sustainability of technology-based learning in tertiary institutions. At the same time, education was hit by a pandemic. However, the authors believe there are minimal studies examining the sustainability of technology-based teaching at the education level, both schools and tertiary institutions, after the pandemic. So, to facilitate this analysis, we have conducted a literature search by electronic means by reading scientific evidence publication reports on technological variables in education and teaching during the pandemic. We searched for data on several published literature sources, including dpi publications.

There were Science publications, MID press, Springers, Taylors and Francis, Emerald Publishing, limited SAGE Publication Paris, IEQID publications, and several other national publications (Mystakidis et al., 2021). After data collection, it is

continued with analysis, which defines the study's problem and purpose, collects data, analyzes it, determines the appropriate analysis according to the qualitative study, and interprets and reports the results (Vaismoradi et al., 2013). The finding indicators that we expect are to fulfill the principle of validity and reliability; in other words, these findings are appropriate in answering the problems and hypotheses of the study qualitatively. This study prioritizes publications released in the last ten years, considering the development and growth of technology and its use in higher education, especially during the pandemic, which is very fast. With secondary data, we conducted this study by electronically searching the Google Scholar application. After a series of analysis stages and so on, we design a report in descriptive qualitative with a semi-literature review literature model (Clark et al., 2019).

Result and Discussion

Technology in higher education post-pandemic

Everyone must adjust to new behaviors due to the Covid-19 epidemic, including school teachers and students. The failure to adapt and evolve will exacerbate the situation and stymie efforts to attain educational objectives. To transition to the post-pandemic period, educational initiatives and techniques are required. Rulandari (2020) explained that the Directorate of Higher Education took three steps in adapting to the Covid-19 pandemic to achieve Indonesia's better education goals. First, through policies issued by the government during a pandemic, such as budget relocation, Ministers regarding Face-to-Face Learning, and coordination with local governments and schools."The Ministry of Education and Culture is improving school health by providing online learning facilities through TVRI, Learning Houses, and many more. The government also issued a new regulation that BOS funds are given directly to school accounts and may be used for school needs during the pandemic. Moreover, monitor and evaluate distance learning (Batubara, 2021).

The second is the transition during the pandemic, where the government has vaccinated teachers and education personnel. The government is also preparing digitalization and telecommunications infrastructure to fulfill learning during a pandemic. In addition, we are conducting surveys of face-to-face learning, preparation for limited face-to-face learning, remedial preparation of school digitization, preparation of the Mobilization School program, and carrying out teaching coaching efforts to support living habits in the new average era by implementing clean and healthy living behaviors (Rapanta et al., 2021). "The third effort made by the Directorate of Higher Education is a post-pandemic strategy. We are strengthening and expanding the digitization of higher education institutions, including in the 3T region. Providing learning optimization, scale-up driving school impact and strengthening the Pancasila Student Profile through various learning modes (online, offline, and project-based learning)," The Directorate of Higher Education hopes that the efforts and strategies that have been carried out will result in changes in behavior in the post-pandemic period. Like the birth of strengthening clean and healthy living behavior, the

use of technology in supporting learning (management, assessment, and learning resources) becomes comprehensive, giving rise to skills in using technology such as accuracy, thoroughness, discipline, and prudence. In addition, it is hoped that this will strengthen the partnership between the government, parents, and the community (Bayerlein et al., 2021).

The Covid-19 epidemic has wreaked havoc on every facet of society, including schooling. It is only that if everyone can go through this terrible time successfully, we will be stronger. Pelenkahu (2022) said that different areas must be preserved and developed to sustain the school's vision and purpose and train pupils to live healthy lives in the post-pandemic age. "First and first, professors must be active and possess administrative and marketing abilities. As a result, schools must assist their instructional personnel with technology advancements." Second, parents in the modern period must be accepted, especially in the aftermath of the epidemic. While supporting university regulations, students' guardians must be critical of the school's state. "The school's connection with the government and other associated parties is the next factor that must be maintained.

Furthermore, schools must be able to offer reliable information to the government about whatever is going on in the field so that a solution may be discovered as soon as possible ". The third part is the library and learning apps, which must be kept up to date. Schools must have learning applications available to pupils, particularly during this epidemic. "Our pupils acquire learning references from their lecturers as well as through diverse media access through the library and learning programs," says the librarian. According to Susanto (2022), three pandemic legacies cannot be eradicated in educational institutions. Teachers must first learn and give. Second, an innovative culture, such as learning through project-based learning.

Data used in higher education learning

This term describes a very large volume of data. This volume of information can be collated, processed, analyzed, and stored securely by the user. Big data has been widely used in the business sector because it can help determine the direction of the business (Baepler & Murdoch, 2010). In higher education, big data can be used to combine all data in higher education management operations, including research data and student and alums data that has been absorbed into the employment sector to facilitate tertiary information services to the public. Augmented reality is a technical foundation that mixes two-dimensional and three-dimensional virtual things into a real-world three-dimensional environment before presenting these virtual elements in real-time. Weather reports or simulated television broadcasts in which journalists stand over a dynamic weather map while standing in front of a blue or green screen are examples of this technology. The chroma-keying method is used in this operation (Aldowah et al., 2019).

This technique is also used in the film and sports industries, such as football on television. Certain advertisements suddenly fall into the middle of the field where all the players are. This is the development of the Princeton Electronic Billboard. The term "electronic commerce" refers to the sale of electronic goods. Cyberattacks in information operations include any action taken to disrupt information confidentiality, integrity, and availability—for example, using particular features to secure client data from hacker assaults. Artificial Intellect is computer technology with human-like intelligence. Humans can program this form of technology to do whatever they choose. Its job is to study data continuously. The benefit is that the more data acquired and evaluated, the better this system produces predictions. Additive manufacturing is a revolutionary innovation for the manufacturing business, commonly associated with 3D printers—digital design drawings created in today's digital era (Avella et al., 2016).

This model represents the system, whereas the simulation represents the operation process over time. This model and simulation can be used in various contexts, including performance optimization technology simulations, safety engineering simulations, test simulations, training and education, and video games. This type is known as cloud computing or technology that makes the internet a data management and applications hub. Computer users are granted access to numerous virtual servers so that configured servers can be accessed over the internet. For example, they offered a virtual server to create online websites for internet users. This technical advancement is a remarkable feat in today's world. As a result, humanity must adapt to satisfy its demands through renewable virtual technology—the entire planet (Chernikova et al., 2020).

Higher education support students with technology

University and other institutions must be able to prepare their students to absorb the changes that take place with solid character and good work skills. So, a prepared graduate is very oriented toward responding to the needs of the world of work in the industrial world, as well as graduates with new pioneering digital-based employment (Hénard & Roseveare, 2012). Job orientation becomes a competitive arena that requires not only skills but also requires solid personal character. So a combination of strong character and skills is essential to answer the demands of the current world of work. Aoun (2017) further explained that the current world of work is an integration of the use of the internet with technology and information-based industrial world production lines. For this reason, character-based education models and concepts, in general, can be developed through the concept of multiple intelligences, which need to be integrated with religious values into the courses offered in education (Aoun, 2017).

This idea can be a solution considering that education is not only aimed at equipping students with technology-based technical skills alone, but higher education must be able to make students become human beings who have faith and noble

character. Thus, there is a great need to integrate faith and moral-based knowledge with technology-based skills. Based on the preceding, it is possible to infer that tertiary education in the 4.0 age is a notion of changing the higher education system into a digitalization system backed by a sophisticated virtual technology system. Thus, tertiary institutions that are adaptive to these changes re-enter their curricula to be more compatible with the current industrial revolution 4.0. Regarding Higher Education policy, developing scientific disciplines and study programs towards Cyber University is also carried out with a distance learning lecture system. Lecturers are human resources determining the transformation of Higher Education (Furlong & Lawn, 2010).

Self-reported academic success declined by 53% as a result of the rapid adjustments, demonstrating that a decent education may still be attainable. Tahiri Bachari (2021) conducted structured interviews with seven female academics in Algeria, primarily from the English department. Interestingly, and in line with Venable (2010), employees regularly highlighted similar challenges in providing high-quality instruction. Members detailed the Indonesian government's order to transfer worked-on example plans into the Learning Management System. Framework CEOs were 'fundamental' and nonconcurrent. Staff needed to prepare for this mandate, as they typically needed to gain prior experience with digital or online education. Following the previous study, staff members frequently experienced difficulties gaining access to the internet, needed to be more motivated to deliver high-quality instruction, had issues with software and hardware, and operated within a culture of absentee online teaching. Even though decent work will be briefly mentioned, students are likely least prepared for self-directed and self-motivated learning when lecturers are ill-equipped to teach effectively (Alzaza & Yaakub, 2011).

In their work, Shammi et al. (2021) present a plan for constructing a post-lockdown sustainable educational environment. This incorporates a reasonable model of online modalities (nonconcurrent information presentations, concurrent conceptualizing and inserting work) with application and information problems sent by nearby conveyance. Although it is likely to mimic prior efforts, the suggested approach represents a sustainable step forward in post-pandemic higher education. To summarize, the COVID-19 pandemic has directly posed a challenge to high-quality education, primarily influenced by students' and faculty members' digital access and technical proficiency, emphasizing the importance of developing an institution's response for all students and staff to create inclusive and equitable education.

To be sustainable, we must promote long-term, inclusive, and inclusive economic growth, full and productive employment, and decent work for all "according to the Industry, Innovation, and Infrastructure Goal of the United Nations (Ossiannilsson, 2022). Encourage inclusive and sustainable industrialization, as well as innovation "are also under pressure. At the same time, the primary focus of higher education is on providing excellent education; goals 8 and 9 emphasize the internal

organizational component of developing a sustainable business model as well as externally (leading communities), which are frequently financially, socially, and environmentally viable (the "triple bottom line" logic). During COVID-19, the capacity to deliver safe, high-quality education and training to ophthalmology students was recognized as a sustainability concern in academic medical facilities (López-Vargas et al., 2021).

This was especially critical since students were transitioning into clinical practice, needing additional personal protection equipment and environmental adjustments to keep staff and students safe. Interestingly, this manuscript made little mention of student populations and more closely resembled protocols found in academic medical centers. This research was done to locate long-term growth methods, and decent working conditions for students and staff in medical practices run by tertiary institutions. Abdulwahed (2017) developed a brief recovery model that considered sustainable development and high-quality staff work. Health problems, problems with one's social and economic surroundings, interruptions in routine, trauma, and a drop in income. In this case, "stopping the spread" was advised to prioritize a return to normalcy. The effort was predicated on including students and staff in the response, which may make achieving the objective of providing adequate employment for staff more difficult (Wiek et al., 2015).

One of the most significant sustainability issues brought on by COVID-19 is the requirement for increased rates of unsustainable consumption to achieve new goals (such as using digital technology for education or reducing the spread of the virus by using plastic bags that can only be used once). Kruk et al., in their self-evaluation, 2018), conduct a more in-depth investigation of this. Indeed, sustainable practices include flexible work schedules, stable student demand, resource repurposing, and bridge funding. Focusing on the rapidity of maintainability drives versus long-term goals that institutions set out to achieve prior to the pandemic may be a test of many of these conditions. The need for society to "ensure sustainable consumption and production practices" is emphasized in the United Nations' Sustainable Development Goal on Responsible Consumption and Production. We see this as the development of graduates' capacity to design sustainable consumption and production patterns in the future in the context of education. While some texts in the sample briefly discussed production or consumption, only one explicitly addressed this (Fonseca et al., 2020).

Technology in post-pandemic lectures

Following the arrival of the Covid-19 pandemic in Indonesia in mid-March 2020, province and local governments enacted rules in the education sector to allow for the continuation of technology-based learning activities, but no longer remotely. This policy includes temporarily replacing distance learning with in-class learning again at the school and tertiary level manifested in an electronic university (e-University) (Simamor et al., 2020). The development of e-University aims to support

the implementation of education so that tertiary institutions can improve information services for their communities via the internet, both inside and outside the tertiary institutions. They provide lecture material online that can be accessed by anyone who needs it, another educational service that can be done via the internet. Universities in Indonesia are educational institutions familiar with and know about the influence of IT on education. Every faculty in the university environment in Indonesia has a community network that anyone can use to get information, even those who have difficulty finding it due to space and time limitations (Amemado, 2014). In the post-Covid 19 pandemics, when the government issued a back-to-school policy, this was very helpful for prospective students, active students, or even alums who needed information about tuition fees, curriculum, supervisors, or many other things. So, the technology-based lecture method is still ideal even though we are entering schools again (Vieira et al., 2014).

The use of technology has also started at the school level in Indonesia, but its impact has yet to be evaluated at the advanced education level. Most students in schools only use technology as an additional resource, and technology still needs to be part of the core curriculum in most schools. Grades, curriculum, students, lecturers, and other data are stored on paper, not technology (Fadhil & Sabic-El-Rayess, 2021). However, the use of technology in secondary schools is on the rise, especially considering the Covid-19 pandemic, which has also required every school and university to carry out online learning. For example, The Ministry of Education and Culture, in collaboration with the Directorate of Higher Education, has created an online learning media platform called “Rumah Belajar," which can be found at https://belajar.kemdikbud.go.id/ Dashboard/. There is also learning that can be done by both lecturers and students, namely the teacher's room with student access at https://ru (Istamia, 2019).

There are many advantages to using information technology and the internet, but Indonesia has several limitations that prevent them from using it to its full potential. In this case, the readiness of the Indonesian government is still questionable (Putri et al., 2020). The process of transforming technology, telecommunications infrastructure, and legal instruments that regulate it are the main contributors to this problem. Is Indonesia's legislative structure suitable to support current innovations in the use of technology in higher education? Technology can help students learn more by allowing them to expand their knowledge and study more than just one source. If a teacher can use technology, then the quality of education in Indonesia will be better. The trend of using technology has changed the way of working online, which continues to be a community need. Likewise, the trend of payments using digital technology systems in tertiary institutions will be increasingly in demand because they are efficient. Third, teleworking or working from home, widely practiced, will produce technology to support efforts to equalize study opportunities in tertiary institutions (Kolb, 2014).

Conclusion

The study to analyze scientific evidence regarding the sustainability of the use of teaching technology in universities in Indonesia has given birth to several understandings related to the above analysis. Through providing several data, we have gained an understanding of teaching. Even though the pandemic response policy has ended and university learning has reopened in the classroom, technology remains essential in increasing learning effectiveness, especially in tertiary institutions. This is because the effectiveness of technology in higher education is not only in the context of information retrieval but in the use of technology to process and implement data-based learning. Furthermore, all of us see that the use of data in learning in tall trees is a necessity that is carried out considering the typical learning in tertiary institutions with technology that functions to conduct extensive data searches and also the implementation of technology-based learning and also an evaluation side that allows for effectiveness.

The following finding is that when higher education support is given to communities such as students, the most dominant support and the one with the most significant impact is academic providing and requiring students to gain skills on how to use technology to improve their learning following the demands of the situation and educational progress even though the pandemic response has ended along with the reopening of face-to-face college classes. Finally, we also explain how Indonesia's post-pandemic lecture system involves technology applications. This is because technology-based learning is helpful for hands-on learning, and when students and other academics have to do data-based learning with technology that can innovate, achieving optimal results compared to learning with only one Face to Face method. We realize that this has shortcomings and limitations in implementing the method provision and reporting. Therefore we hope the parties will provide constructive criticism to improve the refinement of similar studies in the future.

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