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Pandemic and Online Learning at Engineering Colleges

Erica Devi Ayuningrum[1*], Endar Suprih Wihidayat[2], Febri Liantoni[3]

[1*,2,3]Department of Informatics and Computer Engineering Education, Faculty of Teacher Training and Education, Sebelas Maret University, Indonesia

Corresponding Email: ericadevi10@student.uns.ac.id

Abstract:

The Covid-19 pandemic has resulted in social restrictions being implemented in all sectors of life, including the scope of education. The closure of schools, higher education, and other educational institutions resulted in face-to-face learning needing to be carried out as usual. Therefore, online learning is a learning strategy that can be applied in times of crisis like this. Application of online learning, which is carried out without planning and suddenly makes several obstacles arise when this learning is carried out. The purpose of this study is to find out what problems arise when implementing online learning in engineering universities during a pandemic and what solutions can be applied to overcome them. This research is a systematic literature review research with keywords used, namely "online learning" or "online course" and "covid-19" or "pandemic" or "Covid 19". In searching articles, articles that are indexed in the Scopus database are used and are limited to publication years, namely from 2019-2022 (during the COVID-19 pandemic). This study used descriptive analysis with secondary data sources. From the results of this study, the application of online learning, for now, is considered the best solution so that learning can still be carried out. But besides that, there are still many obstacles found in its application due to the need for careful planning and preparation for its implementation. Other obstacles are both technically, facilities, and infrastructure, as well as from the human resources themselves. It is hoped that in the future, the solutions found can add insight and be used as a reference in the application of online learning to be effective and better.

Keywords: *Covid-19, Online Course, Online Learning, Pandemic.*

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Introduction

The world was shocked by the emergence of a virus in the city of Wuhan. China called COVID-19 or corona virus around December 2019. The spread of this virus is so fast and very widespread in all parts of the world; therefore, since March 2020, the WHO (World Health Organization) has designated COVID-19 as a pandemic. Steps taken by state leaders to minimize the spread of this virus continue to be carried out. Some measures such as restrictions on public activities, restrictions on staying at home, work restrictions, closure of the tourism sector, restrictions on domestic and international travel, and closure of educational institutions. The closure of educational institutions can, in fact, reduce the spread of the virus among students but provides new challenges that must be faced by students, parents, educators, and educational institutions (Aslam, 2021). Similarly, when the lockdown was over, it was said that education could not run the same as before. Many norms to guide our daily activities need to be reshuffled in terms of post-pandemic (Eduardo et. al., 2020). As well as the possibility that it can make drastic changes to the way of educating in the future (Rose, 2020).

A big impact is felt on the environment of college students related to work and academic life, namely the change in face-to-face learning to online or distance learning, libraries or closed laboratories, changes in terms of communication methods, new assessment methods and different levels of load and performance (Cao et al., 2020; Owusu-Fordjour et

al., 2020). Likewise, in social life, for example, closing universities requires students to study from their respective homes so that there are no meetings with friends, lecturers, or other academic communities physically (Liu et al., 2020). As well as in terms of mental health, such as the appearance of anxiety, frustration, fear, boredom, anger, and others (Brooks et al., 2020; Ma & Miller, 2021). With COVID-19, students have experienced dramatic life effects that change their daily habits and can also affect their prospects in the future (Aristovnik et al., 2021), as it is known that the world of education has an essential influence in determining the future of a nation. With good quality human resources, it can undoubtedly affect the progress of the country. Therefore, the learning process must be able to run again. New learning methods must be implemented immediately so that learning can continue to run. The positive side of the pandemic can be an opportunity to demonstrate the existing education system.

The majority of options from college institutions around the world are turning to fully online learning, and it is also found that some maintain face-to-face classes with a limited amount of interaction. The study by Mathew and Iloanya(2016) says there are many benefits obtained from the use of technology in online learning or distance learning, such as the involvement of interaction between teachers and educators, access to the latest material obtained easily and quickly, and easier in a wide variety of information content. Although it can be said that face-to-face interaction is very important in building relationships between individuals where technology cannot replace it, in a pandemic situation it can be said to be the new normal in schools (Devine et al., 2020). Another thing that affects the implementation of effective online learning, in addition to the factors of teachers, students themselves, educational institutions, and technology, is how teachers create interactions, and the type of online platform used also affects the creation of online learning effectiveness (Toquero, 2020). Several studies have also revealed the relevance of connectivity and accessibility issues in online learning for example studies from (Roig-Vila et al., 2014) say the importance of accessibility in supporting online learning. According to (Sit et al., 2005) in his study on the application of online learning, it is said that students feel comfortable and have a sense of responsibility for their own learning. In addition, other benefits of online learning are the ease of finding sources of information, saving costs, ease of time and the opportunity to innovate using technology (Bali & Liu, 2018), satisfaction with online learning, including intrinsic motivation (Vanslambrouck et al., 2018) easy access and can be done repeatedly at a speed that can be measured from oneself (Gao et al., 2013).

The purpose of this study is to explain the various impacts of implementing online learning due to the COVID-19 pandemic, which affects the lives of engineering students in universities in order to be able to design solutions, actions, and recommendations for policymakers and higher education institutions regarding how students can be supported in dealing with this crisis. Based on this background, the author has an interest in finding out the relationship between the COVID-19 pandemic and online learning with the research title "Pandemic And Online Learning In Technical Colleges." From the research that has been done before, it will be found more deeply what problems must be faced in universities after the COVID-19 pandemic and what solutions can be given to these problems.

Research Method

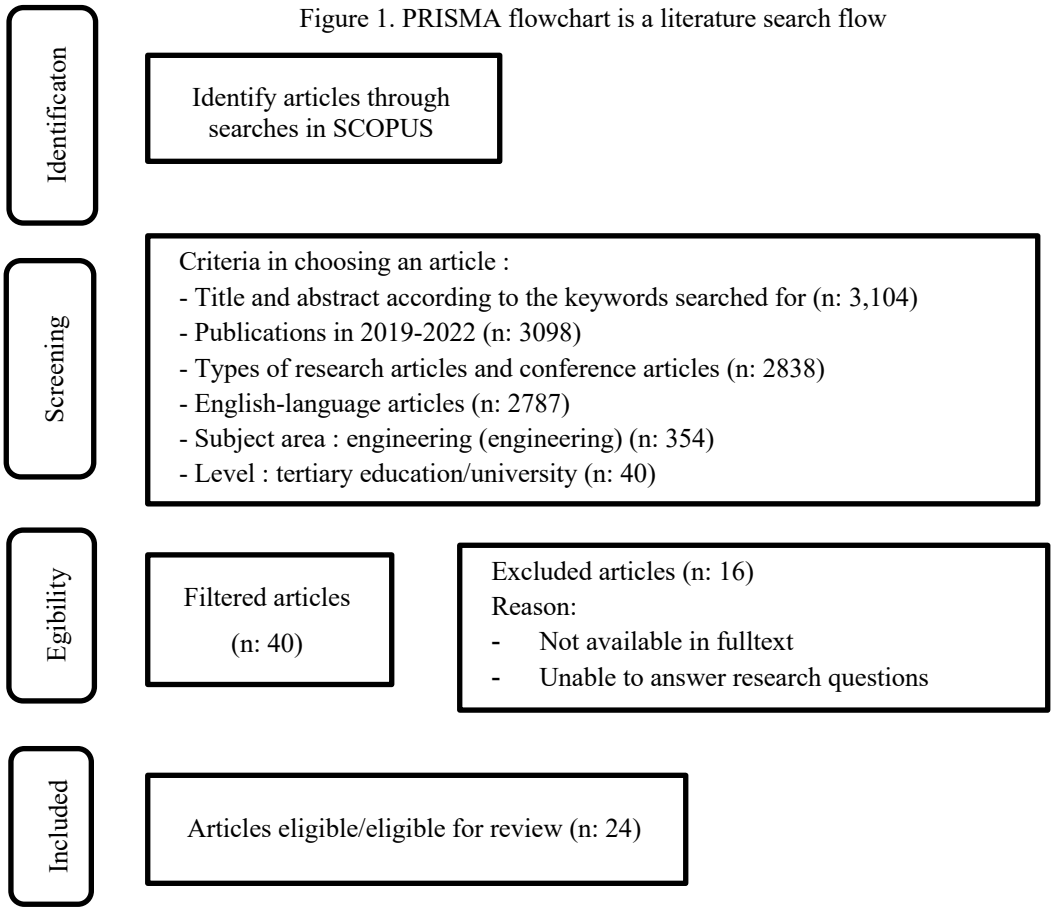
The method used in this study is to use the literature review method or literature review. Literature review research or literature review or literature research is research that explores and critically examines ideas, knowledge, and findings that are in the body of academically oriented literature and also describes its theoretical and methodological contributions to a particular topic. It can also be said that literature review as a description of theories, findings, other research articles obtained from reference materials used as a basis for research activities (Zainal, 2007).

Result and Analysis

The existence of corona virus 19 (COVID-19) spreads in all parts of the world so the WHO determines this outbreak as a global pandemic. To reduce the number of spread of this virus, social restrictions are imposed. The world of education also feels the consequences of this social restriction. So this study aims to find out what are the problems that arise and what solutions can be done during online learning in universities in the field of engineering during the Covid-19. The search for articles was carried out in this study to find answers to research questions by reviewing the articles through a systematic procedure. The literature search process is carried out in one article database, namely Scopus, using keywords, namely "online learning" or "online course" and "covid-19" or "pandemic" or "Covid 19". Reviews of these articles are limited to the year of publication, which is from 2019-2022 (during the COVID-19 pandemic) and can be accessed in fulltext or in full. The criteria for articles only use English articles with article types, namely research articles and conference articles. Another inclusion criterion is that the subject area of the article is

only in the field of engineering in universities that carry out online learning. To explain further the flow in the article search, the PRISMA flowchart is as follows

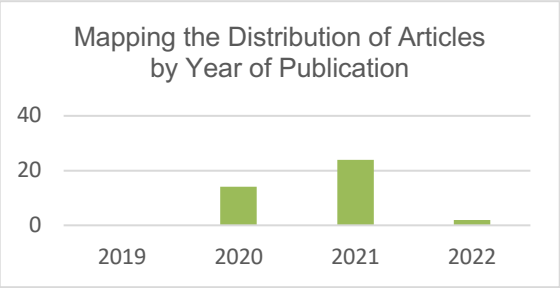
Figure 1. PRISMA flowchart is a literature search flow



The process in searching for articles was carried out from October 2021 to March 2022. From the keywords "online learning" or "online course" and "covid-19" or "pandemic" or "Covid 19" found as many as 3104 articles. Based on the criteria for the publication year from 2019 – 2022 or during the COVID-19 pandemic, it was found that there were 3098 articles. Of the types of articles, namely research articles and conference articles, there were as many as 2838 articles found. Furthermore, from the criteria for articles to be in English there are 2787 articles. For the subject area, namely in the field of engineering, there were 354 articles. Meanwhile, based on the level of education, namely universities, there are found to be as many as 40 articles. The total number of articles is 40 articles obtained based on their relevance but of this total only 24 can answer the research questions of what are the problems that arise and what solutions can be done during online learning in universities in the field of engineering during the Covid-19 pandemic.

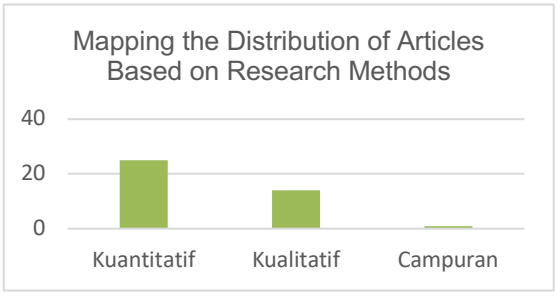
The next step is for the author to identify using a matrix of concepts based on the title of the article, the author, the year of publication of the article, research participants, research methods, findings, research questions and findings that can answer research questions.

Figure 2. Mapping the Distribution of Articles by Year of Publication



Judging from the mapping table of article distribution above based on the year of publication, the search for articles was searched from 2019 to 2022 during the COVID-19 pandemic that hit the world. The total number of articles found was 40 relevant articles. The highest number of articles found in 2021 was 24 articles and the lowest in 2019, where no articles were found at all.

Figure 3. Mapping the Distribution of Articles Based on Research Methods



Judging from the mapping table for the distribution of articles above based on research methods, there are quantitative, qualitative, and mixed research methods. Based on the table, it was found that quantitative research methods have the highest number of 25 articles while mixed research methods have the least number, namely only 1 article.

A descriptive analysis of the literature related to Pandemic research and Online Learning at Technical Colleges was carried out.

Table 1. Analysis of research journals

No	Author	Article Title	Year Published
1	Kyrkjebo E	A Guide to Student-active Online learning in Engineering	2022
2	Petchame J., Iriondo I.,Villegas E.,Fonseca D.,Yesa S.R.,Alaez M	A Qualitive Approach to Help Adjust the Design of Management in ICT Engineering Undergraduate Programs through User Experience in a Smart Classroom Context	2021
3	Patil Y. S., Shinde R. M., Mane S.S.	Active Learning Approach for Online Teaching of Engine Design Course	2022
4	Garcia M., Quiroga J., Ortin F.	An Infrastructure to Deliver Synchronous Remote Programming Labs	2021
5	Esteriegana R., Medina-Meridio J. A., Robina-Ramirez R., Barchino R.	Analysis of Cooperative Skills Development through Relational Coordination in a Gamified Online Learning Environment	2021
6	Habib S., Parthornatt T.	Anticipated and Actual Challenges Pertaining to Online Delivery of University Courses during COVID-19	2020

		Pandemic: The Engineering Faculty's Experience at Assumption University	
7	Kurni M., Saritha K.	Applying Collaborative Learning for Enhancing the Teaching-Learning Process in Online Learning through social media	2021
8	Anusirat S., Al Maani D., Al-Jokhadar A.	Architecture Students' Satisfaction with and Perceptions of Online Design Studios during COVID-19 Lockdown: The Case of Jordan Universities	2021
9	Dudic S., Sulc J., Reljic V., Bajci B., Seslija D., Milenkovic I.	Automatic Device for Remote Measuring of Circularity: Development and Implementation in Education Courses	2020
10	Munoz G.M.H	Collaborative Learning: From Face-to-face to the Virtual Classroom in the COVID-19 Pandemic	2020
11	Ariza M.H., Martinez Sarminento F.H.	Connectivity Characteristics and Level of Acceptance Linked to Online Learning by Higher Education Students during the Confinement Generated by the COVID-19 Pandemic	2020
12	Lecon C.	Corona E-Learning Cocktail: Sustainability of University Education in times of Pandemics	2020
13	Havenga M.	COVID-19: Transition to Online Problem-Based Learning in Robotics – Challenges, Opportunities, and Insights	2020
14	Kim S., Mun H.J.	Design and Development of a Self-Diagnostic Mobile Application for Learning Progress in Non-face-to-face Practice Learning	2021
15	Jo H.S., Jo R.S.	Design and Development of Remote Laboratory System to Facilitate Online Learning in Hardware Programming Subjects	2020
16	Del Muro Alvarez S., Delgado L.D.R.	Mechatronics through Virtual Platforms under COVID-19	2020
17	Makeeva E., Lopukhova J., Gorlova E.	Work in Progress: Designing an Academical Online Course for Technical Students: Structure, Content, Assessment	2021
18	Aihara S., Suzuki H., Tsunoda K., Hoshi Y., Inoue M.	Development of Online Learning Practices in a Japanese University Based on the Questionnaire Surveys	2021
19	Mendonca J., Babo L., Pinto C.M.A	Adaptation to Emergency Remote Teaching by Students with Distinct ICT Backgrounds	2021
20	Prestiado D., Maisyaroh., Zulkarnain W.	Effectiveness of Online Learning at SIPEJAR Using Video Based Learning Media	2020
21	Kaur R., Garg A., Kaur P.	Case Study: Students' Response Toward Online Learning in Engineering Education during COVID-19 Pandemic	2021
22	Nur Handayani A., Norma Mustika S.	Design of Virtual Machine Collaboration on Analog Electronics Course	2021

23	Jiranantanagom P., Tippayakulpiroj K., Saikaew P.	Designing an Interactive Online Learning Platform to Support a Practical Subject during COVID-19 Outbreak	2021
24	Setaiwan A.W	Utilization of Existing Resources to Support Active Distance Learning During COVID-19 Pandemic in Developing Country	2021

Table 2. Grouping of journals by type and method of research

Types of Research	Research Metods	No Research
Quantitative	Experiment	1, 4, 9, 14, 16, 20
	Survey	3, 4, 5, 8, 9, 10, 18, 19, 23
Qualitative	Interview	2, 13, 17
	Document	13
	Observation	7, 12, 15, 17, 22
	Survey	2, 6, 11, 21, 24

Table 3. Articles discussing online learning issues

Problems		Article
1. Technical Facilities and Infrastructure	a. Unpreparedness f students, teachers or investigative institutions in the application of online learning	17
	b. Changes in learning strategies	1, 3, 5, 7, 10, 12, 13, 18, 24
	c. Poor internet network	6, 11, 19, 21
	d. Learning requires a physical library	4, 9, 15, 22
2. Impaired learning focus		8, 19
3. Interaction in online learning is not optional		6, 8, 11, 19, 21
4. Limitations of IT usage capabilities		6, 8, 11, 21
5. Technology adoption use of online platforms		2, 14, 16, 20, 23
6. Online exam assessment adds to educator workload		6, 8
7. Low student learning motivation		19

According to the analysis that has been carried out on these 24 articles, it can be seen the answers to questions from research regarding problems that arise from online learning during the COVID-19 pandemic in universities in the field of engineering namely technical, facilities and infrastructure (unpreparedness of students, teachers, or educational institutions in the application of online learning (Makeeva et. al., 2021), changes in learning strategies (Kyrkjebø, 2020; Estriegana et. al., 2021; Kurni & Saritha, 2021; Havenga, 2020; Patil et. al., 2022; Munoz, 2020; Lecon, 2020; Aihara et. al., 2021; Setiawan, 2021), poor internet networks (Habib & Parthornratt, 2020; Ariza et. al., 2020; Kaur et. al., 2021; Mendoca et. al., 2021), learning requires a physical laboratory (Garcia et. al., 2021; Dudi et. al., 2021; Jo & Jo, 2020; Handayani et. al., 2021), impaired learning focus (Mendoca et. al., 2021; Maani & Alnusairat, 2019), interaction in online learning is not optimal (Habib & Parthornratt, 2020; Maani & Alnusairat, 2019; Kaur et. al., 2021; Ariza et. al., 2020; Mendoca et. al., 2021), limitations in IT capabilities (Maani & Alnusairat, 2019; Kaur et. al., 2021; Ariza et. al k., 2020; Habib & Parthornratt, 2020), adoption of technology and the use of online platforms (Petchamé et. al., 2021; Kim & Mun, 2021; Del Muro Alvarez et. al., 2020; Prestiadi et. al., 2020; Jiranantanagorn et. al , 2021) , online assessment of exams add to the workload of educators (Maani & Alnusairat, 2019; Habib & Parthornratt, 2020), student learning motivation is low (Mendoca et. al., 2021).

Table 4. Articles discussing online learning solutions

Solution			Article
1. Technical Facilities and Infrastructure	a. Designing structure, content, and assessment for students		17
	b. Redesigning learning strategies	Active learning approach	1, 3, 24
		Gamification learning approach	5
		STAD collaborative learning approach	7, 10

		Blended learning approach	12, 18
		Problem-based learning approach	13
	c. Use of backup internet network		6
	d. Remote library deployment		4, 9, 15, 22
2. Implementing learning time management			8
3. Create interaction with good feedback			6, 8
4. Provide training to educators and use user-friendly applications			6, 8
5. Adoption of technology and use of online platforms			2, 14, 16, 20, 23
6. Exam assessment with the integrity of the exam in mind			6, 8
7. Research does not review solutions			11, 19, 21

Solutions that can be applied in overcoming online learning problems in engineering colleges are regarding technical, facilities, and infrastructure (designing structures, content, and assessments for students, redesigning learning strategies, using backup internet networks, implementing remote laboratories), implementing learning time management, creating interactions with good feedback, providing training to educators and using user-friendly applications, the adoption of technology and the use of online platforms, exam assessment with the integrity of the exam in mind, while some articles do not explain the solution.

The pandemic has changed the way some people receive and provide education. Viewed from the positive side, this change will benefit the education sector in the future with surprising innovations. While the pandemic can't give us much time to plan, it can be learned that planning is key. We have to plan everything, if plan A fails, we have to prepare plan B and so on. It's better that we prepare something but it's not used than we don't prepare at all. In addition, the pandemic also teaches us that students must have specific skills, for example, in problem-solving, critical thinking, especially the ability to adapt to survive crises. Meanwhile, educational institutions must build resilience in their systems to ensure and prioritize the presence of these skills in their students. As it is said that disasters may occur anytime and anywhere, preparedness is needed in adapting to the environment. It is hoped that the literature review can be a reference and add insight to educational institutions in responding to the same situation in the future.

Conclusion

Online learning is the most powerful method that can be applied where learning can be carried out while still expressing student safety during the Covid-19 pandemic. It is said that the application of online learning is a "necessity" so that learning can still be carried out. We are forced to practice online learning which has never been implemented before very suddenly and without planning or preparation. It would have been different had we mastered it. So it is natural that the implementation of online learning has many obstacles in its application. It is recommended that there are improvements in the implementation of online learning both from the design of activities and facilities and infrastructure. Therefore, in the future, it is recommended to strengthen IT infrastructure because this is the key to the success of online learning. Students and educators must also be equipped at least with commonly used IT skills. It is also necessary to consider the mental and emotional state of students in designing and implementing any learning strategy. In addition, in panic situations like this, learning is recommended to be made as attractive as possible in order to reduce the feeling of pressure, stress, anxiety and fear by students.

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