Analysis of Obstacles in the Implementation of Online Learning for Undergraduate Students of Electrical Engineering

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Abstract

The Department of Electrical Engineering, especially the S1 (Education) study program, has carried out an online learning process in the even semester of the 2019-2020 academic year as an option to make the learning process continue during the COVID-19 outbreak. This study aims to analyze the obstacles experienced by undergraduate students in Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang in the implementation of the online learning process. The type of research used is descriptive qualitative research. Data retrieval was carried out by distributing a googleform link in which there were 14 statements and distributed to 77 students of the 2017-2020 undergraduate study program. In this study, the results obtained indicate that the most significant obstacle experienced by students in the implementation of online learning is the lack of good delivery of material by lecturers. The online learning process really needs to be optimized and also needs to be evaluated to improve the implementation of online learning in the future.

Keyword: *Online Learning, Online Obstacles*

INTRODUCTION

Information and communication technology in the industrial era 4.0 has experienced very rapid development and has a very large influence on the learning and teaching process. Teachers must be able to take advantage of the ease in accessing technology in order to improve the quality of education, especially in Indonesia. Technological developments can provide changes to the learning implementation process [1]. In improving human resources so that they are reliable and have broad insight so that they can answer future challenges, it can be done by placing education as the main foundation in this regard. A country can break free from the shackles of ignorance, backwardness, and can increase self-confidence to compete with other countries through education [2]. National education in Indonesia is defined as a conscious and planned effort to create a learning atmosphere and learning process, so that students actively develop their potential so that they have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed both for students. itself as well as for the community, nation, and country.

Indonesia is still trying to improve innovation in the field of education, especially in teaching and learning, because a quality education system cannot be separated from the success of teachers in designing and implementing the learning process. Creating a learning environment is one of the important aspects to create a conducive independent learning environment, where the learning environment in the 4.0 education era leads to the development of facilities that provide freedom for students to be able to process learning activities by providing flexible support, and easy access, one of which is learning via the internet [3]. There are important elements in the national definition of education, namely conscious and planned efforts, creating a learning atmosphere and learning process that allows students to actively develop their potential, and equip students with religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed for students' self, society, nation and state. The learning atmosphere and learning process that allows students to actively develop their potential can only be realized through an educational interaction

process between two human elements, namely students as learning parties and educators as teaching parties and students as the main subject. Examples of efforts that can be made to improve the quality of education are by creating qualified, professional and knowledgeable educators. Educators are not only teachers, but also educators, mentors, directors, and student evaluations. Educators are learning agents, therefore educators are expected to have four basic competencies, namely pedagogical competence, social competence, personality competence and professional competence. Educators can be said to be professional when educators can master the learning material, can control the class, can control the behavior of students, be an example, and become a learning person [4].

The development of information technology that utilizes the internet brings many benefits and challenges to human life, besides that it also encourages the emergence of various learning model innovations in the field of education, one of which is the application of online learning. Online learning is a new teaching method that uses electronic devices (especially the Internet) to deliver learning [5]. Online learning is learning based on technology in which learning materials are sent electronically to students remotely remotely using computer networks. However, online learning has been complained by many students and students because it is considered less effective. So far, the lack of mastery of information and communication technology devices has also become a problem in education in Indonesia. This affects the ability of students to access various kinds of information information that results in the progress of the world in general and the world of education in particular [6]. According to Imania (2019), online learning is a form of regular learning that is proposed in digital format via the internet [7]. Online learning is also a learning system that uses internet access, connection, and flexibility, and can add more interaction in the learning process. The advantage of online learning (online) lies in the creation of a new learning atmosphere, and online learning will present a new atmosphere for students who usually study in class. This new atmosphere can foster student enthusiasm for learning. There are several shortcomings in online learning, namely students find it difficult to concentrate on learning because of the unsupportive environment. Limited internet quota or Internet or wifi software packages are important in online learning and are also affected by other factors. Although online learning can be a solution to the difficulties of implementing face-to-face learning during the Covid-19 pandemic. However, in the implementation of online learning, in fact there are obstacles and shortcomings in the implementation of online learning [8].

In the implementation of online learning also has several obstacles experienced by students and educators, these obstacles include (a) Educators and students have limited mastery of information technology, Indonesian conditions do not fully understand the use of technology, and students with the same condition face obstacles and obstacles in using technology every week. (b) Inadequate facilities and infrastructure, different economic conditions and social welfare, make people unable to fully utilize information technology facilities and infrastructure, and this happened during the Covid-19 pandemic. (c) Internet access is limited, and the internet network is still not evenly distributed in every region of Indonesia, especially in remote areas of the country. The poor network conditions make this kind of internet access restriction an obstacle for students and educators to develop online learning. (d) In terms of using internet quotas to meet the needs of online learning, the budgeting is not sufficient, and the economic benefits of online learning are still far beyond expectations so it is not possible to buy quotas. During the online learning process, many obstacles are encountered. One of the obstacles to online learning is the lack of internet service facilities, the lack of direction from lecturers makes students less understanding [9] [10].

From the results of interviews that have been conducted with several undergraduate students of Electrical Engineering, that in the implementation of online learning that they carried out during the Covid-19 pandemic there were several obstacles experienced by students, including the lack of opportunities for students to discuss directly with study partners or with lecturers due to limitations.

the features and quality of the internet network used, the lack of understanding of students regarding the use or operation of online learning applications, the limited data quota for students in participating in the learning process and the search for additional teaching materials, the lack of variety of learning media served by the teacher during the learning process, and the internet network that is uneven and unstable in the student's domicile.The above constraints resulted in the non-optimal process of teaching and learning activities in the delivery of material between students and educators. The ability in online learning is still a lot of students, teachers and students lecturers are not yet proficient, especially for students, teachers or lecturers who are in the regions deep. Online learning is the use of the internet network in learning process. With distance learning / online both students, teachers and students The lecturer has the flexibility of time in its implementation. Even though distance learning is an online system, student learning outcomes remain the main focus in learning. And to obtain good learning outcomes, an online system learning effectiveness is needed so that learning objectives can be achieved. This can be obtained by appreciating student work. Greetings, responses, and feedback or appreciation for the work done are things that should not be forgotten [11] [12]

Based on the description of the results of research interviews regarding the obstacles to implementing online learning for undergraduate students in Electrical Engineering FT UNP, it needs to be done with the aim of knowing the obstacles in implementing online learning for undergraduate students in Electrical Engineering Faculty of Engineering Universitas Negeri Padang. And it is hoped that with this research, S1 Electrical Engineering students can convey the obstacles experienced during the implementation of online learning and for lecturers it can be used as consideration for determining learning models that will later be applied in the online learning process. And for tertiary institutions, especially the electrical engineering department, undergraduate study programs can be input and can be used for evaluation and development of the implementation of online learning in the future.

METHOD

In this study using research methods metode descriptive quantitative survey method. The research procedure carried out in this study consisted of three stages, namely the preparation stage, the implementation stage and then the final stage. The population in this study amounted to 333 students of S1 Electrical Engineering Faculty of Engineering, Universitas Negeri Padang class 2017-2020 with a research sample of 77 students.

The research instrument used in this study was a questionnaire or questionnaire arranged according to a Likert scale. The Likert scale is a scale used to measure the constraints of undergraduate students in implementing online learning activities. With the Likert scale, the measured variables are translated into variable indicators

This instrument is designed to measure the variables of S1 Student Constraints in the Implementation of Online Learning in terms of five indicators, namely the delivery of material, discussion media, devices, learning applications, and data quotas and internet networks. Then the instrument that has been compiled is tested for validity and reliability which aims to ensure the quality of the instrument if it is used in collecting data in research.

The data collection technique used in this research is the distribution of questionnaires or questionnaires consisting of 14 statements that have been tested for validity and reliability tests. The data obtained were analyzed using SPSS 26.0.0 software and Microsoft Excel software. Data processing and analysis techniques were carried out using SPSS 26.0.0 software and Microsoft Excel software by tabulating the data and classifying the data into five categories to see the level of achievement of the respondents.

Table 1. Research Indicators

Variable	Indicators
Constraints of Undergraduate Students in the Implementation of Online Learning	Submission of Material
	Discussion Media
	Gadget
	Learning Apps
	Data Quota and Internet Network

Source: Processed Data 2021

RESULT AND DISCUSSION

The results of the data in this study are in the form of responses given by respondents to online questionnaires that have been distributed via google forms. Respondents in this study were students of the 2017-2020 electrical engineering education study program. Respondents in this study were 77 students consisting of 24 class 2017, 15 class 2018, 11 class 2019 and 27 class 2020. Based on 14 statements that have been distributed to 77 respondents to find out the obstacles to implementing online learning, it is expected to provide an overview a description of the obstacles experienced by undergraduate students during the implementation of online learning.

Below are the results of research on the obstacles experienced by electrical engineering undergraduate students based on each indicator:

1. Indicator of Submission of Material

The fulfillment of educational standards through the use of information technology in the form of computers and gadgets that are interconnected between educators and students is a destination online learning with the use of technology, the delivery of material carried out by educators can be conveyed properly [13]

In the indicators of material delivery, there are: four(4) statements, namely: statements 1. I understand well the material presented by the lecturer during online learning, statements. 2. Lecturers always complete and provide teaching materials to students before the learning process begins. Statement 3. The teaching materials provided are in accordance with the lecture topics to be studied. Statement 4. I feel that my knowledge has increased after doing online learning. The following is a pie chart of the results of filling out the questionnaire:

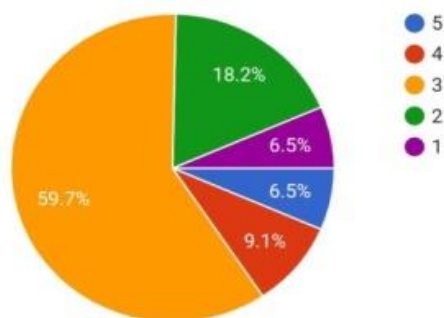**Figure 1. Statement 1**
Source: Processed Data 2021

Figure 2. Statement 2
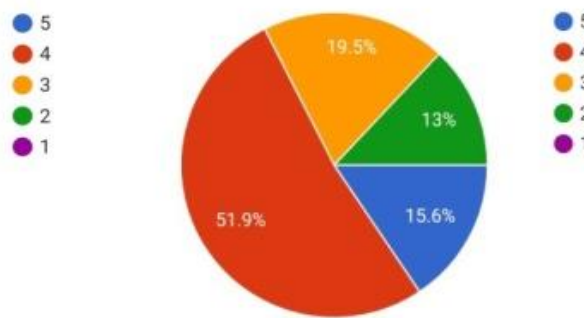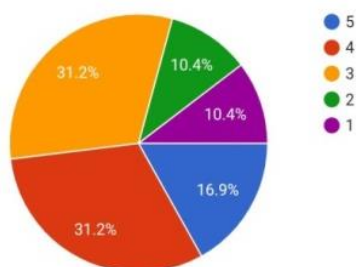Source: Processed Data 2021

Figure 3. Statement 3
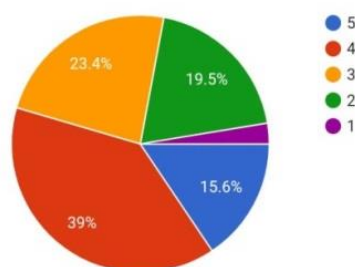*Source: Processed Data 2021*

Figure 4. Statement 4
Source: Processed Data 2021

Based on the data shown in Figure 1, Figure 2, Figure 3, and Figure 4 after being analyzed using SPSS 26.0.0 software, the results of the description of the indicator data for material delivery are as follows:

Table 2. Description of Indicators for Submission of Materials

Category	Score	F	Percentage(%)
Strongly agree	9	12	15.6
Agree	7 -< 9	42	54.6
Disagree	5 -< 7	18	23.4
Disagree	3 -< 5	4	5.2
Strongly Disagree	< 3	1	1.3
Total		77	100

Source: Processed Data 2021

From the table above, the results show that the indicators of material delivery are in the Agree category with a frequency of 42 respondents and a percentage of 54.6%

2. Discussion Media Indicator

In the implementation of learning, online learning is one way in the teaching and learning process, it's just that the implementation of online learning is completely dependent on the internet network. By using the internet networkstudents can be more flexible in finding references for study materials and in discussing with study partners [4]

In the indicator of material delivery, there are two (2) statements, namely: Statement 5. When the implementation of online learning is limited in time, I look for other additional material on the internet and statement 10. The learning application used can be used as a medium for maximum discussion. The following is a pie chart of the results of filling out the discussion media sub-indicator questionnaire:
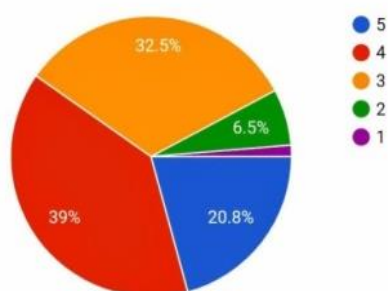

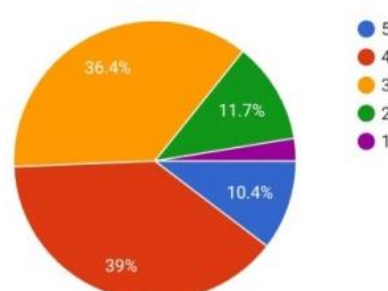**Figure 5. Statement 5**
Source: Processed Data 2021

Figure 6. Statement 10
Source: Processed Data 2021

Based on the data shown in Figure 5 and Figure 6 after being analyzed using SPSS 26.0.0 software, the results of the description of the indicator data for discussion media are as follows:

Table 3. Description of Discussion Media Indicators

Category	Score	F	Percentage(%)
Strongly agree	9	10	13
Agree	7 -< 9	37	48.1
Disagree	5 -< 7	23	29.9
Disagree	3 -< 5	5	6.5
Strongly Disagree	< 3	2	2.6
Total		77	100

Source: Processed Data 2021

From the table above, the results show that the discussion media indicator is in the Agree category with a frequency of 37 respondents and a percentage of 48.1%.

3. Indicator gadget

The availability of computer devices and gadgets in the implementation of online learning is something that must be equipped not only to exist but also to have qualified specifications and in a condition that is suitable for use, because with these qualified specifications it will have an impact on the implementation of the online learning process that runs safely.no problem. There are several aspects that must be understood by institutions in the application of online learning, including learning models, internet networks, computer equipment and gadgets, and several other aspects [14]

In the device indicator there are two (2) statements, namely: statement 6. I have sufficient equipment completeness in the implementation of online learning and statement 7. The device that I use for online learning is in good condition. The following is a pie chart of the results of filling out the sub-indicator questionnaire of the device:
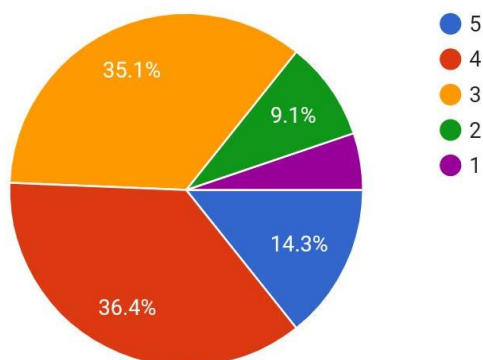
77 responses   77 responses

Figure 7. Statement 6
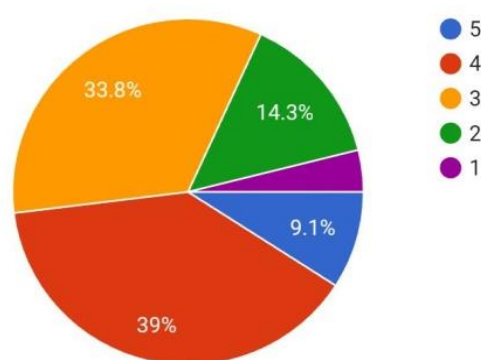Source: Processed Data 2021

Figure 8. Statement 7
Source: Processed Data 2021

Based on the data shown in Figure 7 and Figure 8 after being analyzed using SPSS 26.0.0 software, the results of the description of the device indicator data are as follows:

Table 4. Description of Device Indicators

Category	Score	F	Percentage(%)
Strongly agree	9	11	14.3
Agree	7 -< 9	37	48.1
Disagree	5 -< 7	25	32.5
Disagree	3 -< 5	2	2.6
Strongly Disagree	< 3	2	2.6
Total		77	100

Source: Processed Data 2021

From the table above, the results show that the sub-indicator of the device is in the Good or Not Constrained category with a frequency of 37 respondents and a percentage of 48.1%.

4. Indicator Application Learning

Online learning is learning that is carried out without face to face between educators and students. The implementation of online learning can be carried out through several applications such as Google Classroom, Google Meet, Zoom, and many other applications [15].

In the indicators of material delivery there are two (2) statements, namely: statement 8. I understand every learning application used during online learning and statement 9. I can understand all the features used in the application during online learning. The following is a pie chart of the results of filling out the learning application sub-indicator questionnaire:
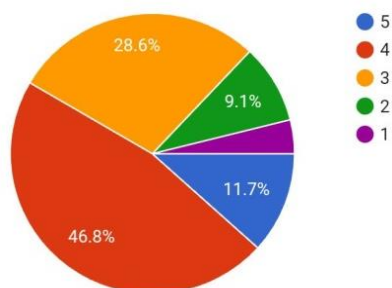

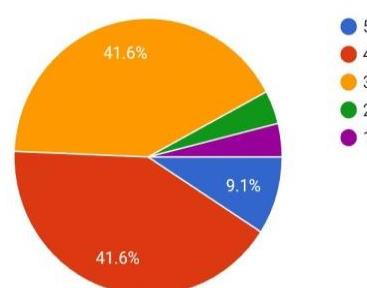**Figure 9. Statement 8**
Source: Processed Data 2021

Figure 10. Statement 9
Source: Processed Data 2021

Based on the data shown in Figure 9 and Figure 10 after being analyzed using SPSS 26.0.0 software, the results of the description of the learning application sub-indicator data are as follows:

Table 5. Description of Learning Application Indicators

Category	Score	F	Percentage(%)
Strongly agree	9	11	14.3
Agree	7 -< 9	37	48.1
Disagree	5 -< 7	30	39
Disagree	3 -< 5	2	2.6
Strongly Disagree	< 3	2	2.6
Total		77	100

Source: Processed Data 2021

From the table above, the results show that the sub-indicator of the device is in the Agree category with a frequency of 37 respondents and a percentage of 48.1%.

5. Indicator of Data Quota and Internet Network

The limited internet quota or internet package that is the link in online learning is one of the obstacles that students will face in the implementation of online learning [16].

In the sub-indicators of material delivery, there are four (4) statements, namely: statement 11. The data quota that I have is sufficient for the implementation of online learning, statement 12. I receive data quota assistance for the implementation of online learning, statement 13. Access internet network that is being in my area is classified as good and easy to access, statement 14. Internet network access in my area is stable so that I do not have to move places during the implementation of online learning. The following is a pie chart of the results of filling out the sub-indicator of data quota and internet network questionnaires:
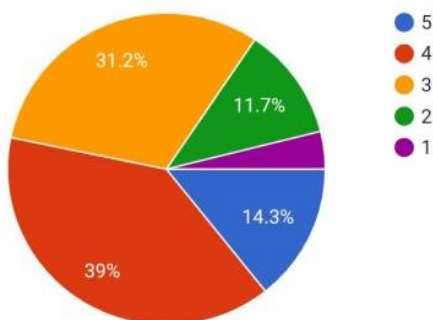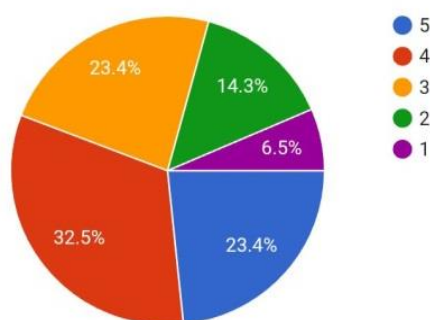
Figure 11. Statement 11
Source: Processed Data 2021

Figure 12. Statement 12
Source: Processed Data 2021

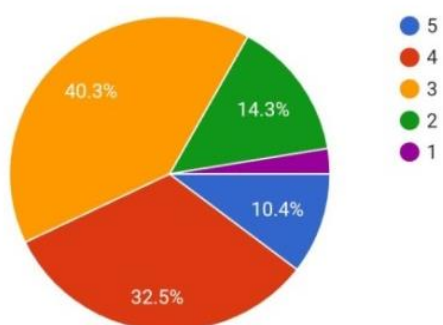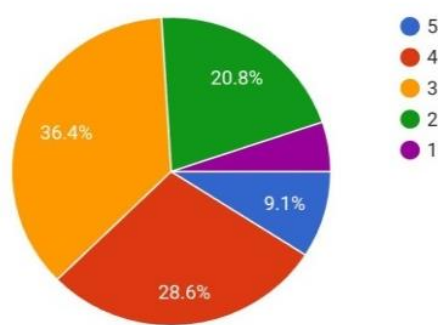**Figure 11. Statement 13**
Source: Processed Data 2021

Figure 12. Statement 14
Source: Processed Data 2021

Based on the data shown in Figure 11, Figure 12, Figure 13, and Figure 14 after being analyzed using SPSS 26.0.0 software, the results of the data description of the data and internet network quota indicators are as follows:

Table 6. Description of Data Quota and Internet Network Indicators

Category	Score	F	Percentage(%)
Strongly agree	19.45	1	1.3
Agree	15.15 -< 19.45	20	26
Disagree	10.85 -< 15.15	45	58.5
Disagree	6.55 -< 10.85	10	13
Strongly Disagree	< 6.55	1	1.3
Total		77	100

Source: Processed Data 2021

From the table above, the results show that the sub-indicator of Data Quotas and Internet Networks is in the Disagree category with a frequency of 45 respondents and a percentage of 58.5%.

Based on the results of research that has been researched that the categories of statements in the questionnaire are converted from strongly agree (SA) , agree (A), disagree (D), moderately agree (MA), strongly disagree (SD), to very not constrained (VNC). , not constrained (NC), moderately constrained (MC), constrained (C), and very constrained (VC) in order to categorize the results of research on indicator variables and each sub-indicator that has been processed with SPSS version 26.00.

From the results of research on the variables constraint to the implementation of online learning has a single indicator, namely information technology in education which is researched through the distribution of online questionnaires to 77 respondents. % and is in the Not Constrained category.

Furthermore, the sub-indicator of material delivery can be categorized as Not Constrained with a score range of 7 -<9, the frequency of 42 respondents with a percentage of 54.6%, then the discussion media sub-indicator can be categorized as Not Constrained with a score range of 7 -<9, the frequency of 37 respondents with a percentage of 48.1% , then the sub-indicator of the device can be categorized as Not Constrained with a score range of 7 -<9, the frequency of 37 respondents with a percentage of 48.1%, then the sub-indicator of learning applications can be categorized Not constrained with a score range of 7 -< 9, the frequency of 37 respondents with a percentage of 48.1%, and finally the sub-indicator of data quota and internet network can be categorized as Moderately Constrained with a score range of 10.85 -< 15.15, a frequency of 45 respondents with a percentage of 58.5%.

Hasil dan pembahasan memaparkan hasil penelitian ataupun analisis yang diperoleh. Berbagai fakta serta fenomena yang dianggap penting dapat dijabarkan lebih lanjut pada bagian ini. Setelah itu, dilanjutkan dengan pembahasan secara mendalam dengan menyebutkan temuan atau kepioniran gagasan beserta signifikansinya.

CONCLUSION

This research was conducted with the aim of finding out the obstacles to implementing online learning for undergraduate students in Electrical Engineering, FT UNP using descriptive quantitative research methods with survey methods with data collection using questionnaires distributed online via google form to 77 respondents. Based on the distribution of online questionnaires, this study revealed with five indicators, among others, the indicators of material delivery can be categorized as not constrained with a percentage of 54.6% of answers Agree or Not Constrained, the indicator of discussion media can be categorized as not constrained with a percentage of 48.1 % of answers Agree or No Constraints, sub-indicators of devices can be

categorized as not constrained with a percentage of 48. 1% of answers Agree or Not Constrained, the indicator of learning applications can be categorized as not constrained with a percentage of 48.1% of answers Agree or Not Constrained, and the indicator of data quota and internet network can be categorized as not constrained with a percentage of 58.5% of answers Less Agree or Moderate Constrained Constrained. Based on the results of this study, it is recommended that the Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, especially the S1 study program, suggest that the results of this study can be taken into consideration in the implementation of online learning that will be implemented in the future. And for other researchers and the sub-indicator of data quota and internet network can be categorized as not constrained with a percentage of 58.5% of answers Disagree or Moderate Constrained Constrained. Based on the results of this study, it is suggested to the Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, especially the S1 study program, it is suggested that the results of this study can be taken into consideration in the implementation of online learning that will be carried out in the future. And for other researchers and the sub-indicator of data quota and internet network can be categorized as not constrained with a percentage of 58.5% of answers Disagree or Moderate Constrained Constrained. Based on the results of this study, it is suggested to the Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, especially the S1 study program, it is suggested that the results of this study can be taken into consideration in the implementation of online learning that will be carried out in the future. And for other researchers Based on the results of this study, it is suggested to the Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, especially the S1 study program, it is suggested that the results of this study can be taken into consideration in the implementation of online learning that will be carried out in the future. And for other researchers Based on the results of this study, it is suggested to the Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, especially the S1 study program, it is suggested that the results of this study can be taken into consideration in the implementation of online learning that will be carried out in the future.

BIBLIOGRAPHY

[1]   S. Sutini, M. Mushofan, A. Ilmia, A. D. Yanti, A. N. Rizky, dan S. Lailiyah, "Efektivitas Pembelajaran Daring dengan Menggunakan E-learning Madrasah Terhadap Optimalisasi Pemahaman Matematika Siswa," *JRPM (Jurnal Rev. Pembelajaran Mat.*, vol. 5, no. 2, 2020, doi: 10.15642/jrpm.2020.5.2.124-136.

[2]   F. Daulay dan H. Effendi, "Efektivitas Model Problem-Based Learning pada Mata Pelajaran Instalasi Tenaga Listrik di SMK," *JTEV (Jurnal Tek. Elektro dan Vokasional)*, vol. 06, no. 01, hal. 42–48, 2020, [Daring]. Tersedia pada: http://103.216.87.80/index.php/jtev/article/view/106926.

[3]   R. Oktavian dan R. F. Aldya, "Efektivitas Pembelajaran Daring Terintegrasi di Era Pendidikan 4.0," *Didakt. J. Pendidik. dan Ilmu Pengetah.*, vol. 20, no. 2, 2020, doi: 10.30651/didaktis.v20i2.4763.

[4]   H. A. Rigianti, "Kendala Pembelajaran Daring Guru Sekolah Dasar Di Banjarnegara," *Elem. Sch. J. Pendidik. dan Pembelajaran ke-SD-an*, vol. 7, no. 2, 2020, doi: 10.31316/esjurnal.v7i2.768.

[5]   O. Candra, "The Development of aFlexibility-Project Based Learning Model on Vocational Education: A Need Analysis," *Turkish J. Comput. Math. Educ.*, vol. 12, no. 3, 2021, doi: 10.17762/turcomat.v12i3.1307.

[6]   N. Fauziyah, "Dampak Covid-19 Terhadap Efektivitas Pembelajaran Daring Pendidikan Islam," *Al-Mau'Izhoh*, vol. 2, no. 2, 2020.

[7]   S. D. Rahmawati, *Kendala Pelaksanaan Pembelajaran Jarak Jauh Melalui Internet Pada Mahasiswa PJJ S1 PGSD Universitas Negeri Semarang*. 2008.

[8]   M. N. Khasanah, T. Ningrum, dan I. R. Aprilia, "Analisis Kendala Mahasiswa Pendidikan Biologi Universitas Tidar Saat Pembelajaran Daring Di Masa Pandemi Covid-19," *NECTAR J. Pendidik. Biol.*, vol. 1, no. 2, 2020.

[9]   C. R. Niani dan C. Rahma, "ANALISIS KENDALA SISTEM BELAJAR DARING TERHADAP PEMBELAJARAN MATEMATIKA DI KAMPUS," *Math Educ. J.*, vol. 4, no. 2, 2020.

[10]   H. Darsono, A. N. Fitri, B. Rahardjo, M. Z. Imanuela, J. Akuntansi, dan P. N. Bandung, "Efektivitas Pembelajaran Jarak Jauh saat Pandemi Covid-19 (Kajian di Politeknik Negeri Bandung)," *Ind. Res. Work. Natl. Semin.*, vol. 19, 2020.

[11]   Z. Abidin, A. Hudaya, dan D. Anjani, "Efektivitas Pembelajaran Jarak Jauh Pada Masa Pandemi Covid-19," *Res. Dev. J. Educ.*, vol. 1, no. 1, hal. 131, 2020, doi: 10.30998/rdje.v1i1.7659.

[12]   M. F. L. Sibuea, M. A. Sembiring, dan R. T. A. Agus, "Efektivitas Pembelajaran Daring Berbasis Media Sosial Facebook Dalam Meningkatkan Hasil Belajar," *J. Sci. Soc. Res.*, vol. 3, no. 1, 2020.

[13]   P. Sari, D. P., & Sutapa, "Efektivitas Pembelajaran Jarak Jauh Dengan Daring Selama Pandemi Covid-19 Mata Pelajaran Pendidikan Jasmani Olahraga Dan Kesehatan (PJOK)," *Pediatr. Crit. Care Med.*, vol. 2, no. 1, 2020.

[14]   L. Fuadi, T. M., Musriandi. R., &Suryani, "Covid-19 : Penerapan Pembelajaran Daring Di Perguruan Tinggi," *J. Dedik. Pendidik.*, vol. 4, no. 2, 2020.

[15]   R. E. Pratama dan S. Mulyati, "Pembelajaran Daring dan Luring pada Masa Pandemi Covid-19," *Gagasan Pendidik. Indones.*, vol. 1, no. 2, 2020, doi: 10.30870/gpi.v1i2.9405.

[16]   H. Putria, L. H. Maula, dan D. A. Uswatun, "Analisis Proses Pembelajaran dalam Jaringan (DARING) Masa Pandemi Covid- 19 Pada Guru Sekolah Dasar," *J. Basicedu*, vol. 4, no. 4, 2020, doi: 10.31004/basicedu.v4i4.460.

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