E-Learning Based Mathematics Learning Media:
An Empirical Study on Operations Research in the COVID-19 Pandemic in Makassar City of Indonesia

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ABSTRACT

The study aims to determine the impact and constraints of the e-learning learning system for Operations Research subject during the COVID-19 pandemic. This research is a descriptive qualitative study that focuses on evaluating learning using online media. This study's population was the 5th-semester students of the undergraduate program in Statistics at the Hasanuddin University. The sample of this research was students participating in the Operations Research subject. The selection and determination of the research subjects were taken by using the purposive sampling technique. Researchers' data sources include (1) primary data sources, namely data obtained by researchers from direct respondents; and (2) secondary data sources obtained by researchers from personal documents and journals related to the research conducted. The results obtained indicate that internal constraints arise in the students themselves, namely the ability to use Information Technology and students' ability to understand the material are not the same. Meanwhile, the external constraints faced by students include: (a) network constraints; (b) limited quota constraints; and (c) uneven facility constraints. Besides, the e-learning learning system's positive side opens the freedom to express student ideas that do not appear during face-to-face lectures because of shame, reluctance, fear, or even not having good verbal skills.

Keywords: Mathematics learning, operations research, COVID-19 pandemic, online learning, impact and constraints.

1. INTRODUCTION

The world of education in Indonesia has entered a new normal state where old learning habits cannot become the primary benchmark. This is because the world changes so fast [1]. Thus, many adjustments should be made to the world of education in Indonesia. This can be started from the implementation of learning, including training aimed at educators [2].

Since then, COVID-19 prevention efforts have been implemented in social and physical distancing arrangements in various lines of life. This policy is based on the increasing number of victims, and the spread of the COVID-19 virus is increasingly difficult to control throughout Indonesia [3,4]. Through the Circular of the Minister of Education and Culture of the Republic of Indonesia No. 3 of 2020 concerning the Prevention of COVID-19 in the Education unit, all higher education in Indonesia, including Hasanuddin University, took firm steps on the Government's appeal to carry out learning activities from home.

Academic activities that are usually carried out on campus during this pandemic must be done from home. Not only students, lecturers, and education staff are forced to work from home to prevent and accelerate the reduction of the COVID-19 outbreak. The policy on the pandemic phenomenon that has had an extraordinary impact has occurred so quickly has forced the world of higher education to change the work pattern of services from conventional to online-based services [3].

Operations research is one of the compulsory subjects in the Statistics study program. The purpose of the Operations Research course is to facilitate students to build professionalism and broad insight into the scope of Operations research. In this case, the aim is to provide knowledge to students about approaches in decision making for problems that often occur in everyday life, which are marked by scientific knowledge through interdisciplinary group efforts aimed at determining the best use of limited resources [5].

Related to the objectives of learning mathematics in operations research courses, in dealing with the Covid-19 pandemic in the world, especially in Indonesia, there are constraints in the Government's program of imposing "Work from Home (WFH) [6]. The aim of the Indonesian Government to apply WFH to the learning process is to break the chain of spreading COVID-19 in Indonesia.

However, related to operations research courses, simplex methods are somewhat difficult to explain through e-learning mathematics. Simplex method material is an optimal solution determination technique using the Gauss Jordan elimination technique [5]. Mathematical calculations in the simplex method require an adequate level of accuracy and have several stages of completion. Also, the material is quite complex, and the mathematical material is from the simplex method, which is rigid and quantitative (numeric). In this case, students tend to be less careful because calculation errors in the process lead to errors in the final result. One solution is that lecturers carry out the process of learning mathematics using e-learning with Zoom and Google Classroom facilities so that they can interact with students [3]. However, using Zoom, students must have sufficient data packages. For students who have an economy that lacks funding difficulties, this is one of the constraints in applying the e-learning mathematics learning process [7].

2. LITERATURE REVIEW

The COVID-19 pandemic demands that we be adaptive to change. The ability and intention to learn in any situation are primary keys so that education can continue to run well [8]. This adaptation must be carried out in order to continue to provide the right to education. Meanwhile, total self-study cannot run entirely. The low level of community literacy causes total independent learning to run entirely, still not. There are still many problems that arise in the field that need to be resolved to achieve educational goals properly. This reinforces the opinion that a lecturer's presence cannot be replaced by any sophisticated machine [9]. In this case, its role will be needed, even though what we see is the infrastructure and teaching materials available in the virtual world (internet), there are countless numbers, such as the control of Zoom

meeting. Therefore, the teaching and learning process that occurs from home still requires activeness, creativity, and innovation from a lecturer so that learning remains interesting, fun, and easy to digest [10].

The development of information and communication technology has impacted the use of teaching aids, such as computers. The internet is responding to e-learning during the face of the COVID-19 pandemic that has hit almost the entire world, especially in Indonesia [11]. It is also in the Operations Research learning processes.

There are three models in Operations Research, namely [12]:

- Iconic (Physical) model. The iconic model is a physical presence that looks like the original of a simple system with different scales—examples: Children's toys, Mockups, Photos, and others.

- Analogue (Diagrammatic) model. The analog model is more abstract than the iconic model because it does not look the same between the model and the real-world—examples: Demand Curves, Maps, Water pipelines, and others.

- Mathematic (Symbolic) model. Mathematical model is the most abstract compared to other models. This model is divided into 2, namely the deterministic model and the probabilistic model. Deterministic models are formed in certain situations. The probabilistic model covers cases in situations of uncertainty.

The definition of media, in general, is anything that can transmit information from information sources to recipients of the information. Media, according to AECT, is anything people use to transmit messages. Meanwhile, Gagne defines the media as a type of component in students' environment that can stimulate them to learn. Briggs defines media as a tool to provide incentives for students so that the learning process occurs. Online or online learning can run well and be effective if accompanied by available infrastructure [13].

Ten characteristics of effective online mathematics learning [14]: (1) Every campus is different. Each university has different distance learning readiness and facilities. Several universities in Indonesia already have e-learning facilities built independently so that students are adaptive to this learning. For universities that do not yet have it, they can use e-learning media that is generally available. (2) Different learning procedures. The different conditions of each different campus result in different learning procedures. Some online learning procedures, for example, submitting assignments via e-mail. Other procedures, for example, learning via video conference. However, some learning activities require the student to come to campus at a specific time in this

situation. (3) Prepare learning facilities. Online learning requires internet networks, supporting applications, laptops/computers, learning materials in hard or soft copy. (4) Schedule adjustments. Learning continues even in a pandemic situation from their respective homes, whether for lecturers, students, or education personnel. With this activity, students will keep students busy to minimize their activities out of the house as a preventive measure for the transmission of COVID-19. (5) Understand the lesson plan. Students must understand the lesson plan, especially the material to be studied in the courses taken. (6) Self-control. Online learning from home requires the awareness of students to be disciplined in the following learning. Lack of lecturer supervision on the learning process is the main constraints. Disciplinary events in online learning are students watching TV, playing games, playing gadgets, and others. (7) Following announcements. Students are required to follow announcements related to academic and non-academic activities from campus. This online learning condition is prone to not getting complete information to students. (8) Students look for a comfortable place during the lecture process to focus and not be distracted by disturbing things. (9) Discipline is the same as offline learning conditions, such as dressing neatly, bathing, and others. This supports a good mood for study. (10) Students also pay attention to the deadlines for assignments given to create assessments optimally by the lecturer.

3. METHOD

The method used in this research is the descriptive qualitative research method. According to [15,16], qualitative research intends to understand the phenomenon of what is experienced by the research subject, for example, behaviour, perception, motivation, actions, and others. Holistically, and using description in the form of words and language, in a specific natural context and using various scientific methods.

The reason the researchers chose this research method is that this is closely related to the title and problem formulations expressed in the introduction, which are more directed at the constraints faced by students in taking online lectures in Operations Research courses during the COVID-19 pandemic, where believes that the problems faced by each student will be different. This is according to the purpose of this study to explore the constraints students face in taking online lectures in the Operations Research course during the COVID-19 pandemic.

This research was carried out on students of the Undergraduate program of Statistics, Faculty of Mathematics and Natural Sciences, the Hasanuddin University. The data sources include (1) primary data sources, namely data obtained by researchers from direct respondents, and (2) secondary data sources

obtained by researchers from personal documents and journals related to the research.

The data analysis technique in this study was carried out at the time of data collection within a certain period. The researchers researched for two months. The activity in data analysis in this study is data reduction.

4. RESULT AND DISCUSSION

Data from the results of this study were obtained by researchers through interview techniques, observation, and documentation of 15 respondents selected from students of the 5th Semester, Undergraduate Program of Statistics, the Hasanuddin University Faculty of Mathematics and Natural Sciences, who took the Operations Research course.

There are several constraints faced by students in taking online lectures on Operations Research courses during the COVID-19 pandemic. These constraints can be described in detail as follows.

4.1. Internal Constraints

Internal constraints arise in the students themselves. In this case, students' constraints include the ability to use Information Technology, and the ability of the students' constraints in understanding the materials are not the same. Technological sophistication does not make students technologically literate as a whole. There are still students who are still not technology savvy. This hinders the smooth running of lectures. For example, what students often experience is not knowing how to share the screen during lectures via the zoom application. This can hinder the fluency of the online lecture process.

Besides that, most of the respondents also experienced problems in understanding the material. According to them, it is better to meet face-to-face with the lecturer because face-to-face can better understand the material. Face-to-face students can ask directly to the lecturer if there is a material that is not understood.

4.2. External Constraints

There are several external constraints faced by students. Some of these constraints are described as follows:

- First, internet network constraints. All respondents stated that they experienced network problems. According to them, not all areas have good internet networks, even though they are from the same provider. This is a significant constraint considering that the required network lecture is the internet.

- Second, limited quota constraints. Lectures on the network, primarily via teleconference via zoom, require much quota. Meanwhile, the economic

situation during the COVID-19 pandemic was unstable. This is also an constraint for students considering that they depend a lot on tuition fees from their parents.

- Third, the constraints on uneven facilities. There are still some students who do not have smartphones or even laptops and computers. This is an constraints in itself for the implementation of online lectures properly.

4.3. Discussion

The regulations regarding the learning process independently from home are regulated in the Minister of Education and Culture Circular No. 4 of 2020 concerning the Implementation of Education Policies in an Emergency for the Spread of Coronavirus Disease (Covid-2019). Thus the university also changes its lecture activities from the original through face-to-face directly to online lectures through the website that has been provided by each campus. Besides, online lectures are also carried out by utilizing Google classrooms as a Learning Management System application that can provide full features of cooperative and collaborative learning activities for lecturers. The lecturers themselves choose these features to carry out lectures online.

Success in online learning depends on learner participation, learning activities, and the interactions between learners. Therefore, during the COVID-19 pandemic, researchers designed lectures so that the objectives of the Operations Research course could be achieved.

Researchers carry out the e-learning lecture process through teleconference via Zoom. Researchers chose zoom because of several things, including the following. (1) The application is free and free to use. (2) Can accommodate a large number of participants with a duration of 40 minutes per meeting. (3) Zoom application can directly confirm the presence and participation of students. (4) Fourth, in this application, there is a screen sharing feature that lecturers and especially presenters can use in showing presentation materials for group assignments and videos or files so that Operations Research lectures can be carried out correctly.

The implementation of the e-learning course process through Teleconference via Zoom is shown in the following figure.
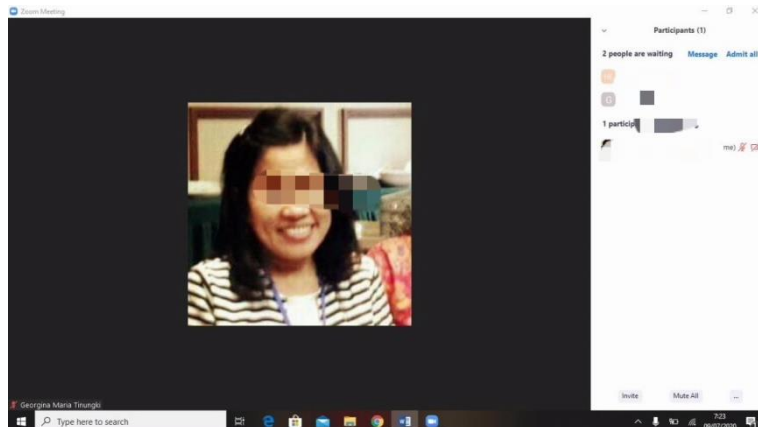

Figure 1 Using zoom, the lecturer as the host was inviting students to join for lecturing.

It can be seen from Figure 1 that the Lecturer as Host is inviting participants in the Operations Research course to join the e-learning course process via Teleconference Via Zoom via the link https://us04web.zoom.us/j/79488685703pwd=LzFSZ1dGNDBFSjhBcWM3Rjlyc1d6QT09.

Figure 2 Online lecture using teleconference via Zoom.

In figure 2, it can be seen that students have started to join one by one. It appears that students are very enthusiastic about the learning process. Online lectures are also carried out by researchers using the Google classroom application to make it easier for students to consult on materials that they think still need additional explanation, as shown in figure 3 below:
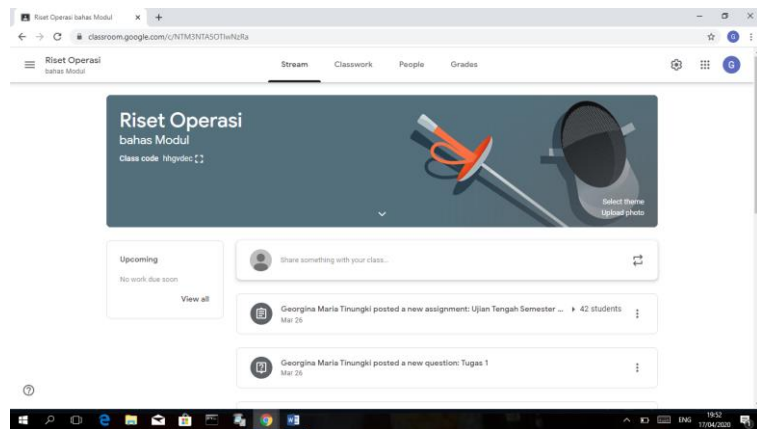

Figure 3 Google classroom as a non-video-teleconference learning media.

As seen in Figure 3, the lecturer creates a new room in the Google classroom application with the Class code: **hhgvde**, where this code is sent to all students participating in the Operations Research course to join so that they can take part in the Operations Research learning process via the Google Classroom app.
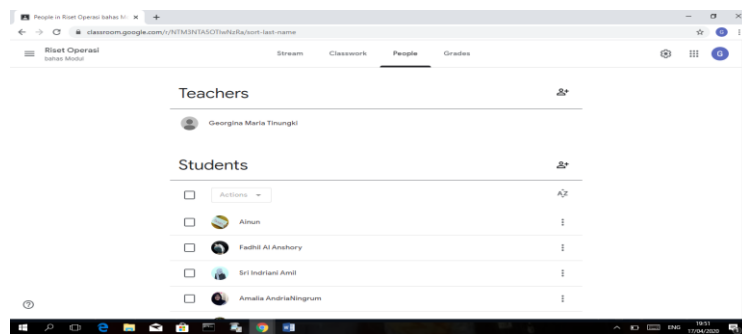

Figure 4 The lecturer checked student attendance through Google Classroom media.

As seen in Figure 4, almost most of the students have joined the Operations Research lecture process using the Google Classroom application media. Furthermore, in Figure 5, the lecturer shares teaching materials with students by giving 20 minutes for students to read, then the lecturer opens a dialogue to discuss the teaching materials.
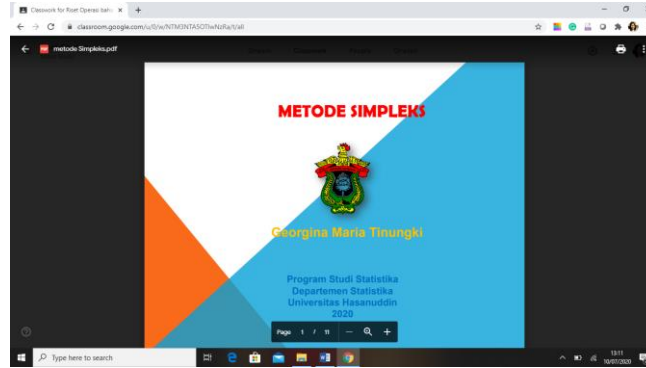

Figure 5. The lecturer shared course materials via Google classroom.

As seen in figure 5, the lecturer's teaching materials, for students to read, then a question and answer discussion is held regarding the Simplex Method problem. During the discussion, the students were very excited because they were very interested in the Simplex Method material.

Before the lecture ends, the lecturer gives assignments carried out by all students in their respective rooms, which have been provided by the lecturer in the Google Classroom application, as shown in figure 6 below.
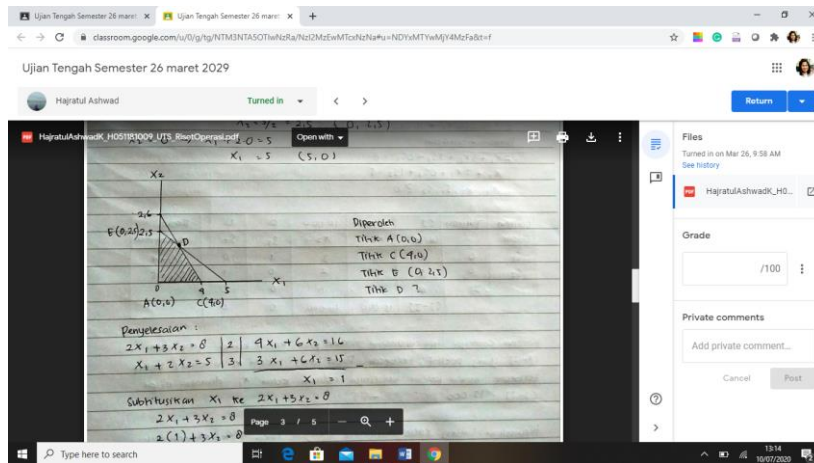

Figure 6 The result of the work on assignment was given to students.

As seen in Figure 6, one of the students answered a question related to determining the Optimal Solution Point, related to the objective function and the constraint function.

The success of lectures on the network is supported by several components, including students, lecturers, learning resources, and existing information technology. Some of the existing components must be well integrated. These are intended so that later lecture objectives can be achieved properly and affect the quality of the resulting graduate output.

5. CONCLUSION

5.1. Conclusion

Based on the research results on the constraints faced by students in taking e-learning courses in

Operations Research courses during the Covid-19 pandemic, it can be concluded that there are internal constraints that arise in students themselves. In this case, students' constraints include the ability to use information technology and the ability of students to understand different materials, especially some materials in operational research courses, such as understanding the simplex method, which requires a high level of understanding. The external constraints faced by students include: (a) network constraints; (b) limited quota constraints; and (c) uneven facility constraints. The e-learning system during the COVID-19 pandemic had both positive and negative sides. The positive side of the e-learning learning system is opening the freedom of expression of student ideas that do not appear during face-to-face lectures because of shame, reluctance, fear, or even not having good verbal skills.

5.2. Recommendation

Lecturers are encouraged to be more creative in providing learning materials online, namely by making learning videos in the form of tutorials uploaded on YouTube, maximizing the use of Google Classroom, whatsapp group, and video conferencing applications such as Zoom. The key to all of this is communication, in which lecturers must continue to pay attention to the development of their students, namely by ensuring that the right to education continues even with technology intermediaries.

AUTHORS' CONTRIBUTIONS

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