# Higher Education Student Satisfaction with Online Learning: The Role of Teaching Material and Infrastructure

Dwi Puspita Sari*, Muhammad Nur Farih, Dimaz Cahya Ardhi, Dheo Rimbano, Jumroh, and Muhammad Nabil Arifin

***Abstract*—The Covid-19 pandemic has accelerated the shift from traditional to online learning in many countries, including Indonesia. This global disaster required higher education institutions to change the learning deliverable from in-person classes to online learning, which is highly different from normal learning processes that cause challenges. Success in online learning depends on the cooperation of some elements. This study examined the role of teaching material, infrastructure, instructors, and higher education institutions in students' satisfaction with online learning. This study distributed a Google Form survey to active college students enrolled for the 2020-2021 academic year. This study is a quantitative research that used associative type analysis and factor analysis to analyze data from an explanatory perspective. At the end of this study, the researchers developed a model showing how four variables—infrastructure, instructor, teaching materials, and higher education institution—affect the success of Indonesian online lectures in higher education students during the Covid-19 pandemic. The study results showed that the instructor has an impact on the teaching material, the institution has an impact on the infrastructure, and instructors have an impact on the infrastructure. However, teaching materials have no impact on the infrastructure.**

***Index Terms*—Covid-19, higher education, Indonesia, online learning, student**

## I. Introduction

Many higher education institutions in Indonesia conduct face-to-face meetings and provide students with paper-based classroom resources to adhere to the traditional teaching methodology. Face-to-face interaction and interpersonal contact during the teaching and learning process offer students access to knowledge and help them understand the teaching materials better. In addition, the physical presence of the instructors and students can have a positive social, psychological, and educational effect on the learners [1].

When the Corona Virus Diseases 2019 (Covid-19) pandemic affected numerous countries, including Indonesia, lectures delivered using the conventional technique abruptly changed. There was a significant effort in the education sector to stop the spread of Covid-19 in the community, and significantly higher education institutions switched from the traditional pedagogical method to online learning. Learning environments that do not physically exist in a classroom are present in online learning, which is fundamentally very different from conventional learning. Due to the lack of face-to-face interaction with the instructors and classmates, the students should manage their learning, including when, where, and how long they will spend reviewing the lecture content. Their prior online course-taking experience influenced students' online learning strategies' effectiveness, and students with more prior online course-taking experience used more effective strategic learning [2].

Students participating in this online learning utilize a variety of portable and mobile devices and software to undertake independent, cognitive learning tasks, access resources, collaborate and connect with classmates online, and contact instructors [3]. However, few Indonesian Higher Education Institution students participated in online classes before the Covid-19 pandemic. Therefore, the success of online lectures depends on cooperation from numerous stakeholders, including higher education institutions, instructors, students, and governments in each country.

Governments in numerous countries have acted by offering online lectures to stop the spread of the Covid-19 pandemic. Similar to governments of other countries that attempted to encourage online learning during the Covid-19 outbreak, the Indian government was able to use the existing E-learning infrastructure while also inventing techniques to adapt it to new situations and create new ones. In India, the Ministry of Human Resources Development's Department of School Education and Literacy has been the driving force behind several projects in this admirable endeavor, including Diksha, Swayam Prabha Channel, Shiksha Van, E-Pathshala, and the National Repository of Open Educational Resources [4]. The Covid-19 outbreak is another example of how Cambodia's government aided online schooling. The Ministry of Education, Youth, and Sport of Cambodia are working to provide online learning opportunities by airing video lessons on television and other online platforms to assist instructors and students in rural Cambodia. The videos are given to instructors and students who find online learning challenging and frustrating due to a lack of dependable internet access and the inability to use cutting-edge technology [5]. With little time to prepare for the new teaching and learning, the shift from lectures to online learning was also abrupt and challenging in Sri Lanka. The University Grants Commission of Sri Lanka and various universities in Sri Lanka took steps to connect the learning management systems of state universities with the Lanka Education and Research Network, which provides Internet

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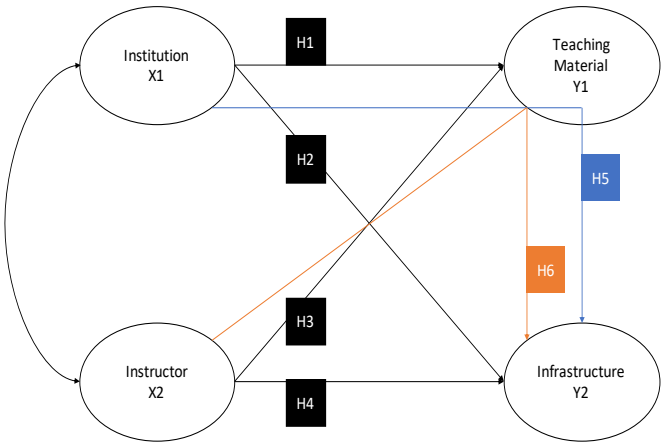
access for education and research in the country, greatly easing the transition [6]. In Indonesia, the Ministry of Education and Culture's Data Center and Information Technology provides cellular operators with a 15 GB monthly internet data allocation for students and instructors.

In its implementation, online learning instruction may deliver via audio, digital video, and computer technology, including synchronous interactive, computer-assisted training, and video-based online instruction [7]. For instance, synchronous interactive online instruction implements online lectures in a way that demands all students to be present simultaneously, limiting the natural flexibility of a regular online class concerning scheduling [8]. Higher education institutions were compelled to use online instruction, such as synchronous online learning, under the movement control order in Malaysia because campuses had to be closed to slow the spread of the Covid-19 virus [9]. Flexible scheduling for online lectures enables students to continue working, look after their children, and fulfilling other obligations [10]. Given its flexibility, it is hardly unexpected that online learning has become a commonplace option for working professionals in industrialized countries. Without anyone seeing the learning process, online learning aids students by teaching them to manage their time wisely while studying the teaching materials [11]. The Covid-19 pandemic is seen to have several advantages for online learning. However, many parties feel unprepared to deliver lectures online, including universities, instructors, and students. The traditional learning method fosters stronger interaction between students and instructors, which can impact learning and motivation, demonstrating why it outperformed online learning [12]. To create effective online lectures amid the Covid-19 pandemic, universities, instructors, and students must work well together. However, information and communication technology infrastructure is a crucial element that enables the implementation of online lectures in cutting-edge electronic learning environments centered on content delivery [13].

In practice, three crucial elements must work effectively in online lectures to deliver satisfaction and effective learning results. Interactions encompass interactions between students and instructors and between students and other students, making up the three components, along with facilities and course design [14]. The most important contextual factors to support digital learning activities were the higher education administration's digitalization policy and commitment; institutional equipment; technical and pedagogical aid; basic digital skills; and technology-related teaching talents [15].

Due to the nature of online lectures, students are not required to attend the class physically. Apart from allowing students to engage with their instructors and classmates in person, online learning can be a frustrating experience for most students because it demands them to spend more time on computers [16]. Although how the material is delivered and interactions between instructors and students differ between online and in-person lectures, both learning formats strongly emphasize four techniques: time management, effort regulation, critical thinking, and metacognitive strategies. These techniques should improve academic success [17]. Academic accomplishment refers to the performance results demonstrating the amount to which a person has achieved specified goals that were the focus of activities in instructional contexts, including higher education [18]. Academic achievement depends on time management, which includes setting aside regular study sessions that can be conducted in person with traditional learning techniques or virtually with online learning methods using various online meeting software. After the instructor has delivered the teaching materials, it is up to the online lecture students to select when and how long they can access the learning materials. Students must self-regulate to be engaged and maintain their cognition, behaviors, and affect during online lectures [19].

The community learning movement was further driven by social learning technologies and collaborative learning, in addition to adopting various tactics to succeed in online lectures. A community of inquiry framework is created using a social constructivist and situated learning viewpoint as a model for online teaching, learning, and research [20]. Three critical elements of a person's learning ecology are depicted in the innermost circle of a model to facilitate integrated learning across disciplines: learner engagement, digital resources, peer cooperation, and social support [21].




---------- : Line of Causal Influence
---------- : Line of First Mediation
---------- : Line of Second Mediation

Fig. 1. Research framework.

Fig. 1 shows the research conceptual framework of the study. Based on Fig. 1, the hypothesis of the study explanation is as follow.

H1: There is a relationship between institution (X1) and teaching material (Y1).

H2: There is a relationship between institution (X1) and infrastructure (Y2).

H3: There is a relationship between instructor (X2) and teaching material (Y1).

H4: There is a relationship between instructor (X2) and infrastructure (Y2).

H5: The role of teaching materials in mediating institutional influence on infrastructure.

H6: The role of teaching materials in mediating the influence of instructors on infrastructure.

There was some research conducted, and the research showed that technology infrastructure, institutions, students, and teaching materials were the essential elements that support online learning [12–15]. However, few studies still discuss how those elements satisfy students with their online

learning in Indonesia. This study examined how the infrastructure, the instructors, the instructional materials, and the institution impact students' satisfaction with their online learning experiences in Indonesia. The association between each of these variables will be demonstrated through this investigation. This study's research question is "Is there any relationship between students' satisfaction with online learning experience with teaching material, infrastructure, instructor, and higher education institution?"

## II. Research Methodology

The population in this study were students enrolled in private and public higher education institutions in Indonesia in 2021. Based on the Ministry of Education and Culture of the Republic of Indonesia data, 9,220,781 students are actively enrolled in private and public higher education institutions representing students from some cities and districts in Indonesia. This study will compile data and information from a survey sent to students actively enrolled and taking classes in the 2020/2021 academic year. The survey data collected from the participants will be confidential. In addition, before starting the survey, the researchers asked for the participant's consent, and after participants completed and submitted the survey, the researcher considered the submission to represent the participant's consent to participate in the study.

Closed-ended questions were distributed using Google Forms to students actively attending online lectures in the 2020–2021 academic year. Since the peak of Covid-19 in Indonesia occurred in 2020, this study focused on students who actively participated in online lectures during the 2020/2021 academic year. Because during that academic year, online learning in Indonesia become ubiquitous. This survey is divided into six categories: demographics, online learning media, online learning connectivity, online learning readiness, online learning assessment, and blended learning. A 5-point Likert scale was used for several survey questions, ranging from very good (5 points), good (4 points), fair (3 points), poor (2 points), and very poor (1 point). Students were asked to respond to the questions and rate each online course.

The Slovin Formula was utilized in this study's sample procedure, which was used as follows.

$$n = \frac{N}{1 + N \times e^2}$$

According to the Higher Education Database of the Ministry of Education and Culture of the Republic of Indonesia, the number of students enrolled in higher education in 2022 was 9,220,781. So, the researchers used the number as the study population.

$$n = \frac{N}{1 + N \times e^2} = \frac{9{,}220{,}781}{1 + 9{,}220{,}781 \times (0.03)^2} = 1110.97$$

$n$ : Number of samples
$N$ : Number of populations
e : Margin of error

The sample for the survey was 1,111 respondents. It is out of a population ($N$) of 9,220,781 students, with a margin of error ($e$) of 0.03. Due to many research populations, a margin of error ($e$) of 0.03 was applied [22]. After validating the data, 1,111 respondents in total were gathered from the online survey. This study uses an intermediary variable (Y1) to determine how the role of mediation influences a specific variable. It is a quantitative study using a type of factor analysis.

## III. Result

### A. Demography

Among the 1,111 respondents who participated in this survey, the female students dominate the percentage with 53.65%. The respondents were students who actively participated in online learning from semesters 1 to 10 at higher education institutions in Indonesia.

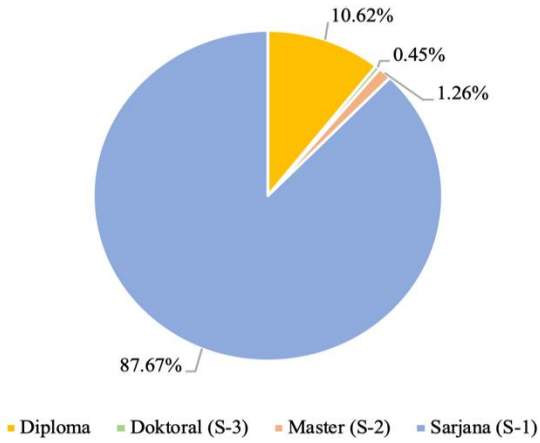



Fig. 2. Educational demographics.

Fig. 2 shows that that the students enrolled in the undergraduate represented 87.67% of survey respondents. Following these are diploma, master, and doctorate students, with percentages of 10.62%, 1.26%, and 0.45%, respectively. The students enrolled in the sixth semester had the highest percentage, with 38.79%. This number was followed by students who enrolled in the fourth and eighth semesters with a percentage of 24.95% and 18.57%, respectively.

This survey's participants are active college students in some provinces, including North Sumatra, West Sumatra, Riau, Bangka Belitung, Jambi, Bengkulu, South Sumatra, and Lampung. Respondents came from various faculties such as Education, Economy, Pharmacy, Law, Science, Technology, Communication, Arts, Sport Science, and Literature. However, the three highest faculties were the participants enrolled in Sports Science, Education, and Economy, with 25.38%, 20.25%, and 19.53%, respectively. In addition, there were various majors, for instance, nursing, communication, law, management, government, accounting, and information technology. Therefore, in this survey, the respondents were categorized into three: science, social, and language, with a percentage of 52.75%, 39.33%, and 7.92%, respectively.

### B. Online Learning

The research survey showed that students use a variety of providers from Indonesia's internet service providers to access online lectures. Those used providers were categorized into two types: state-owned and private enterprises, with 55.63% and 44.37%, respectively.

Fig. 3 shows that Smartphones were chosen by 75.97% of respondents as the device used to access online learning among the many other devices students utilize. Additionally, students use desktop computers, tablets/iPads, and notebook/laptop computers at percentages of 18.36%, 4.77%, and 0.90%, respectively. Mobile phone providers and personal hotspots from the mobile phone provider connections have the largest proportion, with 73.18%, in addition to the high rate of mobile phone use in online learning. This statistic is considerable in comparison to WiFi and LAN, which have rates of 26.55% and 0.27%, respectively. According to this survey, students actively engaged in their studies comply with the government's order that everyone stay inside during the Covid-19 pandemic. The home is the greatest location for attending and using online learning, according to 88.12%. Family/residence relatives came in second with 3.60%, followed by workplace with 3.24%. The remaining respondents who did not have reliable internet access at home mentioned internet cafés and public parks as convenient places to take online.

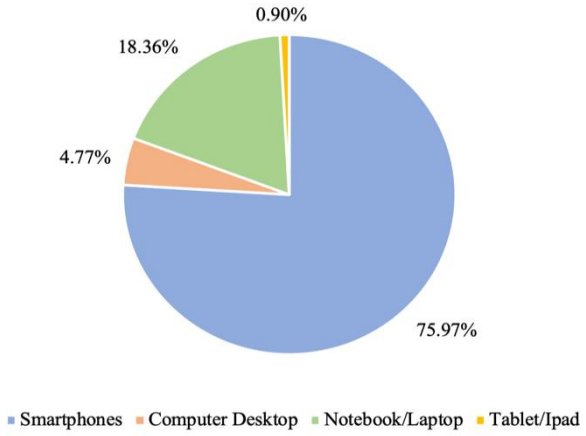



Fig. 3. Online learning devices.

The Ministry of Education and Culture of the Republic of Indonesia has maintained online learning platforms and tools across the country for accessing online educational resources during the lockdown brought on by the Covid-19 pandemic since March 2020. Online learning resources in Indonesia include educational radio, learning house, Indonesian Online Learning System (SPADA), and TV education, all of which are supported by the Center for Education and Culture Radio Media Development and are available in Indonesian and English [23].

According to survey respondents, the lecturers implemented online lectures through meetings utilizing online meeting programs, distributed lecture materials via various social media, or a mix of online sessions and social media use. A total of 59.14% of lecturers conduct online lectures using online meeting tools like Zoom Cloud Meeting, Webex, Google Meeting, and Skype. This percentage is relatively high compared to courses that use social media or a mix of social media and online meeting software. The use of social media and online meeting apps percentages in the delivery of online lectures with 38.97% and 1.89%, respectively. In addition, 79.57% of respondents said that their lecturers used Zoom Cloud Meetings to facilitate online lectures when evaluated from the ratio of the number of online meeting applications. Zoom Cloud Meetings opportunities in Indonesia were quite significant because it is a user-friendly and easy-to-use application that makes it easier for users to adapt to it [24]. Most lecturers have chosen this application for online learning because it gives many free facilities, including a 40-minute chance at each session, and limits 100 users to each meeting. On the other hand, some students claimed their instructors used another platform for online learning, including learning management systems from their higher education institution. The use of learning management systems as software applications for the delivery of education courses shows that online education has revolutionized and changed how people view knowledge and skill acquisition [25].

The type of online learning implemented by video conferencing, like Zoom Cloud Meeting, is categorized as a synchronous type of online learning. In contrast, asynchronous online learning typically involves email, learning management systems, and social media [26]. Synchronous and asynchronous methods differ in principle regarding the potential to facilitate social interaction [27]. Synchronous teaching and learning methods allow interaction between students and instructors via chat tools or video conferencing. On the other hand, asynchronous methods allow interaction with the learning materials, including discussions via forums and recorded lectures. Both synchronous and asynchronous learning processes use online tools to deliver the learning materials to the students. Google Meet and Google Classroom, two of the Google company's software programs, came in second and third, respectively, with 45.27 percent and 43.83 percent.

During the Covid-19 pandemic, lecturers use Webex, Skype, and different e-learning platforms from their campuses to facilitate online lectures. Although many applications can be used as technology application media that can facilitate online lectures, from the many applications, there are still various challenges and problems. Although many programs can be utilized as technology application media to support online lectures, there are also numerous difficulties and issues with these applications. The problems while using Zoom Cloud Meetings in online lectures arise during online learning activities. For example, students need more awareness in exploring their abilities to use various facilities available in Zoom Cloud Meetings, so students tend to be passive in using the Zoom Cloud Meeting application [28].

According to 74.44% of students, instructors often spend one to two hours online learning. Less than an hour-long online lecture came in second with a rate of 20.34%. The remaining time, which comprises 4.05% and 1.17%, respectively, is often spent by lecturers between three to four hours to over four hours. 90.46% of instructors use Microsoft PowerPoint when they deliver lessons online. The

distribution of books and journals, both domestically and globally, came in second with percentages of 29.07% and 13.32%, respectively.

Fig. 4 shows the percentage of student readiness to participate in online learning, where most students at colleges on the island of Sumatra feel well prepared and very prepared to participate in online lectures, reaching 71.64%. On the other hand, 4.23% and 1.98% of students felt unprepared and very unprepared to participate in online learning, respectively. This study categorizes four elements that can promote a student's readiness to take online courses: the instructor, the teaching materials, the infrastructure, and the institutions.

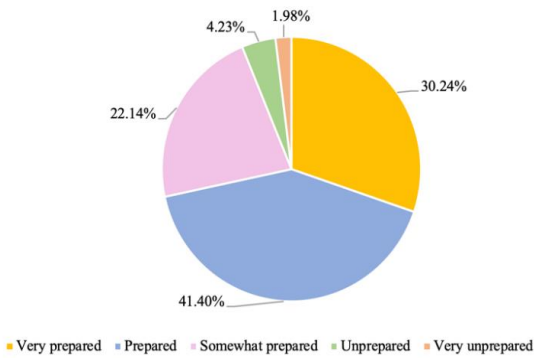



Fig. 4. Readiness of online learning.

The first factor is the instructor's ability to teach at each higher education institution where students attend classes. The ability of lecturers who provide online instruction supports students' readiness to enroll in online courses. According to the student responses to the study survey, 48.15% of respondents thought their online instructors have good quality. Additionally, 34.47% of respondents felt their online learning instructors were outstanding. The high rate of student satisfaction with the ability of their online instructors demonstrates that these instructors can adjust to new technologies to facilitate online instruction.

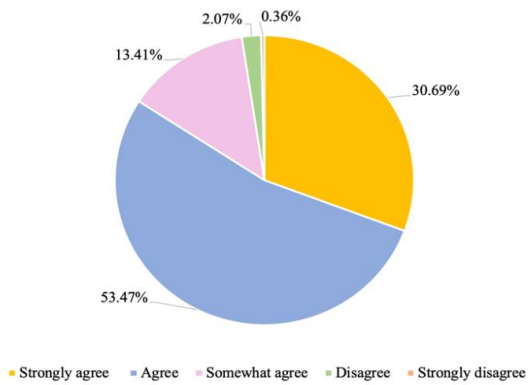



Fig. 5. Suitability of learning materials.

Fig. 5 shows that 84.16% of students agree that the learning materials presented by their instructors were suitable for online learning. However, 2.43% of students disagreed that their instructors present suitable learning material during online learning. The lecture content is also critical in determining how prepared a lecturer is to teach online, which is a second element after the lecturer's skills. Naturally, the content frequently presented in person to be online is fairly equalized. According to this survey, up to 43.11% of students believe they comprehend the information presented by their instructors during online lectures. Students who thought they grasped the content well enough and the material covered in online classes came in at 39.06% and 12.33%, respectively, after this proportion. Nevertheless, a sizable portion of students, 5.49%, believe they do not comprehend or do not understand.

Infrastructure is the third element that helps students succeed in online lectures. Infrastructure like lecture gadgets and internet connections are essential for successful online classes. According to the poll, 45.99% of students believe their online course infrastructure is adequate. At 30.24% and 17.01%, students who say that the supporting infrastructure for online lectures is pretty excellent and very good follow this number. However, 6.75% of students still feel that their school does not have the appropriate infrastructure.

The institution is a fourth element that contributes to the success of online lectures and the three previously mentioned elements. Universities should promote the proper operation of online classes as a venue for students to study. Up to 41.94 percent of students are pleased with the online courses offered by their colleges and universities. The very satisfied and quite satisfied categories are followed by this percentage, with 27.36% and 24.03%, respectively.

In addition to closed-ended questions, this study's survey included three open-ended questions. The first free-response question inquiries about the benefits of online courses during the Covid-19 pandemic. Most respondents indicated that the relatively flexible scheduling of online classes is an advantage. In addition, respondents believe that online lectures that do not require students to attend face-to-face lectures on their campuses allow them to save on transportation costs. In contrast, the next open-ended question concerns the disadvantages of online courses. Most respondents considered online lectures less effective due to the occasionally unstable internet connection and the need to purchase an internet subscription. Aside from that, many respondents found it challenging to comprehend the content presented during online lectures owing to the instructors' inability to give it online. Finally, in the last question of this survey, respondents were asked how to improve the online classes at their institutions. Frequent suggestions include providing free internet capacity so students can attend online classes without incurring additional costs. In addition, many students desire instructors to be more interactive during online lectures to increase student engagement. Aside from that, some students recommend that instructors add interesting material in online classes to engage students. In addition, many students indicated that their institutions should improve their learning management information systems so that their students can effectively participate in online lectures.

## IV. Analysis and Discussion

### A. Validity and Reliability Test

In this study, researchers conducted validity and reliability tests to measure and confirm that the research instruments were valid and reliable. The data validity was assessed using

the Pearson Product Moment correlation formula. In the beginning, the survey tested on 50 students before testing the contents of the survey. The validity and reliability tests were used for those 50 samples and a two-tailed significance level ($\alpha = 0.05$). Therefore, based on those samples and significance level, the r table used for this validity test was 0.273.

TABLE I: SATISFACTION VALIDITY

| Variable | r count | r table | Validity |
|---|---|---|---|
| Institution | 0.866 | 0.273 | Valid |
| Instructor | 0.892 | 0.273 | Valid |
| Teaching Material | 0.902 | 0.273 | Valid |
| Infrastructure | 0.639 | 0.273 | Valid |

Table I shows the validity test for four research variables: higher education institution, lecturer, teaching material, and infrastructure. In addition, the table showed that the r count for each attribute of those four variables was higher than the r table in the four existing variables. Thus, all satisfaction attributes evaluated with the Pearson Product Moment test were valid and reliable, allowing them to be utilized in research.

Based on the relationship between the dependent variable and the independent variable, it can be divided into five levels of relationship, namely: negligible correlation with $0 \leq r < 0.10$, weak correlation with $0.10 \leq r < 0.39$, moderate correlation with $0.39 \leq r < 0.69$, strong correlation with $0.69 \leq r < 0.89$, and very strong correlation with $0.89 \leq r < 1.00$ [29]. As the four research variables were valid with their respective values of r count > 0.10, it can be concluded that there was a correlation between the level of online learning satisfaction of higher education students and four research variables: higher education institution, instructor, teaching materials, and infrastructure.

The reliability test was conducted after the validity test, with the condition that if Cronbach's Alpha ($\alpha = 0.05$) was greater than 0.20, the questionnaire for this research survey could be considered reliable or consistent. In contrast, if Cronbach's Alpha ($\alpha = 0.05$) is less than 0.20, this study's survey questionnaire can be considered unreliable or inconsistent. Like the validity tests, the higher education institution, the lecturer, the teaching material, and the infrastructure were the four research factors that the reliability test was undertaken to examine.

TABLE II: SATISFACTION RELIABILITY

| Variable | Cronbach'Alpha | Reliability |
|---|---|---|
| Institution | 0.505 | Reliable |
| Instructor | 0.819 | Reliable |
| Teaching Material | 0.860 | Reliable |
| Infrastructure | 0.567 | Reliable |

Table II displays the results of the survey's reliability tests on all satisfaction attributes. Unlike the validity test, the reliability test only tests the research instruments for each variable, not the attribute. The satisfaction reliability test table above shows that the two Cronbach's Alpha values for instructor and teaching material variables presented above were greater than 0.60. That value indicated the highly reliable results for both variables. On the other hand, the other two Cronbach's Alpha values for higher education institution and infrastructure variables were in the range of 0.40 to 0.60, indicating moderate reliability. Therefore, based on the reliability test, it can be concluded that all satisfaction attributes have been considered reliable or suitable for use in the present study. After those two tests were completed, the survey was deployed to the qualified participants.

In this study, the Cronbach Alpha score was used to categorize levels of reliability. Less reliable is defined as a score between 0.0 and 0.20, rather reliable is defined as a score between 0.20 to 0.40, moderate reliable is defined as a score between 0.40 and 0.60, reliable is defined as a score between 0.60 and 0.80, and very reliable is defined as a score between 0.80 and 1.00 [30]. In addition, reliability tests on the instrument were conducted to determine whether the questionnaire could be used repeatedly on different persons [31].

### *B. Relationship Model*

Although there are several issues with its adoption, such as a shortage of trained instructors, infrastructure, and student readiness during the initial development of E-learning, many universities have begun integrating it into their educational system. Even though many students are disadvantaged by their incapacity to access online learning, online learning has the potential to attract a large number of participants. Therefore, universities should put more emphasis on enabling online lectures rather than making the gaps students face in online learning worse since the specific circumstances students face when taking online learning can have a significant influence [32].

Success in online learning is influenced by various elements, including student characteristics, assistance from lecturers, technology, systems, institutional support, course content, knowledge management, and online discussion groups [33]. Therefore, higher education institutions must maintain quality as much as possible throughout the Covid-19 pandemic. Additionally, there were three factors considered, including instructors quality, technical service quality, and service quality, influencing how satisfied students are with online learning. As a result, higher education institutions must maintain quality as much as possible during the Covid-19 pandemic. Some factors were essential in implementing online learning during the Covid-19 pandemic, including student attitudes, quality of online learning, and satisfaction [34]. The institution, instructor, teaching materials, and infrastructure were the four factors that were studied in this study to determine the relationship between the four factors that affect student satisfaction in online lectures.

Some students choose online learning over traditional face-to-face instruction. However, there is currently no option but to deliver lessons online due to the Covid-19 pandemic. Student preparation and adaptability to various online platforms significantly impact how satisfied students are with their online learning experiences. Support and guidance were required for the student's readiness and willingness to engage in online learning [35]. Effective student interactions can be challenging to motivate and maintain, especially in online learning environments where learning groups and massive open online courses are frequently utilized to improve learning in higher education [36]. Social networking, online shared workspaces, NovoEd, and other applications can all be used in learning groups. The

distances between students are virtually spanned because of their robust technology and social media skills. Additionally, cross-cultural contact is growing due to internationalization efforts, as shown in student exchange, faculty mobility, and substantial open online course offerings [37].

Fig. 6 shows one learning model solution that may be created by focusing on the causality pattern between variables of this study. By paying attention to the research findings, it is clear that improving the infrastructure and teaching materials should be the priority when developing an online learning activity. Improving the infrastructure and teaching are significant factors, particularly regarding the causality between instructors and their teaching materials. It is because individual quality is the principal capital in the online learning environment, where all skills and materials must be meticulously prepared to support student satisfaction. The causality of the institution with infrastructure is another equally significant aspect [36]. Institutions acting as online learning providers must blend an online learning pattern well. The higher education institution cannot adopt conventional learning or even take specific traditional patterns and apply them to online learning; doing so turns the pattern more into hybrid learning than online learning.

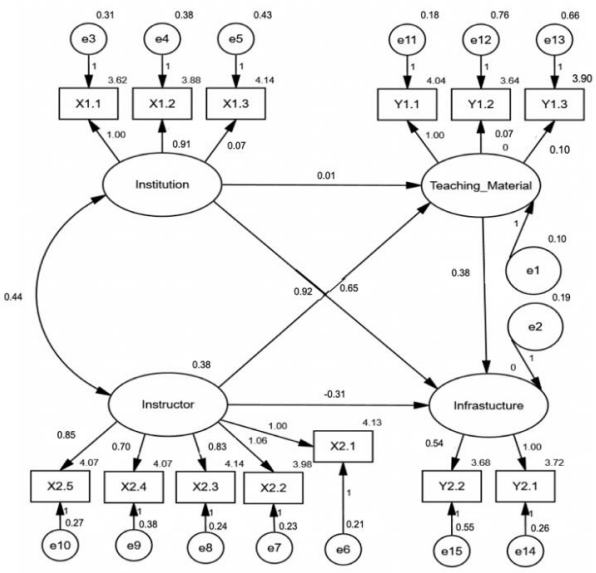



Fig. 6. Research model.

TABLE III: GOODNESS OF FIT (GOFI)

| No | Good Fit measure | Generated value | Matching target | Conclusion |
|---|---|---|---|---|
| **A** | **Absolute fit measure** | | | |
| 1 | Chi Squre / df value | 0.305 | Value below 2 and/or 2 | Good fit |
| 2 | P Value | 0.000 | Equal to or below 0.000 | Good fit |
| 3 | NCP | 0.934 | Approaching number 1 | Good fit |
| 4 | RMSEA | 0.082 | Between 0.05 to 0.08 | Good fit |
| **B** | **Incremental fit measure** | | | |
| 1 | NFI | 0.931 | Above or equal to 0.90 | Good fit |
| 2 | CFI | 0.936 | Above or equal to 0.90 | Good fit |
| 3 | IFI | 0.936 | Above or equal to 0.90 | Good fit |
| 4 | RFI | 0.912 | Above or equal to 0.90 | Good fit |

Table III illustrates how a model might be good or meet (a good fit). In this study, the researchers analyzed an online learning model that higher education institutions can adopt for online learning. The table demonstrates that all sizes meet the criteria for a good fit in absolute and incremental fit measurements. This further demonstrates that the model in Fig. 5 meets the conditions for the goodness of fit [38–40].

In addition to having a basic understanding of technology, instructors who use online lectures must also have positive attitudes toward technology. However, instructors must be able to create lesson plans that will help students succeed when attending online classes. The study results demonstrate that the instructor affects the teaching material with a P-Value of 0.000, which is less than the 0.005 significance level. Higher education students receive instruction from instructors using a variety of resources in addition to textbooks. In online lectures, instructors may supply teaching materials in the form of Microsoft PowerPoint presentations, online learning modules, research articles from various national and international publications, and video tutorials due to the advancement of technology and the growing usage of digital tools. Making sure the study sessions include enough activities to keep students interested needs careful consideration when creating online study content [41]. Using instructional resources in the classroom can assist the instructor in clearly explaining new concepts and improving student knowledge of the concepts being taught [42]. Teaching materials make learning more engaging by motivating students to learn.

Most instructional design approaches require numerous stages to be completed before producing educational materials, such as design, development, and implementation. Consider how each piece of educational content is fascinating, approachable, and engaging when assessing it. There is a relationship between these two variables, as evidenced by the significance of an instructor's involvement in creating high-quality teaching materials to assist the transfer of knowledge from instructor to students. The main competencies required for instructors while conducting online lectures: are the ability to communicate clearly and consistently, expertise in information technology and subject-matter expertise, management, vision, open-mindedness, and leadership [43]. Online courses can give students systematic access to course resources, learning activities, and interaction [44]. As a result, by effectively applying appropriate resources and technologies, students can access content, acquire skills, and participate in higher-order thinking activities. Additionally, when designing online lessons, one should adhere to the seven principles of instructional practice for successful teaching and learning: encouraging interaction between students and faculty, encouraging student cooperation, encouraging active learning, encouraging prompt feedback, encouraging time on task, encouraging high expectations, and encouraging diversity in learning styles [45].

The results of this research indicate that institutions impact infrastructure in addition to the instructor variable that influences instructional materials, with a P-Value of 0.000 or less. Institutions have the power and duty to complete infrastructure because they are educational institutions.

Infrastructure for online lectures might involve a range of hardware, software, connections to the internet, and media. The use of media in online lectures serves to draw students' attention and increase their motivation to attend online lectures, where students can engage in various activities that support online lectures that can improve learning outcomes in addition to listening to the material provided by the instructors [46]. On the other side, this study's P value of 0.502 and above demonstrates that instructors have no impact on infrastructure. As educators, instructors employ current technology to facilitate online courses during the Covid-19 pandemic. Still, they have little control over the infrastructure colleges provide for holding such lectures.

Technical system quality positively influences instructors quality, while infrastructure does not affect it [47]. For instance, a suitable online learning platform has assisted the instructor in assessing online learning and facilitating efficient learning. Unlike face-to-face lectures, online learning instructors must have the knowledge, abilities, and skills to administer the online teaching system and interact with students online. The difficulties of conducting online lectures, such as a slow internet connection, are numerous. Although an instructor cannot change the current infrastructure, an instructor can make the most of some of the infrastructure or tools available in online lectures, such as using active learning tools. In this case, switching to online learning could exacerbate long-standing equity problems, so an instructor must also be prepared to use infrastructures like internet access, hardware, and software [48]. The instructor acts as active learning comprises approaches that focus more on developing students' skills than transmitting the information. Instructors can use various platforms to interact through video, audio, and live chat, giving the impression of a personal meeting from a safe distance during the Covid-19 pandemic [49].

The association between the institution and the instructional materials has a P value of 0.903, higher than 0.005, as seen in Table IV about the relationship output discussed below. Therefore, the institution has no impact on the instructional materials. Due to the Covid-19 pandemic, the shift to online teaching and learning was accelerated, considering several crucial issues relating to higher education institution support. For example, how lecturers were trained to teach online, whether the institution had a pedagogical vision for online learning, and how to assist students in learning online. Institutional decisions influence teaching preparation for online teaching and learning in higher education regarding the environments for such learning and teaching [50]. Students are expected to be motivated and engaged to ensure the success of online learning. They can change attitudes toward it, including the intrinsic incentive to learn, extrinsic motivation, and amotivation [51].

TABLE IV: RELATIONSHIP OUTPUT

| Relations | S.E. | C.R. |
|---|---|---|
| Institution to teaching material | 0.085 | 0.122 |
| Instructor to teaching material | 0.109 | 8.432 |
| Teaching material to infrastructure | 0.474 | 0.801 |
| Instructor to infrastructure | 0.466 | −0.671 |
| Institution to infrastructure | 0.118 | 5.497 |

The P Value of 0.423 above 0.005 further indicates no association between teaching materials and infrastructure. Infrastructure makes it simple for instructors to share resources online, but it has little bearing on the teaching materials instructors give to their students. On the other hand, the institution's infrastructure to support students' sustainability of online lectures for students may be impacted. Infrastructure and instructional support are essential to scaffold learning to facilitate learners' cognitive processes in online learning, where instructional support can motivate learners to pursue self-directed learning [7].

Fig. 7 shows a pattern of mediating relationships between institutional characteristics, educational materials, and infrastructure. For example, Fig. 7 above shows that the Sobel test score of 0.120 is under 1.96, and the probability value of 0.90 is greater than 0 [38–40]. In general, a policy published by higher education institutions will influence the availability of infrastructure. However, when other factors mediate the relationship, such as the adequacy of teaching materials, the question will emerge as to whether this variable can indeed intervene in the influence of institutions' policies on infrastructural facilities, mainly when implementing online learning.

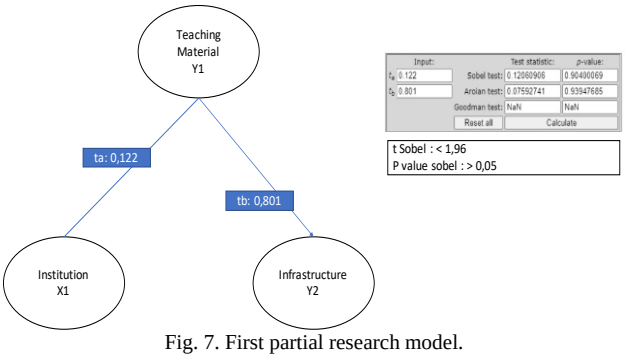



Fig. 7. First partial research model.

Fig. 8 provides a mediating interaction pattern between the instructor, teaching material, and infrastructure factors. The Sobel test score of 0.797 falls below the value of 1.96, and the probability value of 0.42 exceeds the value of 0.05. When other factors mediate the relationship, such as the sufficiency of teaching materials, instructors in institutions will influence the management and utilization of the infrastructure given by higher education institutions. When introducing online learning, the question will arise as to whether this factor can influence instructors' management and infrastructure utilization [38–40]. These two sub-models strengthen the model in Fig. 6 developed in this study, so higher education institutions can adopt this model when implementing online learning.

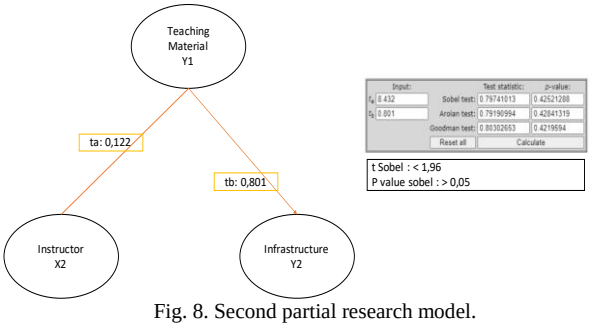



Fig. 8. Second partial research model.

In this study, the Sobel test calculation was utilized to determine the importance of mediation in determining the relationship between exogenous and endogenous factors [52]. The calculated *t* Sobel from both the first mediation relationship and the second mediation connection, each value was found to be below 1.96 based on the Sobel test calculation results. This leads to the conclusion that the effectiveness of the lectures can mitigate the impact of lecture policies established by higher education institutions during the Covid-19 pandemic on the utilization of infrastructure by higher education institutions and lecturers. The instructor's material quality can then buffer the lecturers' efficacy in the face of the Covid-19 pandemic and how effectively higher education institutions and lecturers utilize their infrastructure.

This study research model, as shown in figure 6, showed that the development of the infrastructure offered by universities is unaffected by the lecturers' skills during the Covid-19 pandemic. Because online learning relies on supporting infrastructure, it is necessary that this relationship not be one-way for learning patterns that differ from conventional ones. With a Sobel test score of 0.120 < 1.96, teaching materials have a role in mitigating the impact of institutions on infrastructure. The effectiveness of the delivered lectures can moderate the impact of lecture policies that higher education institutions enacted during the Covid-19 pandemic on the utilization of infrastructure by instructors and higher education institutions. Because the quality of the learning will reflect the quality of the institution, the learning quality becomes a critical link that must exist while learning online. With a Sobel test score of 0.797 < 1.96, teaching materials rank sixth in mitigating the impact of instructors on infrastructure.

In the Covid-19 pandemic era, the quality of the lecturer's material can moderate the effect of the lecturer's quality on the infrastructure utilization by higher education institutions and instructors. Instructors and teaching materials cannot be separated because of their close relationships. In this study, however, teaching materials did not directly affect the infrastructure for deploying online lectures. In this survey, respondents believed that the infrastructure to support online learning needed to be improved, particularly at private tertiary institutions, which affected student satisfaction with online lectures. In addition, additional concerns, such as inconsistent internet signals in online implementation and rules made by the Indonesian government supporting online lectures, must be considered.

This study suggests that all stakeholders must work together to ensure student satisfaction with online education throughout the pandemic. For instance, online learning requires support from higher education institutions and the necessary infrastructure. In addition, they required specific requirements to support their online learning, such as regulations for lecturers conducting online lectures, such as system support, and online lecture learning programs, such as E-learning, given by affiliated higher education institutions. Online learning not only requires standard E-learning but also quick and easy access to instructional resources. Even though the Indonesian government, through the Ministry of Education and Culture, has provided monthly internet data to both students and instructors, internet stability necessitates the construction of several infrastructures that can support reliable internet connections. Thus, students can participate in online lectures by reducing the likelihood of connection loss, which might impede the smooth operation of online lectures.

Only higher education institutions with governmental authorization to conduct online lectures have implemented online learning thus far in Indonesia. Before the Covid-19 pandemic, many public and private higher education institutions in Indonesia had no authorization to conduct online learning. Consequently, higher education institutions may adopt this model to conduct online lectures during a pandemic. The institutions can adopt the model to conduct online learning subject to existing central and regional government regulations, such as the joint decree of the four ministers concerning guidelines for organizing learning in the 2020/2021 academic year and 2020/2021 academic year during the corona virus disease (Covid-19) pandemic [53].

## V. Conclusion

The Covid-19 pandemic will eventually end, and life will return to normal as before it began to alter how people go about their everyday tasks. The world of education will once more hold in-person seminars. While delivering online lectures during this pandemic, numerous lessons can be learned. Even while the circumstances surrounding this crisis can be put behind us, there is still a chance that another crisis will develop and prevent regular schooling. Therefore, there is a need for an advancement in online education that would enable students to engage in and ultimately succeed in online lectures. In this study, four factors that affect the success of online lectures were identified. These factors are institutions as educational providers; instructors as education facilitators; teaching materials that support the implementation of education; and infrastructure as infrastructure that links instructors and students.

This study addressed six research hypothesizes the researchers posed at the beginning of the study. First, institutions have a probability value of 0.000 to 0.05 of affecting infrastructure. It is clear that different decisions made by higher education institutions during the Covid-19 pandemic, such as the development and improvement of the infrastructure needed to support online lectures, have supported online learning and affected how well students could participate in them. Additionally, the government's policy in Indonesia of allocating internet quotas for instructors and students has a favorable effect on the viability of online lectures. Second, the instructor's probability of impacting the teaching materials is 0.000 < 0.05. Although instructors are free to conduct lectures anywhere online, they must make necessary changes to the offered content to effectively deliver and receive it during online lectures. Third, a likelihood value of 0.903 > 0.05 indicates that the institution has no impact on the teaching materials. The varied policies implemented by colleges and universities during online lectures amid the Covid-19 outbreak had no bearing on the skill of the information instructors supplied to their students. Institutions need more readiness in the face of

abrupt changes, a too-broad demographic base, unequal networks, and adopting learning styles. Fourth, with a likelihood value of 0.502 > 0.05, instructors do not impact infrastructure.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

Dwi Puspita Sari developed the research instruments and outlined the study's design. Muhammad Nur Farih produced the results of the literature review. After analyzing and testing the data, Dimaz Cahya Ardhi created the pie diagram and tables. Dheo Rimbano developed and discussed the research model. Finally, Jumroh examined the survey results. Muhammad Nabil Arifin deployed a study survey and gathered the survey's data. The final manuscript was written with the participation of all authors.

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