Undergraduate Students' Difficulties in Following Distance Learning in Mathematics Based on E-Learning During the Covid-19 Pandemic

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Abstract **– The success of implementing e-learning depends on students' perceptions regarding this learning, the ability to use IT, to the online learning process carried out in mathematics courses. This paper describes how students experienced difficulties in following mathematics learning based on e-learning during the Covid-19 as seen from the research variables developed. This research subject were 500 students who came from various undergraduate study programs. The research data were collected through online questionnaires and analyzed using structural equation modeling. The results showed that students' views and the ability to use IT affected online learning that was undertaken during the Covid-19.**

Keywords **– Difficulty in Following E-Learning, Distance Learning of Mathematics Based on E-Learning, Student Views, IT Ability, E-Learning during the COVID-19 Pandemic.**

1. Introduction

Technology in the learning process is not a new topic in the education sector, especially in higher education.

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Technology had been applied in the learning process, such as GeoGebra, Autograph, Desmos, and Cabri-3D, which are used in mathematics learning; Duolingo in learning English; until the most frequently used namely Microsoft PowerPoint and Macromedia Flash in almost all subjects. Technology plays a dual role in the learning process. From the student's perspective, technology acts as a medium to understand abstract concepts and material by turning them into a more visual one. These assisted students to understand and apply these concepts in solving problems, while from the lecturer's perspective, technology plays a role in helping lecturers as a medium in transferring information to students and a visual learning support tool.

The important role of technology in learning affects improving the quality of education. Technology is not only used as a media or learning support tool, but it is also used in every other part of the educational process, from implementation to learning evaluation. While the use of technology in learning shows that the learning process requires supporting tools and facilities that can provide new experiences for students and lecturers, learning and teaching using technology are a good strategy in organizing the concept of implementation and evaluation of the education system [1]. The need for technology is getting higher when the learning process is no longer done face-to-face but is done virtually or often referred to as online learning (e-learning). E-Learning provides opportunities for students to study anywhere and anytime. Technology facilitates students to improve new skills, one of which is using technology [2]. The application of e-learning can also improve communication skills between lecturers and students [3].

Online-based distance learning (e-learning) is becoming increasingly developed with a variety of different techniques and strategies. This phenomenon emerged because of the COVID-19 pandemic, which is increasingly widespread throughout the world,

including Indonesia. This type of learning is one of the efforts made to protect students, lecturers, and all elements of society in the educational environment from the spread of Covid-19, with the emergence of the COVID-19 pandemic requiring face-to-face learning to be transformed into distance learning using technology assistance. This effort raises the fact that technology acts not only as a medium, but also as a substitute for face-to-face learning that cannot be done [4]. Distance learning is an alternative that can be done hence students and lecturers continue to carry out learning and achieve the expected learning outcomes. Lecturers have to take advantage of asynchronous learning which can take advantage of technology in the learning process as an effort to increase teaching capacity virtually [5], [6]. Several previous studies that refer to the use of e-learning before the outbreak of the COVID-19 pandemic can be seen in the following description: Üzela & Özdemira [7] who obtained the fact that the application of e-learning in normal phase learning is effective in increasing positive attitudes and mathematical abilities in mathematics teachers. Freiman et al. [8] provide results that e-learning (computer and technology) application has a real impact on helping students understand math problems in real contexts. Loong [9] shows that 53.3% of students feel helped by e-learning system, this is because students have easy access to teaching materials anywhere and anytime. Tawil et al. [10] research showed different results from the previous studies which show that face-to-face teaching and learning by lecturers is more effective in increasing student understanding of mathematics and statistics compared to the help of e-learning media. These results are also strengthened by the results obtained by Cimermanová [11], which stated that the application of e-learning can be used as an option for technology-based learning, but it has to also be noted that the role of teachers or lecturers in e-learning is different from traditional face-to-face learning. Valverde-Berrocoso et al. [12] explained several reasons why the use of e-learning did not have a positive effect in learning, including low student motivation and student confidence in understanding the material independently, to the influence of the ability of lecturers to provide teaching materials through e-learning media.

Research results related to the use of e-learning in learning before the COVID-19 pandemic are also not much different from the results of its application during the COVID-19 pandemic. Mailizar et.al [13] conducted research on middle school level including mathematics teachers and obtained the results that the use of e-learning provided several obstacles in its implementation, including the ability of students and teachers to use technology, the involvement of the curriculum in encouraging the effectiveness of using e-learning, especially during the COVID-19 pandemic, and teachers' views on the application of technology in learning. The same result was obtained by König et al. [14] in which the use of e-learning does not have an effective impact in helping students understand learning material, provides its difficulties for both students and teachers in using technology, lack of adequate internet network support so as not to maximize the learning process during the COVID-19 pandemic, and the difficulty of teachers in providing abstract teaching in the context of technology-based teaching. Slightly different results were obtained by Shahzad et. al [15] in which the use of e-learning provides significant convenience for university students in Malaysia in obtaining learning during the COVID-19 pandemic, and Wijaya [16] in which the use of e-learning makes it easy for Chinese students to understand the material, especially the teaching material provided via video.

Based on the research results above, it is a challenge for both lecturers and students to apply e-learning, especially mathematics learning, which contains a lot of abstract and computational material. The use of e-learning not only has a positive impact but also often has a negative impact on the implementation of learning. This should be analyzed further, what causes the use of e-learning to have a positive or negative impact. In a condition wherein lecturers are required to work harder in helping students understand mathematical concepts through e-learning, changes in the mathematics learning process which are usually carried out face-to-face are also experiencing significant difficulties for both lecturers and students, especially when transformed into e-learning. In the application of e-learning, students were also required to be active in participating in distance learning mathematics, build interpersonal communication between students and students, as well as students and lecturers, and increase learning independence hence they have to be able to use e-learning used in the learning process [17]. Judging from this, it is necessary to carry out further research related to the effectiveness of distance learning of mathematics based on e-learning application which can be seen from the perspective of students' perceptions in following the learning process, as well as what difficulties students experience. Hence, lecturers can make improvements on a learning process which resulted in the achievement of learning competencies and students' mathematical abilities increase. Therefore, to carry out this research, the researcher formulated several research problems as follows:

1. What difficulties did students experience while taking e-learning for distance learning in

mathematics subject during the COVID-19 pandemic?
2. Is there a relationship between the ability to use IT and difficulties in using e-learning when participating in distance learning of mathematics subjects during the COVID-19 pandemic?
3. Is there a significant difference between students' views on the difficulties in using e-learning when participating in distance learning of mathematics subjects during the COVID-19 pandemic based on the online learning process?
4. Is there a significant difference between students' views on the difficulties in using e-learning when participating in distance learning mathematics during the COVID-19 pandemic based on the type of mathematics courses taken?
5. Is there a significant difference between students' views on the difficulties in using e-learning when participating in distance learning mathematics during the COVID-19 pandemic based on the gender of the student?

2. Method

This research is a quantitative study using a cross-sectional questionnaire [18]. The research approach selection refers to quantitative methods that are considered capable of providing reliable, valid, objective, and generalizable findings. The data collection technique is using a questionnaire which is one of the most widely used quantitative instruments. By this technique, the questionnaire can be given to many research samples based on a representative sample of the population hence generalizations can be made to the entire population. This research had a random sample of 500 participants (226 male and 274 female). The sample came from undergraduate students who take mathematics courses (from various study programs) and came from Sumatera Utara Province. Furthermore, the participants in this research consisted of 44% of 1st-year students, 50.80% of 2nd-year students, and 5.20% of 3rd-year students. The table that describes the demographic background of the participants in this research can be seen in Table 1 below:

Table 1. Demographic Background of Research Participants

Demographic Background		Number of Participants	Percentage
Gender	Male	226	45.20%
	Female	274	54.80%
Undergraduate Degree Level	First Year	220	44.00%
	Second Year	254	50.80%
	Third Year	26	5.20%

The research instrument used was a questionnaire developed based on a special conceptual framework for this research (can be seen in the Appendix). The questionnaire consisted of four variables, namely students' ability to use technology (KPIT), students' views regarding e-learning (PM), online learning/e-learning process (PPD), and the type of mathematics courses taken by students (JMK). Each of these variables consists of several indicators or statements consisting of five scales, namely Strongly Agree, Agree, Slightly Disagree, Disagree, and Strongly Disagree. The questionnaire data developed consisted of 36 construct statements describing the four variables of this research. Validation of questionnaire content is carried out by experts in the field of educational technology and mathematics learning. The validation results indicate that the questionnaire is included in the good category by the validator. The questionnaire validated using the rubric form that consists of indicators of integrating e-learning during pandemic Covid-19. The experts as validators checked the questionnaire and offered advice to make that questionnaire better.

The questionnaire data that was obtained was then analyzed using the analysis technique of structural equation modeling (SEM) with the help of STATCAL and LISREL software analysis tools. The selection of SEM analysis techniques is based on the formulation of research problems that intend to identify the relationship between variables and their indicators, and explain the relationship between variables or explain the quality between factors. While the stages of data analysis carried out were in the form of grouping data based on variables and types of data, tabulating data, presenting data for each variable under the research, performing calculations to answer problem formulations, and performing calculations to test the formulated hypotheses, in this research, the variables involved in data analysis were latent variables formed by several indicators. Research in this field involves multivariable, multi-relationship, and tiered. The variables used in this research can be seen Table 2 below:

Table 2. Description of Research Variable

Variables	Description
X_1	Students' ability to use technology (KPIT)
Y	Difficulty in using e-learning when following the distance learning process of mathematics during the COVID-19 pandemic
X_2	Students' views regarding e-learning (PM)
Y_1	The difficulty in using e-learning when following the distance learning process of mathematics during the COVID-19 pandemic based on the online learning process (PPD)
Y_2	Difficulties in using e-learning when following the distance learning process of mathematics during the COVID-19 pandemic based on the type of courses taken (JMK)

The data processing process is carried out in two stages, namely testing the measurement model which includes validity and reliability and testing the structural model, which includes testing the significance of the influence of independent or exogenous variables on the dependent or endogenous variable. Validity and reliability testing is carried out in order to test whether the indicator variables used are truly significant in terms of reflecting the construct or Latin variables (convergent validity). Some of the measures tested in this research include: Standardized Loading Factor (SLF) Size, Construct Reliability (CR) Size, and Average Variance Extracted (AVE) Size. Good convergent validity is indicated by the high SLF value. Hair et al. [19] stated that CR value ≥ 0.7 is included in good reliability, while 0.6 ≤ CR value < 0.7 is included in the category of acceptable reliability, provided that the indicator variables show good validity. The CR size can be calculated with the following formula:

$$CR = \frac{(\sum_{i=1}^{n} SLF_i)^2}{(\sum_{i=1}^{n} SLF_i)^2 + (\sum_{i=1}^{n} e_i)} \quad (1)$$

The AVE value ≥ 0.5 indicates Adequate Convergence. AVE size can be calculated using the following formula:

$$AVE = \frac{\sum_{i=1}^{n} SLF_i^2}{\sum_{i=1}^{n} SLF_i^2 + \sum_{i=1}^{n} e_i} \quad (2)$$

The research data is then analyzed at the structural model stage, and later it is evaluated whether test results can answer the formulation of this research problem.

3. Result

Based on the analysis results of validity and reliability measurement model testing on each research variable, namely Students' Ability to Apply IT (KPIT), Students' Views (PM), Online Learning Process (PPD), and Type of Subject (JMK) obtained SLF values which can be seen in Fig. 1 below:

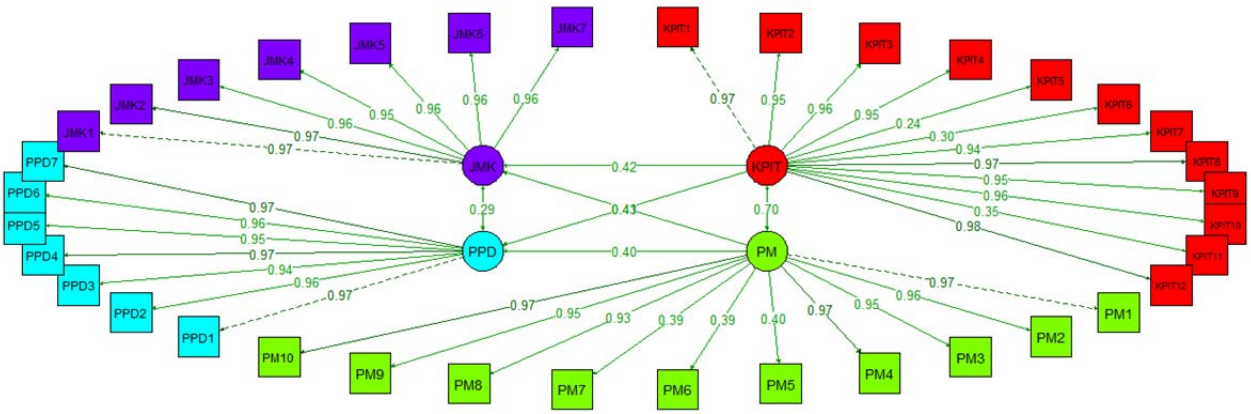

Figure 1. Standardized Loading Factor (SLF)

Based on Fig. 1, it can be seen that the SLF value on the KPIT5, KPIT6, KPIT11, PM5, PM6, and PM7 indicators is smaller than 0.5. Thus, the six indicators were eliminated from the further analysis process. Furthermore, the SLF testing phase without involving indicators with an SLF value < 0.5 can be seen in Fig. 2 below:

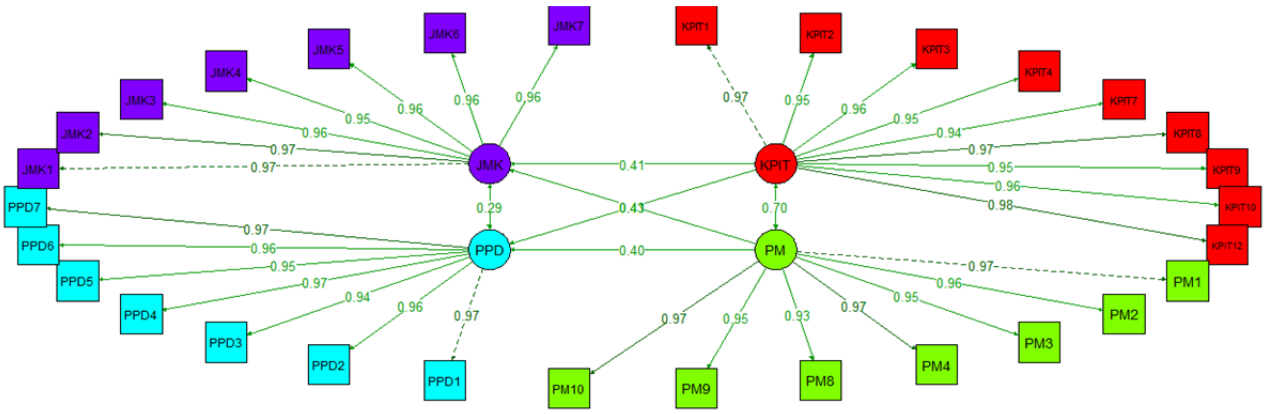

Figure 2. Standardized Loading Factor (SLF) After Elimination of Invalid Indicators

Based on the results in Fig. 2 above, the overall SLF value of each indicator is $SLF > 0.5$. This shows that good convergent validity has been achieved based on the SLF measure. Furthermore, testing the AVE and CR values based on the KPIT, PM, PPD, and JMK variables can be seen in Table 3 below:

Table 3. AVE and CR Value Based on KPIT, PM, PPD, and JMK Variables

Latent Variables	Average Variance Extracted (AVE)	Construct Reliability (CR)
KPIT	0.9212	0.9906
PM	0.9178	0.9874
PPD	0.9195	0.9876
JMK	0.9246	0.9885

Based on Table 3 above, it is identified that all AVE values of each variable are $AVE > 0.5$, which means that the results obtained have met good convergent validity based on the AVE size. Furthermore, it is identified that all CR values of each variable are $CR > 0.7$, which also means that the results obtained have met the good convergent validity based on the CR size. The next test stage is to test the fit of the overall model, which can be seen in Table 4 below:

Table 4. Overall Model Match Test

Measures	Values	Benchmark Value	Model to Data Match
RMSEA	0.0278	< 0.1	Yes
NFI	0.9823	> 0.9	Yes
CFI	0.995	> 0.9	Yes
GFI	0.9314	> 0.9	Yes
AGFI	0.9201	> 0.9	Yes
SRMR	0.0076	< 0.05	Yes

Based on the aforementioned Table 4, the result shows that the SEM model as a whole has a good ability in terms of matching the sample data (good fit). The testing stage is continued to the second stage, namely the structural model test, which aims to test the significance of the influence between variables. The test results can be seen in Fig. 3 below:

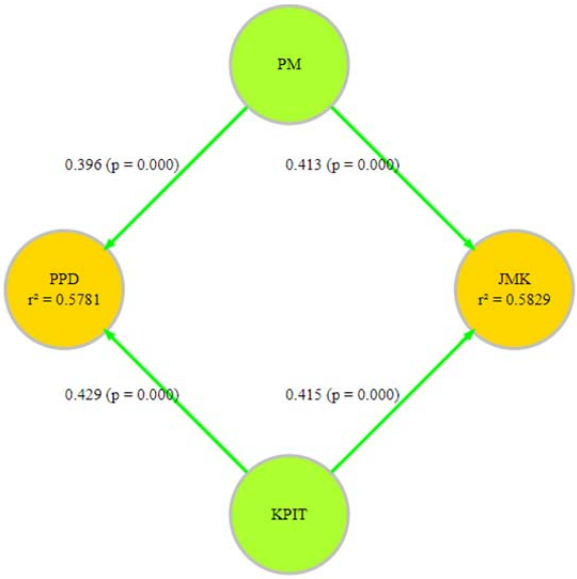

Figure 3. Significance Testing

Based on the test results in Fig. 3, the following results obtained are as follows:

a. It is identified that PM has a positive effect on PPD, with a path coefficient of 0.396 and significant with $p = 0.000 < 0.05$.
b. It is identified that KPIT has a positive effect on PPD, with a path coefficient value of 0.429 and significant with $p = 0.000 < 0.05$.
c. It is identified that PM has a positive effect on JMK, with a path coefficient of 0.413 and is significant with $p = 0.000 < 0.05$.
d. It is identified that KPIT has a positive effect on JMK, with a path coefficient value of 0.415 and significant with $p = 0.000 < 0.05$.
e. It is identified that the coefficient of determination (R Square) value and the PPD variable is 0.5781, which means that the PM and KPIT variables are able to influence the PPD variable by 57.81%. The coefficient of determination (R Square) value of the JMK variable is 0.5829, which means that the PM and KPIT variables are able to influence the JMK variable by 58.29%.

The results of further testing regarding the differences in the KPIT, PM, PPD, and JMK variables based on gender can be seen in Fig. 4 below:

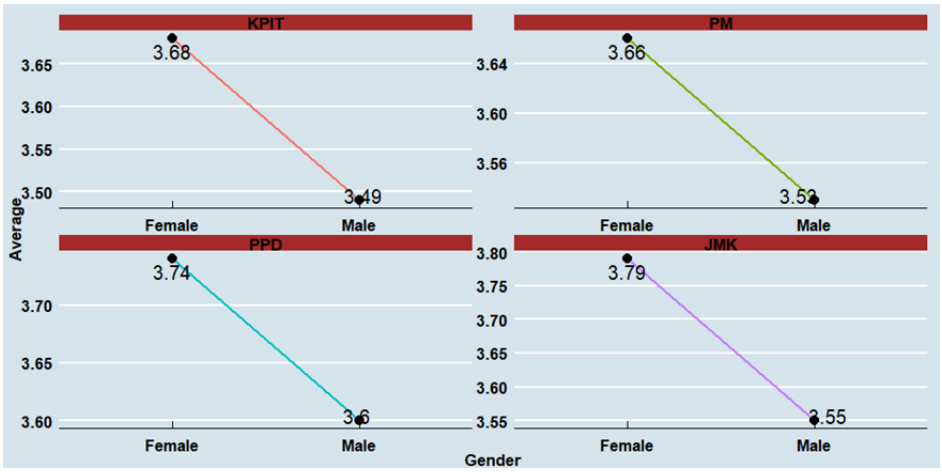

Figure 4. Difference Between KPIT, PM, PPD, and JMK Indicators by Gender

4. Discussion

4.1. Ability to use IT and Students' views Affect the Online Learning Process

Based on the analysis results, it showed that the ability to use IT affects the online learning process carried out by students during the COVID-19 pandemic. This is in accordance with the research results obtained by Parkes et al. [20] dan Attard & Holmes [21], in which students also feel anxious and insecure when the learning process changed from face-to-face to online learning, and in which students are not ready to use technology in the learning process and the low level of technology-mastery makes the use of e-learning and some types of online learning ineffective. Online learning does not provide individual satisfaction for students, especially when their ability to use technology is not optimal hence the content of teaching materials that have been prepared by lecturers cannot be studied optimally. It can be said that students' views have a positive influence on the online learning process, according to the analysis results obtained in this research, where students feel that the lack of interaction intensity between students and lecturers, technical problems with online learning systems, and difficulties in understanding instructional objectives are the main obstacles in the process of implementing online learning [22]**.** This shows that student approval in the implementation of e-learning is a good first step. Why is this necessary? This is based on the similarity of perceptions between students and lecturers who carry out online learning. Online learning has a learning environment that is different from traditional learning in general.

Online learning requires good cooperation not only between lecturers and students but also between students themselves. The ease of interaction obtained in the implementation of traditional learning (face-to-face learning as has been done so far) will be difficult to obtain in an online learning atmosphere. Students' views on online-based learning need to be considered. It has to be ensured that online learning which is carried out is not just providing teaching materials or teaching videos, but the learning process stops. With the focus of learning not only as a process of understanding the material presented in the teaching video, but also the establishment of similarities in student's perceptions and opinions regarding the understanding of the teaching material they get [23], the learning process still needs to pay attention to a structured discussion environment even though it is carried out in the form of online discussions [24]. This is done to keep the learning environment similar to face-to-face learning.

4.2. Ability of using IT and Students' views Affect Learning in the Selected Mathematics Subject

The results obtained also explained that the views of students also influenced the mathematics courses they took. This represents an important point in the online learning process. Students will be successful in online learning if we look at the readiness of the lecturers in providing optimal teaching material, especially in mathematics courses which involve a lot of numerical calculations and analysis. When these students take e-learning of mathematics subjects, they are required to be independent and creative in gaining an understanding of the material given, for students who have low mathematical abilities, they will find it difficult to follow e-learning in mathematics subject. Meanwhile, when

they take part in face-to-face mathematics subject, the presence of the lecturer provides maximum support for their attainment of understanding. Zamista et al. [25] explained in the results of his research that students had negative perceptions of online-based calculus learning. The results showed that students had difficulty understanding things about algorithms, mathematical propositions, and mathematical symbols which resulted in decreased student's motivation and learning performance. Related to the research results, it showed that the success or failure of online learning is not only borne by students but also needs optimal support by lecturers in presenting creative and innovative teaching materials, which can provide virtual assistance to students. The presence of lecturer's creativity in summarizing learning material is an important point in reducing student's difficulties in the e-learning-based mathematics subject process. The lecturers' treatment when teaching mathematics also needs to pay attention to the teaching material that will be presented. The difficulty level of the teaching material also needs to be considered; hence the lecturer can ensure summarizing the difficult material in simpler concepts, and can also use tools such as mathematics learning software or create learning using a supportive online learning model. In this context, the ability to use IT for lecturers is also expected to be one of the supports in providing interesting and interactive teaching materials for students [26], [27].

In line with the research results obtained, the optimal implementation of e-learning (especially in mathematics courses) can occur when there is significant automation of interaction between students and lecturers, and reserves the maximum possible time for interaction between lecturers and students. This can be done by virtual face-to-face, both of which can support optimal online-based mathematics learning [28]. In addition, lecturers and students need to agree that online-based mathematics learning needs a higher intensity of understanding compared to face-to-face learning as usual. While a different perspective was given by Gonzalez et al. [29], in his research results show that the presence of the COVID-19 pandemic has a positive effect on student learning performance. For this reason, these challenges need to be conveyed at the beginning of online learning and there are needs which have to become a mutual agreement before online learning takes place. It is stated that before the COVID-19 pandemic, the consistency of students in participating in learning was still not optimal, in which students did not learn continuously. However, the effect of Covid-19 lockdown resulted in the switch of face-to-face learning to online learning, making student learning performance increase. Learning becomes a continuous habit and affects the improvement of their learning performance. Based on his research related to student learning habits in Vietnam during the COVID-19 pandemic, Trung, et al. [30] focused on independent learning that resulted in an increasing consistency of learning hours. The continuity of online-based mathematics learning can be maintained by ensuring the consistency of student's learning, student's motivation and enthusiasm, creativity and innovation of lecturers in providing material, and institutional support in facilitating the online learning process itself. These research results indicate that online learning both in terms of online-based mathematics learning has various effects on student's interest in learning.

4.3. Difference between Students' views on the Difficulties in using E-learning when Participating in Distance Learning Mathematics During the COVID-19 Pandemic based on the Gender of the Student

Based on the aforementioned Fig. 4, the results show that on average, KPIT value variable for female students is higher than KPIT value variable for male students. The research results contradict the idea that technology-related activities are seen as a "male domain" [31], and men tend to be more interactive and responsive in providing views regarding the situation and conditions they are living in. Likewise, in the test scores for other variables, it is identified that the value of the PM, PPD, and JMK variables on average have a higher value for female students than male students. In this research context, it is determined that female students had higher perceptual scores for all research variables compared to male students.

5. Conclusion

Overall, this research analyzes the difficulties experienced by students in participating in e-learning-based of mathematics distance learning in several variable approaches, including: based on students' views, students' ability to use IT, the types of mathematics courses studied, and the process of implementing online learning. After testing the hypothesis and path analysis using STATCAL AND LISREL software on the full equation model with the SEM method, it is identified that two independent variables, students' ability to use IT and students' views, have a positive and statistically significant effect on the difficulty variable in using e-learning in mathematics distance learning during the COVID-19 pandemic based on the online learning process and the type of mathematics courses taken. The variables of the ability to use IT and students' views have a

positive and significant effect on the difficulty variable in using e-learning in distance learning of mathematics during the COVID-19 pandemic based on the online learning process, this can be seen from the significant value of each p-value of $p = 0.000$. The variables of the ability to use IT and students' views have a positive and significant effect on the difficulty variable in using e-learning in distance learning of mathematics during the COVID-19 pandemic based on the type of mathematics courses taken. This can be seen from the significant value of each p-value of $p = 0.000$.

However, the results of this study do not claim that online learning based on e-learning in mathematics does not have a positive effect on students' learning performance. It should be noted that the results of this study were obtained during the online learning process of the COVID-19 pandemic, which means that there is a pandemic effect which results in changes in the learning process that are emergency in nature. The mental unpreparedness and self-confidence of students and the support for the ability to use technology by both students and lecturers are indicators that need to be emphasized.

The existence of technology should indeed facilitate the transfer of knowledge in the mathematics learning process [32]**.** The presence of various supporting mathematics learning software, such as: GeoGebra**,** Autograph, Desmos, and other software such as the presence of growing online learning applications such as Edmodo, Google Classroom, and the Online Learning System (SPADA) developed by educational institutions, and the application of learning models that support online learning, such as Blended Learning, Flipped Classroom, also has a positive effect on the development of students' mathematics learning outcomes.

Technology in learning provides more attractive and interactive learning environment, and if this presence is packaged in online learning in difficult times such as the COVID-19 pandemic, optimal cooperation is needed by all community stakeholders in the world of education, starting from students, lecturers, officials, institutions, as well as parents [33], [34]. Through this research, it is expected that educators, both lecturers and teachers, need to pay attention to many additional variables before finally carrying out e-learning based distance learning of mathematics. However, we still cannot forget that the learning environment created in online learning still cannot replace the role of lecturers and teachers in providing more concrete and basic mathematical understanding.

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