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# The DeLone and McLean model for measuring success in online learning systems: Indonesian evidence

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| Article Info | ABSTRACT |
|---|---|
| | The development of information and communication technology (ICT) during the era of the fourth industrial revolution, the impact of the COVID-19 pandemic in 2020, and the government's call for large-scale social restrictions have led to the emergence of online learning systems (OLS) in higher education. This study develops a measurement model for the success of OLS based on the DeLone & McLean model. Surveys were conducted on a sample of 175 students from domestic and international universities. Data processing used the partial least squares structural equation modeling or PLS-SEM method, and root cause analysis. The results show that platform quality has a positive influence on OLS success, whether mediated by user satisfaction or OLS usage. Social influence has a positive effect on OLS success, mediated by OLS usage. User computer anxiety has a negative effect on OLS success, mediated by user satisfaction. Recommendations to improve OLS success include adjusting internet package rates to make them more affordable, improving signal strength to various locations for better coverage, limiting the number of users in one learning session for more effective OLS, and the need for organizational support in using the right applications.<br><br> |

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## 1. INTRODUCTION

Ever since the beginning of the COVID-19 outbreak, the Indonesian authorities have enforced regulations to limit gatherings in public spaces, businesses, and educational institutions. As a consequence, students and educators are required to conduct all their academic activities from their homes by utilizing online platforms for virtual meetings and classes [1]–[5]. Online learning systems (OLS), which are defined as various functions to support virtual classrooms to improve the quality of teaching and learning activities [6]–[8], are a great opportunity for application and internet service providers to collaborate in gaining profits [1], [9].

With the work-from-home (WFH) program, requests for an internet network installation at home increased dramatically in March 2020 compared to the previous month by 30-40% [10]. At the time of COVID-19, the use of educational e-learning platforms with video conferencing tools dominated teaching and learning, namely Zoom, Microsoft Teams, Moodle, and Google Classroom and their effectiveness was proven to offer the right solution for emergency online teaching difficulties [11]. Zoom usage per day could reach 200 million in March, and 300 million in the following month compared to December 2019 of 10 million and the initial launch of Zoom in 2013 of 3 million usages [12], [13]. Meanwhile, the use of Google Meet per day reached 100 million, which increased by 300% since January [14].

People are using Zoom because it is easy to use and free of cost, but its competitors are catching up. Measuring video conferencing application performance metrics against the performance of the three most popular platforms in education and business, namely Google Meet, Microsoft Teams, and Zoom, it was found that there are substantial differences in the way the three applications treat video and audio streaming. While each platform has its benefits, there are no ideal applications, their performance depending on audio, video, or network bandwidth [15]. Even though the OLS can be a solution for learning activities when the offline system cannot be implemented, it does not mean that there are no negative impacts. According to Sabeh et al. [16], 83.3% of respondents agree that students' motivation and seriousness in learning decrease when undergoing OLS, and 60.8% of respondents agree that OLS can cause students to become addicted or excessive in using gadgets.

There are several methods for determining the efficacy of an information system (IS). The usage of numerous models is one of the most widely used and dependable approaches to evaluating IS. Among them, the DeLone and McLean model (D&M model) is a well-known and widely used tool [17], [18]. This model was first introduced in 1992 and was upgraded with major revisions in 2003. The D&M model is intended to assess many elements of an IS, including quality, user happiness, system usage or intention to use, and net benefits [8], [19]–[23].

By modifying the paradigm, the D&M model is still frequently utilized as study material today. Among these are study findings from [6], [12], [21], [24], [25], indicating that system quality, information quality, and service quality all have a beneficial impact on user satisfaction with OLS. Furthermore, according to Aldholay et al. [20] study findings, system quality, information quality, and service quality all have a beneficial influence on behavioral intention to use. According to research findings from [6], [21], [24], [25], user happiness has a favorable influence on net benefits.

Nonetheless, research done by Hiremath et al. [26] and Jeyaraj [27] show that the quality of information has no effect on user satisfaction. Similarly, the outcomes of Ouajdouni et al. [28] research indicate that the quality of the system has little effect on OLS use. According to Shahzad et al. [12], the influence of system quality, information quality, and service quality on e-learning portals is indirect, mediated through system usage and user satisfaction as intermediary factors.

This study uses the platform quality variable, which is a fusion of system, information, and service qualities [29]. As per the findings of Lee et al. [29], the quality of the platform has a favorable influence on platform loyalty. Additionally, according to Shahzad et al. [12] and Ouajdouni et al. [28] research suggests that user satisfaction plays a crucial role in the effectiveness of OLS. The research results from Ouajdouni et al. [28] show that social influence has a positive effect on the use of OLS, while computer user anxiety has a negative effect on user satisfaction in OLS. Hence, based on these observations, we can formulate: i) H1: Platform quality has a positive effect on the success of OLS through user satisfaction; ii) H2: Platform quality has a positive effect on the success of OLS through the use of OLS; iii) H3: Social influence has a positive effect on the success of OLS through the use of OLS; and iv) H4: User anxiety in using computers has a negative effect on the success of OLS through user satisfaction.

Based on empirical phenomena, this research analyzes the influence of platform quality, social and user computer anxiety on the success of OLS using video conferencing applications both through user satisfaction and OLS use. In addition, this research analyzes the root causes and solutions to the not yet optimal success of this OLS. This research is expected to provide practical benefits and theoretical contributions regarding measuring the quality and success of information systems. Hopefully, this research can also be used as a reference for optimizing OLS based on/using video conferencing applications, especially in improving the various dimensions that influence it. This research is different from previous studies for promoting a novelty i.e., combining variables in the research of authors [19], [29] (platform quality), and [28] (social influence and user computer anxiety). Based on the literature review, previous research, and hypotheses, the theoretical framework of this research can be illustrated in Figure 1.
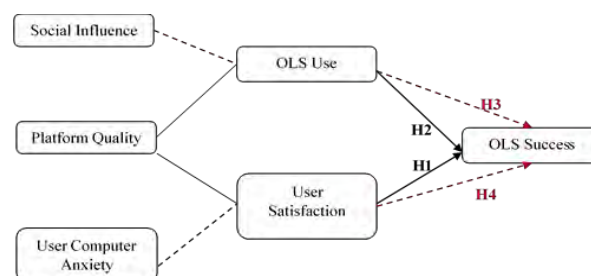


Figure 1 Theoretical framework

## 2.    RESEARCH METHOD

The research method used is a mixed method, an intellectual and practical synthesis based on qualitative and quantitative research [30]. This research is also associative, which asks about the relationship between two or more variables that will function to explain, predict, and control phenomena [22]. In the research context, the researchers conduct a verification analysis, testing the research hypothesis (quantitative): the influence of platform quality, and social and user anxiety on the success of OLS through the use and satisfaction of OLS users. Once the survey data has been collected, the researchers conduct a verification analysis: testing the research hypotheses that have been proposed by the authors (quantitative) and looking for light and heavy obstacles to find solutions to optimize the success of OLS using video conferencing applications (qualitative). This study encompasses three categories of latent factors (independent variables, mediating variables, and dependent variables). Independent variables include the social impact and learners' computer anxiety, mediating variables are OLS usage and user satisfaction, and the dependent variable is OLS performance. Variable operationalization is described in Table 1. The measures in this study are taken on a 5-point ordinal/Likert scale (1. strongly disagree, 2. strongly disagree, 3. strongly disagree, 4. Agree, and 5. strongly agree).

Table 1. Variable operationalization

| Latent variable | Manifest variables (indicators) |
| --- | --- |
| Platform quality [6], [25] | Complete system information |
| | System information is easy to understand |
| | Accurate system information |
| | Information systems meet the needs |
| | Interesting system display |
| | System problems are quickly serviced |
| Social influence [28] | Important person |
| | People who influence behavior |
| | People whose opinion is valued |
| | Organization |
| User computer anxiety [28] | Nervousness |
| | Bad premonition |
| | Inconveniences |
| OLS use [28] | Obtain information |
| | Publish information |
| | Communicate with peers and educators |
| | Do coursework |
| User satisfaction [6], [25] | Satisfied with use |
| | Satisfied with system information |
| | Satisfied with system performance |
| | Self-confident |
| | Satisfying needs |
| | Overall interaction |
| OLS success [6], [25], [28] | Positive impact |
| | Opportunity for more achievement |
| | Facilitate knowledge transfer |
| | Help increase independence |
| | OLS performance was good overall |
| | OLS was successful overall |

The population used as respondents in this study are Indonesian students currently studying at domestic and foreign universities. According to Hair *et al*. [31], the optimal number of samples is 5-10 times the highest indicator of one latent variable or 10 times the highest number of structural paths leading to a latent variable. The researchers determined 175 samples of Indonesian students currently studying at local and foreign universities. The sample of respondents currently studying at domestic universities are 28 public and private universities. Their domiciles come from several provinces in Indonesia, including North Sumatra, DKI Jakarta, West Java, Central Java, East Java, South Sumatra, Aceh, D.I. Yogyakarta, Riau Archipelago, East Nusa Tenggara, Riau, and West Sumatra. Samples of Indonesian student respondents from foreign universities came from Australia (University of Melbourne, Australian National University, Monash University, University of Queensland, and the University of Sydney), China (Suzhou University of Science and Technology and Xi'an Jiaotong Liverpool University), and Singapore (Curtin University Singapore).

Structural model testing, which aims to test the hypothesis, uses partial least square (PLS) analysis which is a variance-based structural equation modeling (SEM) method [13], [32]. The evaluation of this research model is divided into two stages, the evaluation measurement (outer model) and testing of the structural model (inner model). After knowing the results of hypothesis testing, a root cause analysis is carried

out. The 5-whys is one of the popular analytical methods that aims to find solutions that start from the root of the problem [33]. The measurement (outer model) evaluation consists of convergent validity, discriminant validity, and reliability in a construct/variable that is built, which must be able to meet the applicable parameters as seen in Table 2. According to the table, all indicators that are part of the latent variable have an outer loading factor value greater than 0.7, which is higher than other variables' cross-loading. This indicates that the requirements for both convergent and discriminant validity have been met.

Table 3 shows all average variance extracted or AVE values are above 0.5. Table 4 shows the Fornell-Larcker criterion for assessing discriminant validity involving latent variables to prevent multicollinearity problems. The table display the √AVE value of the user satisfaction or LS correlation variable, is 0.866, which is greater than the correlation value of the LS variable with user computer anxiety or LCA (-0.229) and others. This also applies to other variables, where the value of √AVE on the variable itself shows a greater value than the correlation between latent variables. Table 5 shows all reliability parameters have a value above 0,7, meaning they have met the reliability requirements. Thus, the evaluation measurement has fulfilled all the requirements, and it can be said that the model that has been formed is valid and reliable.

Table 2. Test parameters of validity and reliability [34], [35]

| Outer model | Parameter | Requirements |
|---|---|---|
| Convergent validity | Outer loading | >0.7 |
| | Average variance extracted (AVE) | >0.5 |
| Discriminant validity | Fornell-Larcker criterion | √AVE > correlation between latent variables |
| | Cross loading | Loading factor > correlation between latent variables and manifest |
| Reliability | Composite reliability, Cronbach's alpha and rho_A | >0.7 |

Table 3. Average variance extracted (AVE)

| Variable | AVE |
|---|---|
| User computer anxiety | 0.770 |
| User satisfaction | 0.749 |
| OLS success | 0.741 |
| OLS use | 0.655 |
| Platform quality | 0.631 |
| Social influence | 0.661 |

Source: The results of data processing by PLS-SEM

Table 4. Fornell-Larcker criterion for assessing discriminant validity

| Variable | LCA | LS | OlsSc | OlsU | PQ | ScInf |
|---|---|---|---|---|---|---|
| User computer anxiety (LCA) | 0.877 | | | | | |
| User satisfaction (LS) | -0.229 | 0.866 | | | | |
| Online learning system success (OlsSc) | -0.296 | 0.814 | 0.861 | | | |
| Online learning systen use (OlsU) | -0.371 | 0.645 | 0.669 | 0.810 | | |
| Platform quality (PQ) | -0.127 | 0.631 | 0.538 | 0.528 | 0.794 | |
| Social influence (ScInf) | -0.168 | 0.464 | 0.425 | 0.460 | 0.535 | 0.813 |

Source: The results of data processing by PLS-SEM

Table 5. Reliability parameter test results

| Variable | Cronbach's alpha | rho_A | Composite reliability |
|---|---|---|---|
| User computer anxiety | 0.855 | 0.902 | 0.909 |
| User satisfaction | 0.933 | 0.934 | 0.947 |
| OLS success | 0.930 | 0.933 | 0.945 |
| OLS use | 0.827 | 0.833 | 0.884 |
| Platform quality | 0.883 | 0.887 | 0.911 |
| Social influence | 0.830 | 0.843 | 0.886 |

Source: The results of data processing by PLS-SEM

Table 6 illustrates the impact of platform quality and social influence on OLS usage, resulting in a coefficient of determination of 0.323. This means that 32.3% of OLS usage can be accounted for by the influence of platform quality and social influence, whereas the remaining 67.7% is attributable to other variables beyond the scope of this study. Furthermore, the effect of platform quality and user computer anxiety on user satisfaction yields a coefficient of determination of 0.421. This implies that 42.1% of user satisfaction can be attributed to the influence of platform quality and user computer anxiety, while the remaining 57.9%

can be explained by other variables not examined in this study. Finally, the impact of platform quality, social influence, user computer anxiety, OLS usage, and user satisfaction on OLS success results in a coefficient of determination of 0.701. This indicates that 70.1% of OLS success can be explained by the influence of platform quality, social influence, user computer anxiety, OLS usage, and user satisfaction, whereas the remaining 29.9% is attributable to other variables not considered in this study. Figure 2 shows the result of testing the outer and inner models using the Smart PLS software version 3. In this case, the researchers use a significance level of 5%.

Table 6. The coefficient of determination in structural model testing

| Variable | R Square | R square adjusted |
|---|---|---|
| OLS Use | 0.323 | 0.315 |
| Learner satisfaction | 0.421 | 0.414 |
| OLS Success | 0.701 | 0.692 |

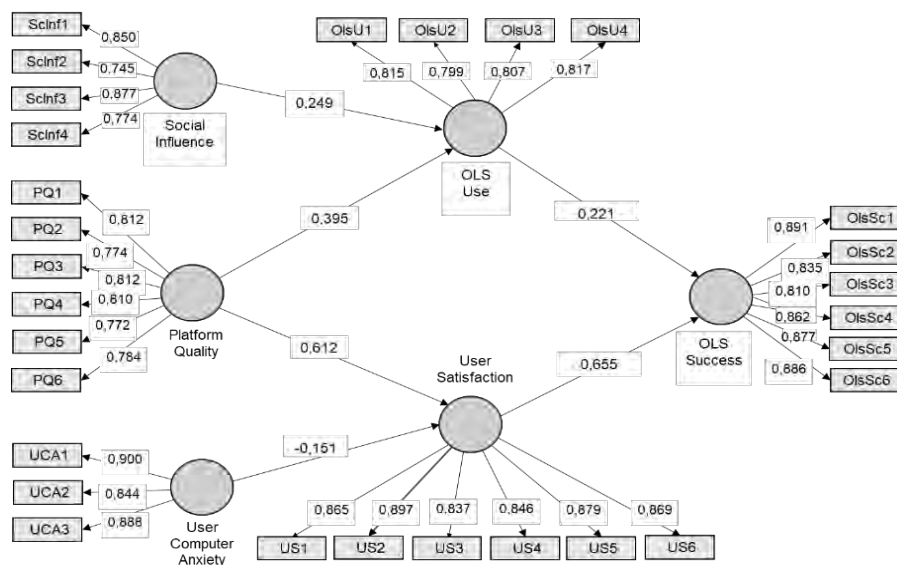Source: The results of data processing by PLS-SEM



Figure 2. Outer and inner model test results

## 3. RESULTS AND DISCUSSION

Based on the processing of the respondent's profile, most respondents are female, coming from Gen Z and currently occupying the bachelor/S1 level. The intensity of using video conferencing applications is an average of 4-6 times a week. The most popular video conferencing application is Zoom. Table 7 shows all the direct effect path coefficient values in the structural model test with significant results (P values <0.05 or T statistics >T table 1.96) and have a positive or negative direction. Table 8 shows all the path coefficient values of the indirect effect on the structural model testing; the results are significant and have a positive or negative direction. The outcomes of the study are presented in Table 9, indicating that: i) The platform's quality has a favorable impact on OLS success through user satisfaction; ii) Platform quality has a constructive impact on OLS success through OLS usage; iii) Social influence has a beneficial impact on OLS success through OLS usage; and iv) User computer anxiety has an adverse effect on OLS success through user satisfaction.

Table 7. Direct effect path coefficient values in structural model testing

| Path analysis | Original sample | Sample mean | Standard deviation | T stat | P values |
|---|---|---|---|---|---|
| User computer anxiety → User satisfaction | -0.151 | -0.151 | 0.062 | 2.439 | 0.008 |
| User satisfaction → OLS success | 0.655 | 0.651 | 0.064 | 10.207 | 0.000 |
| OLS use → OLS success | 0.221 | 0.222 | 0.073 | 3.041 | 0.001 |
| Platform quality → User satisfaction | 0.612 | 0.615 | 0.053 | 11.622 | 0.000 |
| Platform quality → OLS use | 0.395 | 0.393 | 0.076 | 5.226 | 0.000 |
| Social influence → OLS use | 0.249 | 0.260 | 0.088 | 2.842 | 0.002 |

Source: The results of data processing by PLS-SEM

Table 8. Indirect effect path coefficient values in structural model testing

| Path analysis | Original sample | Sample mean | Standard deviation | T stat | P values |
|---|---|---|---|---|---|
| Platform quality → OLS use → OLS success | 0.087 | 0.087 | 0.033 | 2.610 | 0.005 |
| User computer anxiety → user satisfaction → OLS success | -0.099 | -0.097 | 0.038 | 2.622 | 0.005 |
| Social influence → OLS use → OLS success | 0.055 | 0.058 | 0.027 | 2.018 | 0.022 |
| Platform quality → user satisfaction → OLS success | 0.401 | 0.401 | 0.056 | 7.110 | 0.000 |

Source: The results of data processing by PLS-SEM

Table 9. Hypothesis test results

| Hypothesis | Result | Proof | Conclusion |
|---|---|---|---|
| H1 | Accepted | T stat=7.11>1.96 P value=0.000<0.05 (significant) | Platform quality has a positive effect on the success of OLS through user satisfaction |
| H2 | Accepted | T stat=2.61>1.96 P value=0.005<0.05 (significant) | Platform quality has a positive effect on the success of OLS through the use of OLS |
| H3 | Accepted | T stat=2.02>1.96 P value=0.022<0.05 (significant) | Social influence has a positive effect on the success of OLS through the use of OLS |
| H4 | Accepted | T stat=2.62>1.96 P value=0.005<0.05 (significant) | User anxiety in using computers has a negative effect on the success of OLS through user satisfaction |

### 3.1. The effect of platform quality on OLS through user satisfaction

The effect of platform quality on OLS through user satisfaction is significant and positive. It can be interpreted that the higher the platform quality, the higher OLS success through high user satisfaction. Based on observations, most users are satisfied with the performance of the video conferencing application system used (agree=41.71% and strongly agree=30.86%). This is because the platform has provided services and resolved problems quickly (agreed=41.14% and strongly agree=18.29%), provided adequate information (agree=39.43% and strongly agree=41.71%) and regularly and periodically release/update the latest system. The results of testing the path of influence are in line with the basic theory of DeLone & McLean's information system success model and research by researchers [12], [28].

### 3.2. The effect of platform quality on the OLS success through the OLS use

The impact of platform quality on OLS success through the utilization of OLS is positive and statistically significant. This implies that OLS success increases with higher platform quality, as well as the use of good OLS. The majority of students were observed to use the system effectively, as indicated by the positive tendency of the latent variable. This is partly due to the high quality of the platform application, which is reflected in the positive tendency of the latent variable. These findings align with the fundamental principles of DeLone & McLean's information system success model and the research conducted by Shahzad et al. [12].

### 3.3. The social influence on the variable OLS success through OLS use

The social influence on the variable OLS success through OLS use is significant and positive. It can be interpreted that the higher the social influence, the more success of OLS through the use of good OLS. Based on observations, Zoom is the most widely used application because it is influenced by the surrounding environment/organization. However, most users only use the trial version, which is limited in duration. Even though most users are able to use the system well (the latent variable tends to be positive), the time limit reduces its effectiveness. In this case, when the duration limit runs out, users have to reopen the application, which takes time. Buying a Zoom package or using another application can be a solution. The results of testing the path of influence are in line with the basic theory of DeLone & McLean's information system success model and research by researchers [28], [36].

### 3.4. The effect of user computer anxiety on the OLS success through the user satisfaction

The effect of user computer anxiety on the OLS success through user satisfaction is significant and negative. It can be interpreted that the lower the user's anxiety in using the computer, the more success of OLS through high user satisfaction. The success of OLS is also influenced by user satisfaction the only user confidence in using the computer. Based on observations, most users are confident using computers (agree=36.00% and strongly agree=26.86%. Users who are not confident will increase their anxiety in using computers for OLS; thus, when online learning uses conference applications and videos, they are not actively following. The results of testing the path of influence are in line with the basic theory of DeLone & McLean's information system success model and research by previous studies [28], [37].

The researchers use root cause analysis with the 5-whys method to find the right solution, so it is expected to optimize OLS. Based on the 5-whys method, the following questions arise based on previous

answers (tic-tac-toe), answers based on evidence, and evidence based on real conditions in the research phenomenon [38]. The 'why tree diagram' can be seen in Figure 3. Based on 'why tree diagram' analysis, suggestions for increasing the success of OLS are adjusting internet package rates which are still quite high so that they are more affordable, increasing signal strength to various locations to make it more evenly distributed, limiting the number of users in one lesson session so that OLS is more effective, and the need for organizational support in using the right application.
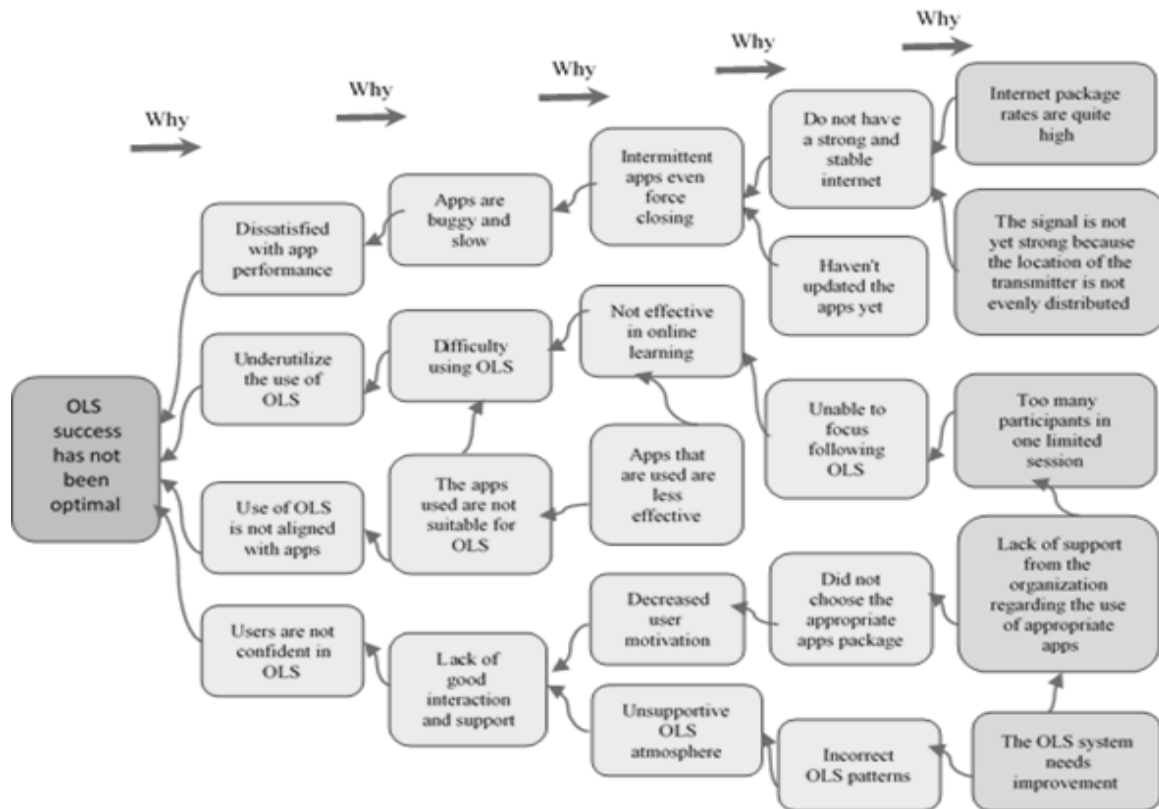


Figure 3. Why tree diagram

## 4.    CONCLUSION

The quality of the platform has a positive impact on the success of OLS, which is facilitated by the utilization of OLS and user satisfaction as intermediate variables. In addition, social influence positively impacts OLS effectiveness, which is also mediated by the utilization of OLS. However, the negative effect of user computer anxiety on the success of OLS is mediated by user satisfaction. Suggestions for increasing the success of OLS are adjusting internet package rates which are still quite high so that they are more affordable, increasing signal strength to various locations to make it more evenly distributed, limiting the number of users in one lesson session so that OLS is more effective, and the need for organizational support in using the right application.

Although the research has been carried out optimally, it still has some limitations. This research is limited to OLS using video conferencing applications, so the results cannot be generalized to other OLS, such as mixed or hybrid learning models, asynchronous, and synchronous online courses in real-time. This study selected respondents limited to Indonesian students studying at domestic and foreign universities. Further research can use other respondents, for example employees, professionals/business owners, housewives, and entrepreneurs. This study uses the variables platform quality, social influence, computer user anxiety, OLS use, and user satisfaction in measuring the success of OLS. Further research may involve other variables, such as relationship quality, perceived usefulness, and loyalty.

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