Analysis of User Acceptance of the Electronic Malaria Monitoring System Based on Technology Acceptance Model

Inda D Lestantri[1], Ilham[1], Yusnita[1], Aan Kardiana[1], Indra Budi[2], Dana Indra[2]
[1]*Information Technology Faculty, Yarsi University, Letjen Sutoyo Street, Jakarta, Indonesia.*
[2]*Computer Science Faculty, Indonesia University, Depok, West Java, Indonesia.*
indah.lestari@polman.astra.ac.id

***Abstract*—Malaria is one the diseases that can cause death, especially in high-risk community groups, namely the pregnant women, infants, and toddlers. More than 310 million people worldwide are infected with malaria every year and about 2 to 3 million people died of malaria. In the area of Tanah Bumbu, the Maternal Mortality Rate (MMR) in 2010 reported 10 deaths in 4,517 live births childbirth. In this case, it is crucial to combat Malaria at the Malaria-based region. This activity should be supported by the role of information technology. Malaria Monitoring System Electronic (e-Mamosys) is an application system developed in an effort to monitor patients with malaria. The application was tested to investigate the effects of beliefs, attitudes towards the acceptance of users. This test covers five variables, namely the perceived usefulness, perceived ease of use, personalization, computer self-efficacy and trust. The test was performed by 30 respondents, including the doctors, health professionals, administrative personnel, and patients. Measurement of the user acceptance of e-Mamosys was carried out using the Technology Acceptance Model (TAM). The results from the study showed personalization effect on perceived usefulness and perceived ease of use. This shows that the e-Mamosys can provide the information needs of users. To gain confidence to the users, e-Mamosys needs to be improved in terms of comfort and security.**

***Index Terms*—e-Mamosys; Application; QA; TAM; Technology Acceptance Model.**

I. INTRODUCTION

Malaria is a public health problem. It can cause death, especially in high-risk groups, such as the infants, toddlers and pregnant women. Malaria also directly causes anemia and lower labor productivity, as well as negative impact on tourism. Every year more than 300 million people worldwide are infected with malaria and 2-3 million deaths (WHO, 2010; Ministry of Health, 2011; Laihad, 2011). Malaria is a disease-based environment. Malaria is caused by environmental factors that are not healthy. Malaria can also contribute to high morbidity and mortality. Until now, malaria has been found widespread in Indonesia and can occur suddenly in an area, which has been declared free of malaria. There are more than 15 million clinical malaria patients in Indonesia with 30,000 deaths reported through the health care unit in Indonesia every year (Household Health Survey, 1995).

Malaria is an infectious disease that is still problematic for the Health Office (PHO) in several regions of Indonesia. Malaria affects all age groups (Health, 2011). It has the risk of death, especially for pregnant women or new mothers and large enough for patients with anemia, because anemia is closely related to malaria. In the province of South Kalimantan, the maternal mortality rate (MMR) in 2010 reported 109 per 68,462 the number of live births. This statistic is below the MMR in Indonesia in 2009, amounting to 226 per 100,000 live birth rate.

For example, the MMR in Tanah Bumbu regency for 2010 is 10 maternity deaths in 4,517 live birth rate or 221.59 per 100,000 live birth rate. Almost all districts in Tanah Bumbu are malaria endemic areas. Cases of malaria in Tanah Bumbu regency can be seen in Table 1.

Table 1
Clinical Malaria cases by year of reporting

No	Parameter	Year					
		2004	2005	2006	2007	2008	2009
1	Malaria clinic (Cases)	1448	1251	1021	996	858	1804
2	CFR	-	0,24	-	0,3	0,23	0,5
3	Prevalence clinic at risk	6%	5%	4%	4%	4%	7%

From Table 1 above, it can be seen that the district of Tanah Bumbu is a malaria endemic area. Malaria cases and deaths from malaria have been reported throughout the year, reinforced by evidence of the 2009 outbreaks of malaria with most cases in the village of New Emil.

The high number of deaths from malaria needs serious treatment, including area-based malaria prevention program, which should also be supported by information technology. Malaria Electronic Monitoring System (e-Mamosys) is a web-based application system developed to monitor and handle patients with malaria.

e-Mamosys testing was conducted to gauge user acceptance of the application. The test was conducted by distributing questionnaires at 30 correspondents consisting of seven administrative officers, eight officers lab, seven drug officers, six doctors and two leaders. The factors that were measured include the perceive of use and perceive usefulness. Data from the questionnaires were administered using multiple linear hypothesis approaches.

II. LITERATURE REVIEW

A. Technology Acceptance Model (TAM)

The application is a form of information technology software, and this application is considered successful if users use the application. Users use the application due to several factors: The application helps to facilitate user's job,

it is easy to use, the user has the desire to use it, the user believe in using it , as well as the user has the ability to use it and the devices that support it.

Usability is derived from the word "Usable" which means it can be used properly. An application must be able to provide benefits, easy to learn, and give satisfaction to the users (Joseph Dumas and Janice Redish, 1999). According to Jacob Nielsen, usability is a quality attribute that describes or measures the ease of use of an interface. The word "usability" also refers to a method for improving the ease of use during the design process.

There is a strong linkage between the user's acceptance and the usability in the application usage. An application that has strong usability allows users to use the application. Usability is measured by five criteria, namely: learnability, efficiency, memorability, errors, and satisfaction.

A theory used to explain the user acceptance of the use of information technology is Technology Acceptance Model (TAM), which was introduced by Fred D. Davis in 1986. The main purpose of TAM theory is to explore the influence of external factors, which include beliefs, attitudes, and goals of the users of information technology acceptance.

TAM models assume that the actual use of an application is generally determined by the results of an evaluation of the benefits derived from using the application. The picture below is an overview of the TAM model.

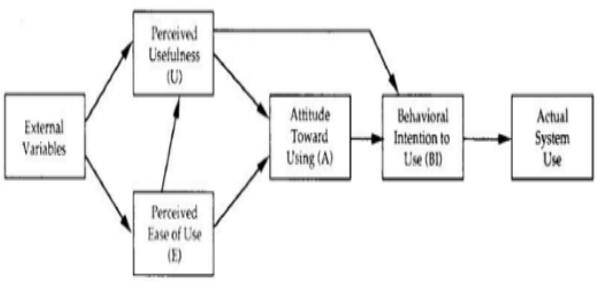

Figure 1: Technology Acceptance Model (TAM)

B. Examination

The tests performed to investigate the user's acceptance of the application are as follows:

A. Validity Test

Validity test is used to measure the validity of an instrument. An instrument, which is less valid means having a low validity [1]. The formula used to test the validity is the formula proposed by Pearson, known as Product Moment Correlation formula [1]. Product Moment Correlation formula is as follows:

$$\mathbf{r_{xy}} = \frac{\sum \mathbf{XY}}{\sqrt{\{\mathbf{N}\sum \mathbf{X^2} - (\sum \mathbf{X^2})\}\{\mathbf{N}\sum \mathbf{Y^2} - (\sum \mathbf{Y^2})\}}} \quad (1)$$

where:

r_{xy} is Product Moment Correlation Coefficient
N is Number of subjects trial
ΣX is Total score grain
ΣX² is Total score grain squares
ΣY is Total Score
ΣY² is Number of total score squares
ΣXY is Total score point multiplication with a total score

Furthermore, the correlation obtained was compared to the value of correlation r_table.

B. Reliability Test

Test Reliability is used to measure whether an instrument is trustworthy enough to be used as a data collector in order for such instruments to be considered good [1]. To test the reliability of instrument used, which has a value of either 1 and 0, the reliability test formula used is as follows:

$$\mathbf{r_{11}} = (\frac{\mathbf{k}}{(\mathbf{k}-\mathbf{1})})(\mathbf{1} - \frac{\sum \boldsymbol{\sigma}_{\mathbf{b}^2}}{\boldsymbol{\sigma}_{\mathbf{t}}^2}) \quad (2)$$

where:

r_{11} is Reliability instruments
k is a number of the questions or the amount of matter
Σσb² is Total variance grain
σt² is Variance total

If the value r_{11} after the admission produces smaller values of r_table, it can be concluded that such instruments are not reliable.

C. Normality Test

The objective of data normality test is to determine whether the regression model or residual confounding variables have a normal distribution. Normality test is useful at the early stages in the selection methods of data analysis. If the data are normal, statistical parametric is used, and if the data are not normal, nonparametric statistics are used.

D. Test Heteroscedasticity

This test aims to determine whether there is inequality variable from one observation to another observation in the regression model. The model is called homoscedasticity, if the variables are fixed, while it is called heteroscedasticity, if the variables are different. A good regression model is a homoskedasticity (Ghozali, 2005).

III. METHODOLOGY

The method used in this research is the method steps testing activities. The step-by-step testing activities can be seen in Figure 2.

The explanation of drawing lines of inquiry is as follows:

1. Studying the Literature
   At this stage, the study of literature was conducted by studying reference books such as papers and journals related to the previous research. The selection method for viewing user's acceptance was carried out from this literature review.
2. Making Questionnaire
   At this stage, the questionnaire was used to measure the perceived ease of use and the perceived usefulness. There are five variables to be measured, which are the perceived ease of use, perceived usefulness, personalization, trust and intention to use.
3. Distributing Questionnaire
   This stage focused on the distribution of questionnaire to the respondents. The purpose of the survey was to evaluate the usability of the application using the TAM model. Primary data drawn from the respondents' feedback to the statements in the questionnaire were collected. The method of

sampling was conducted by adopting sampling nonprobability, through purposive sampling technique. Samples were taken from health workers who use the monitoring system malaria.

4. Calibration
   This stage involved processing the results of the data. The tests performed include the validity, reliability, normality test, and heteroscedasticity test.
5. Analysis and Conclusion
   This stage focused on analyzing the tests in the previous stage and drawing conclusion based on the results.

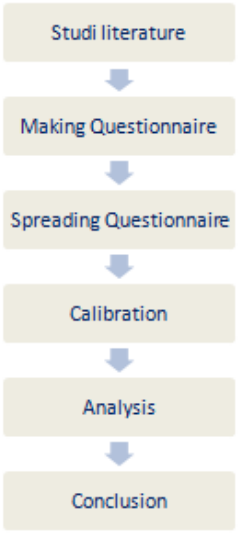

Figure 2: Stages Testing

IV. Results and Discussion

Testing was done by collecting the primary data in the form of respondents' feedback to the statements in the questionnaire. The method of sampling was conducted using sampling nonprobability, through purposive sampling technique. Samples were taken from health workers, as the users of e-Mamosys. The measurement of user acceptance of the e-Mamosys focused on the perceived usefulness and perceived of use. In this study, five variables were measured, namely the perceived usefulness, perceived ease of use, personalization, computer self-efficacy, and trust.

The perceived usefulness (Y1) is the degree to which one is sure that the use of the application system will help in improving the performance of the organization (Doll, 1998). The perceived ease of use (Y2) is the level of user's convenience operational system in doing its work. Personalization (X1) is the degree to which users are using the application system according to their desire and need to obtain specific information. Computer self-efficacy (X2) is the level of capability in using the application system. Trust (X3) is the level of willingness of users to other users within the application system based on the belief that other users will take action as expected.

The tests were conducted on 30 correspondents consisting of seven administrative officers, eight lab officers, seven drug officers, six doctors and two leaders. Data for the testing was drwan from the questionnaires containing statements with Likert scale. The data, which were in the form of ordinal data was transformed into interval data using the method of the successive interval (MSI). For ease of calculation, the testing was conducted with the help of Microsoft Excel and SPSS for windows. Table 2, 3, 4, 5 and 6 show the value of each question of the questionnaire based on the variables used.

Table 2
Perceived Usefulness Variable (Y1)

No	Question	min	max	mean	Standard deviation
1	Application system to enhance the effectiveness of the work	3	5	4,066667	0,639684
2	Application system addresses the needs of information	3	5	3,733333	0,691492
3	Application system helped me improve performance	2	5	4,033333	0,668675
4	Application system helped the efficiency of health services	3	5	4,066667	0,583292

Table 3
Perceived Ease of Use (Y2)

No	Question	min	max	mean	Standard deviation
1	Application system a convenient interface	2	5	3,9	0,758856
2	Application systems provide convenience for the patient to enter transaction data	2	5	3,8	0,761124
3	Application system provides transaction reports	3	5	4	0,694808
4	The application system can access the data on patient history	3	5	4,1333	0,681445
5	The application system can identify and verify error	3	5	3,9333	0,639684
6	The application system is easy to use back even long unused	3	5	3,7	0,651259

Table 4
Personalization (X1)

No	Question	min	max	mean	Standard deviation
1	Application system provides accurate information about transaction patients	3	5	3,9	0,661764
2	Application system provides information in a short time	3	5	4,066667	0,691492
3	The Application system generates current information	3	5	4	0,525226
4	Application system can filter transaction patient	3	5	4	0,643268
5	Application system provides comprehensive information on transaction patients	3	5	3,733333	0,639684

Table 5
Computer self-efficacy (X2)

No	Question	min	max	mean	Standard deviation
1	Application system helps me to enhance the effectiveness of the work	2	5	4.3	0,794577
2	Application system is able to answer the needs of the information sought	2	5	3,93333	0,73968
3	The Application system doesn't help me to improve the work of the organization	3	5	3,933333	0,73968
4	Application system helps me the efficiency of health services	3	5	4,03333	0,71839

Table 6
Trust(X3)

No	Question	min	max	mean	Standard deviation
1	I am willing to do the transaction data with the other parts	3	5	4,03333	0,718395
2	I feel safe making transactions with the rest of data access	3	5	4,03333	0,413841
3	The permission goes well	2	5	3,7	0,702213
4	Application system gives me to change passwords regularly	2	5	3,4	0,932183
5	The Application system helps me to use a random password	3	5	3,76667	0,727932

A. Validity Test

Validity test is done with a formula of bivariate correlation person. Each question is valid if the value of each question is above the magnitude of the critical r_table (0.3061). A summary of the results of the validity (Y1) test is presented in Table 7.

The validity test showed that all of the questions for each variable have a value greater than the Pearson Correlation critical r_table (0.361). It can be concluded that all questions are valid, hence they can be used as a research instrument.

Table 7
Validity of (Y1)

No Question	Rxy	r(table)	SaSS
1	0,677	0,361	Valid
2	0,656	0,361	Valid
3	0,644	0,361	Valid
4	0,657	0,361	Valid

B. Reliability Test

Reliability tests was performed using the alpha formula. The significant reliability test is performed at the level of a = 0.05. Instruments can be said to be reliable if the alpha value is greater than the table (0.632).

The test results show the reliability coefficient with the value of 0.783 Y1, Y2 of 0843, amounting to 0.654 X1, X2 and X3 amounted to 0.743 at 0.686 respectively. Based on these values, it can be concluded that all the variables in this study were reliable or consistent, hence they can be used as a research instrument.

Table 8
Reliability Test

Variables	Rxy	r(table)	SaSS
Y1	0,783	0,632	Reliable
Y2	0,843	0,632	Reliable
X1	0,654	0,632	Reliable
X2	0,743	0,632	Reliable
X3	0,686	0,632	Reliable

C. Classical Assumption Test

The purpose of the classic assumption testing is to provide assurance that the regression equation is accurate in estimation, unbiased and consistent.

D. Normality Test

Normality test results showed that the coefficient Asymp. Sig. (2-tailed) for the first normality test is 0.963, greater than 0.05. It can be concluded in the first test of normality that there is a normal distribution of data.

E. Heteroskedastic Test

The heteroskedastic test of the first regression model showed that the significance of this test is greater than 0.05. It can be concluded in the first heteroskedastic test, that there is free data heteroskedastic. The second heteroskedastic test also showed similar result.

F. Multiple Regression Analysis

Multiple regression analysis was conducted with SPSS for windows. Table 9 shows the dependent variable Y1.

Table 9
Significant Result (Y1)

Variable	B	T_{hitung}	Sig
Constant	1,730	2,422	0,23
Personalization	0,614	2,348	0,027
Computer Self Efficacy	0,053	0,341	0,736
Trust	-0,102	-0,5433	0,592
$F_{hitung} = 3,764$			
$R^2 = 0,303$			

According to Table 9, the multiple linear regression equations are as follows:

$$Y1 = 1.730 + 0.614\,X1 + 0.053\,X2 - X3\,0.102 \quad (3)$$

The interpretations of the multiple linear regression equations are:

1. The constant value of 1.730 indicates if personalization, computer self-efficacy, and trust remain (unchanged), then the value of consistency perceived usefulness is 1,730.
2. Personalization has a coefficient of 0.614 with a positive direction, then the value of perceived usefulness will increase by 0.614 assuming there is no additional value of computer self-efficacy and trust.
3. Computer self-efficacy has a coefficient of 0.053 with a positive direction, then the value of perceived usefulness will increase by 0,053, assuming no additional value of personalization and trust.
4. The Trust has a coefficient of -0.102 with a negative direction, then the value of perceived usefulness will be decreased by -0.102 assuming no additional value to personalization and computer self-efficacy.

The multiple linear regression analysis for the second regression model can be seen in Table 10.

Table 10
Significant Result (Y2)

Variable	B	T_{hitung}	Sig
Constant	0,538	1,156	0,23
Personalization	0,557	3,273	0,003
Computer Self Efficacy	0,108	1,076	0,292
Trust	0,195	1,592	0,123
$F_{hitung} = 17,715$			
$R^2 = 0,671$			

According to Table 10, the multiple linear regression equation is as follows:

$$Y2 = 0,538 + 0,557\,X1 + 0,108\,X2 + 0,195\,X3 \quad (4)$$

The interpretations of the multiple linear regression equations are:

1. The constant value of 0.538 indicates if personalization, computer self-efficacy, and trust remain (unchanged), then the value of consistency perceived ease of use is 0.538.
2. Personalization has a coefficient of 0.557 with a positive direction, then the value of perceived ease of use will be increased by 0.557, assuming no value addition of computer self-efficacy and trust.
3. Computer self-efficacy has a coefficient with a positive direction of 0.108, then the value of perceived ease of use will be increased by 0.053, assuming no value addition of personalization and trust.
4. The Trust has a coefficient with the positive direction of 0.195, then the value of perceived ease of use will increase by -0.195 assuming no value addition to personalization and computer self-efficacy.

G. Hypotheses

Based on the Table 10 and 11, the results of hypotheses testing are as follows:

1. Personalization effect on perceived usefulness. Figure 3 shows that the level of significance of two-sided t-test for variable personalization is 0027. The level of significance at the t test one side is 0.0135, which is less than 0.05. This means H1 is accepted implying that personalization has positive effect on the perceived usefulness.
2. Computer self-efficacy influences the perceived usefulness. Figure 3 shows a significant level of t-test two sides to the computer self-efficacy variables is 0.736. The level of significance at the t-test one side is larger than 0.368 from 0.05 level of significance. This shows that H2 is rejected implying that the computer self-efficacy has no effect on the perceived usefulness.
3. Trust effect on perceived usefulness. Figure 3 shows the level of significance of two-sided t test for variables trusts is 0.592. The level of significance at the t-test one side is 0.296, which is greater than 0.05. It describes that the H3 is rejected, which means that the trust has no effect on the perceived usefulness.
4. Personalization affects the perceived ease of use. Figure 4 shows the significance level of the two-sided t-test for personalization variables at 0.003. The level of significance at the t-test one side is 0.0015, which is less than 0.05. This shows that H4 is accepted, which means that personalization has positive effect on the perceived ease of use.
5. Computer self-efficacy affects the perceived ease of use. Figure 4 shows that the significance level of t-test two sides to the computer self-efficacy variable of 0.292. The level of significance in t-test one side is 0,146 greater than 0.05. This shows that H5 is rejected. This means that the computer self-efficacy no effect on the perceived ease of use.
6. Trust effect on perceived ease of use . In table 4 it can be seen that the level of significance of two-sided t test for variables trusts by 0.123. The level of significance at the t-test one side is larger than the 0.061 from 0.05. This shows that H6 rejected. This means that the trust has no effect on the perceived ease of use.

V. CONCLUSION

Based on the hypothesis, personalization influential variables have positive relationship to both the dependent variable (perceived usefulness and perceived ease of use). In contrast to the variable of computer self-efficacy and trust, they have negative effects on both the dependent variables. Judging from the positive effect of the variable personalization, user's information needs if the malaria monitoring system can provide information in accordance with the wishes and needs of the user.

At this time, the variable self-efficacy and trust have no effect, hence there are future needs to restore the system from the convenience factor and scalability.

The number of respondents should be increased in terms of area, age, education to expand the testing area so that research results can be generalized. Further, other variables should be added to look at other factors that may influence user's acceptance of the application.

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