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Measuring E-Learning Systems Success: Implementing D & M IS Success Model

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Abstract — Electronic learning (e-learning) has been widely used as a complement subject to traditional learning methods. Implementing e-learning is becoming one of many solutions in effecting the study process offered by higher educational institutions, such as Universitas Pembangunan Nasional "Veteran" Jakarta = UPNVJ and Sekolah Tinggi Teknologi Telematika Telkom (ST3 Telkom) Purwokerto, Central Java. The objective of this research is to measure the e-learning system success implemented by UPNVJ and ST3 Telkom Purwokerto and then compare the similarities and differences between of two. The modified DeLone & McLean Information Systems Success Model and part of Technology Acceptance Model are adopted in this study. The respondents are students who have been experience in using e-learning and are selected randomly from the Faculty of Computer Science of UPNVJ and from ST3 Telkom Purwokerto. The total respondents are 387, which consist of 215 students from UPNVJ and 172 from ST3 Telkom Purwokerto. For the results at UPNVJ, there are two hypotheses that were proven insignificant and at ST3 Telkom there are three hypotheses that were proven insignificant. Findings at UPNVJ show that the e-learning benefit can be explained by its independent variables by 53.8%%, and at ST3 Telkom by 60.6%. These percentages show that the predictors explained 53.8% for UPNVJ's e-learning benefit and 60.6% e-learning benefit for ST3 Telkom Purwokerto. These findings could be considered as novelties, because they are different from the original model.

Keywords. E-Learning, Blended Learning, ICT, DeLone and McLean Information Systems Success Model, TAM.

I. INTRODUCTION

The term "e-learning" or electronic learning has been around quite sometime in recent years, but unfortunately some academicians are still unaware of what it actually means. Some people are still questioning how it can help them achieve their success in education. E-learning made it possible because of Information and Communication Technology (ICT), especially because of the Internet technology. Up until the time that

Internet technology became available, education was conducted in a classroom of students with a teacher who lead the process. At this time in the era of ICT, this type of educational process is in the process of changing from teacher centred to a student centred method. One of the tools is e-learning which is possible because of ICT.

In the ICT era as today, it's rare to find universities without having Internet access. ICT has a dramatic impact on almost every facet of our lives including on higher educational operations. By accessing the internet, users have many advantages, and one of them is electronic learning (better known as e-learning). E-learning system's offer many advantages and also compensates the weaknesses of the traditional learning systems. Many higher education institutions and universities have implemented e-learning. This includes the University of National Development "Veteran" Jakarta (Universitas Pembangunan Nasional "Veteran" Jakarta = UPNVJ) and Telkom School of Telematics (Sekolah Tinggi Teknologi Telematika = ST3 Telkom) Purwokerto. These two higher educational institutions do not fully implemented e-learning, rather using it as complementing tool to its traditional methods of learning (which is known as blended learning). But, the success of e-learning systems cannot be evaluated using a single proxy construct [1]. Furthermore, the measure's of e-learning systems success must incorporate different aspects of the e-learning systems success construct if it is to be a useful diagnostic instrument [1].

E-learning has become a major phenomenon and discussion among scholars, especially in the area of ICT, in recent years. It's causing a shift changing from traditional to internet based learning. It's mainly because e-learning conducted via internet, without internet connection e-learning is not possible to be implemented. Dorobat's [2] proposed model and future research to a more comprehensive model for the evaluation of E-Learning System Success (ELSS). Her [2] proposed model based on six perspectives: overall system quality; user perceived control; usefulness and user satisfaction.

user attitude; social factors; and benefits of using the e-learning systems. In her conclusions, she proposed a more comprehensive model of ELSS. Meanwhile, Park [3] concluded his research that the result of his study demonstrated that some TAM constructs had a direct and indirect effect on university students' behavior to use e-learning. Furthermore, he said that this type of research needs to be implemented in other e-learning circumstances or infrastructures. So, the purpose of this study is to measure the e-learning systems success implemented in the two higher educational institutions mentioned above. In doing so, researcher combine the DeLone & McLean Information Systems Success Model with part of Technology Acceptance Model. In addition to that, by implementing this model, novelties can be obtained because D & M IS and TAM have been around quite sometime since its original version. After so many years these models have been implemented, developments and modifications have been made from its original version; researcher thinks that something must be done to evaluate it. One of the reasons because the development of ICTs is so fast from time to time, therefore we need to keep up with it.

II. LITERATURE REVIEW

A. E-learning, E-learning Systems and Blended Learning

ICT advancements such as the growth of the Internet provide huge advantages and opportunities for everyone to learn more that are hard to resist. One of these advantages is electronic learning or e-learning that is learning enable by internet connection. E-learning is a term used to describe using computer technology to deliver instructional material for learning. No single definition of e-learning is adopted by researchers in this area of study. E-learning provides a way for the higher education institutions to increase efficiency and effectiveness by delivering study material through the Internet. However, in my opinion, e-learning is not intended to replace lecturers but rather to supplement the educational activities conducted in higher educational institutions. By having supplement materials provided by the institutions, students may learn anywhere and anytime without any lecturer physically present among them. In the meantime, to not failing in implementing e-learning, the institutions should take into account how people learn understand and remember things.

In short term, definition of e-learning is Internet-enabled learning [4]. Components of e-learning can be included content delivery in multiple formats, management of the learning experience and a networked community of learners, content developers and experts [4]. The e-learning systems are platforms facilitating the learning process that aim at the learning process flexibility and the adoption of teaching methods to the individual learning style of student [2]. Meanwhile, blended learning is a learning methods aims to achieving the learning objectives through the application of a specific technologies in order to customize the act of learning and to transfer knowledge and skills to the right person at the right time [2]. Blended learning can be defined as using a combination of face-to-face and online methods of learning. So,

e-learning systems are the most recent ICT applications phenomena in higher education institutions.

B. DeLone and McLean Information Systems Success Model

The initial DeLone and McLean's Information Systems Success Model, hereafter referred to as the D & M IS Success Model, is a theory which was trying to determine the information success by identifying six critical variables that is system quality, information quality, use, user satisfaction, individual impact and organizational impact [4]. Furthermore, it was said that if information systems research is to make a contribution to the world of practice, a well-defined outcome measure (measures) is essential. Also, the evaluation of I/S practice, policies and procedures requires an I/S success measure against which various strategies can be tested (p 61).

In the updated D & M IS Model [6] they modified the six dimensions became: system quality, information quality and service quality as independent variables, usage and user satisfaction as inter mediate variables and net benefits as dependent variable. In this model, net benefits variable is the most important one. So that the solutions provided by information systems (IS) have been a central theme in IS success research. Solutions and their organizational context have also been the focus of extensive study within the educational as well as in the managerial fields.

1. *Systems Quality*. System Quality is manifested in the system's overall performance [7]. DeLone and McLean [5] explain system quality as the desired characteristics of the information system itself which produces the information. System quality was measured in term of ease-of-use, functionality, reliability, flexibility, data quality, portability, integration, and importance [6]. According to Petter et al. [8], system quality as the desirable of an information system has several components such as ease of use, system flexibility, system reliability, and ease of learning.

2. *Information Quality*. Information quality refers to the wanted characteristics of the information that the IS produce DeLone and McLean [5]. Petter et al. [8] describe information quality as the desirable characteristics of the system outputs; that is, management reports and Webpages. Information quality refers to the quality of the information that the system is able to store, deliver, or produce, and is one of the commonest dimensions along which information systems are evaluated. Information quality was measured in terms of accuracy, timeliness, completeness, relevance, and consistency [6]. The quality of the information will determine user satisfaction. According to Elpez and Fink [9] information technology has become a tool with which to produce accurate, reliable, and timely information through the development of information systems. It is in line with the opinion of Petter et al. [8] that in measuring information quality consisting of relevance, understandability, accuracy, conciseness, completeness, understandability, currency, timeliness, and usability. Information quality is often seen as a key dimension of user satisfaction.

3. *Service Quality*. Service Quality can be explained as the overall support delivered by service provider, applies

regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an Internet service provider [6]. According to Petter et al. [8] there are four of the main components of service quality, i.e. responsiveness, assurance, reliability, and empathy.

4. *Use & Intention to Use.* Usage measures everything from a visit to a website, to navigation within the site, to information retrieval, to execution of a transaction [4]. The systems use is one of important constructs to measure the e-learning benefit that also as an intention to use [10].

5. *User Satisfaction.* User satisfaction refers to the users' level of satisfaction with the reports, web sites, and support services [8]. DeLone and McLean [5] stated that user satisfaction is the most widely used measure of IS success and one of the reasons is that the appeal of satisfaction as a success measure is that most of the other measures are so poor; they are conceptually weak or empirically difficult to obtain. User satisfaction can be described as the summary of a person's attitudes or feelings towards several factors affecting that specific situation. In our research User Satisfaction was seen as students' opinions on using the e-learning and its environments.

6. *Net Benefit.* Net benefits refer to the extent to which IS are contributing to the success of individuals, groups, organizations, industries, and nations [8]. For example: improved decision-making, improved productivity, increased sales, cost reductions, improved profits, market efficiency, consumer welfare, creation of jobs, and economic development. Net benefits are the most important success measures as they capture the balance of positive and negative impacts of our customers, suppliers, employees, organizations, markets, industries, economies, and even our societies [6]. Furthermore, even though net benefit was the most important variable but it cannot be analyzed and understood without system quality, information quality, and service quality measurements. In this study, the net benefit refers to the e-learning benefit, because when measuring net benefits, we could use the same measure on benefit contents of the e-learning.

C. Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) is one of the well-known research models used mostly in the area of information technology which originally proposed by Davis in 1985 [11]. Basically, TAM was developed intentionally to find out the factors that lead the users either accept or reject information technology. TAM posits that two particular beliefs, *Perceived Usefulness* and *Perceived Ease of Use*, are of primary relevance for computer acceptance behavior [12]. For this reason, in this study, researchers adopted part of TAM variables, that is: *Perceived Ease-of-Use* and *Perceived Usefulness*, and then combined them with the D & M IS Model becomes research model.

1. *Perceived Usefulness (PU).* One of two importance variables in TAM that may influence systems use is PU. PU is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" [13]. Also, PU is also defined as the prospective user's subjective probability that using a specific application system

will increase his or her job performance within an organizational context [12].

2. *Perceived Ease-of-Use (PEU).* Number two of two importance variables in TAM that may influence system use is PEU. PEU, refers to "the degree to which a person believes that using a particular system would be free of effort" [13]. This follows from the definition of "ease": "freedom from difficulty or great effort" [13].

D. Theoretical Framework and Hypotheses

According to Sekaran [14] a theoretical framework is a conceptual model of how one theorizes or makes logical sense of the relationships among the several factors that have been identified as important to the problem. Furthermore Sekaran [14] said that the theoretical framework discusses the interrelationships among the variables that are deemed to be integral to the dynamics of the situation being investigated. So theoretically, it explains the relationship between the dependent and independent variables. Theoretical framework is used when we have more than two variables in our research. So, the research model in this study, as depicted in Figure 1.

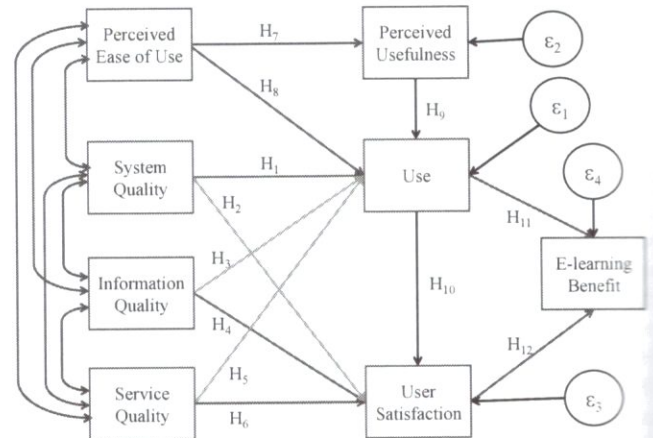


Figure 1. Research Model

Based on the research model, this study tested the following hypotheses:

- H1: System Quality has a significant effect on the Usage & Intention to Use.
- H2: System Quality has a significant effect on the User Satisfaction.
- H3: Information Quality has a significant effect on the Usage & Intention to Use.
- H4: Information Quality has a significant effect on the User Satisfaction.
- H5: Service Quality has a significant effect on the Usage & Intention to Use.
- H6: Service Quality has a significant effect on the User Satisfaction.
- H7: Perceived Ease-of-Use has a significant effect on the Perceived Usefulness.

- III: Perceived Ease-of-Use has a significant effect on the Usage & Intention to Use.
- III: Perceived Usefulness has a significant effect on the Usage & Intention to Use.
- III: Usage & Intention to Use has a significant effect on the User Satisfaction.
- III: Usage & Intention to Use has a significant effect on the E-learning Benefit.
- III: User Satisfaction has a significant effect on the E-learning Benefit.

III. RESEARCH METHODOLOGY

The research method employed in this study is survey research with causative approach. The results of the research will be analyzed using path analysis and structural equation modelling (SEM) software, which is AMOS (Analysis of Moment Structures) [15]. Path analysis (SEM models without latent variables) is employed in this study to analyse the relationship among variables, specifically to measure the direct and indirect effect from exogenous variables to endogenous variables [16]. Maximum Likelihood estimation method is implemented using AMOS and the chosen outputs are minimization history, standardized estimates, squared multiple correlations and indirect, direct & total effects [17] [18]. This research was done without any special treatment to the data obtained by the researcher.

The survey was conducted at University of National Development "Veteran" Jakarta (Universitas Pembangunan Nasional "Veteran" Jakarta = UPNVJ) and Telkom School of Telematics (Sekolah Tinggi Teknologi Telematika = ST3 Telkom) Purwokerto in March to June 2015. The two universities were chosen because they have implemented e-learning as additional methods of learning to complement traditional methods of learning.

Two hundred and fifteen (215) students from UPNVJ were selected randomly as respondents from the Faculty of Computer Science and one hundred and seventy two (172) students were also selected randomly from the Telkom School of Telematics Purwokerto. Those respondents provide enough representation of the student population of the two universities. The main reason is that by using AMOS as an analytical tool, is that by having 100 - 150 respondents then is good to go [17]. Maximum likelihood estimation techniques require samples ranged from 150 - 400 [19].

The survey questions in the form of a questionnaire, as the research instrument, using five-point Likert scales were used with the anchors "1 = strongly disagree" and "5 = strongly agree." Before distributed to the respondents, the instrument was tested using Pearson Product Moment formula to test its validation and using Alpha Cronbach to test its reliability. Basic decision making in validity test is if "the significance value < 0.05," then the instrument is valid. Basic decision making in reliability test is if "the value of Cronbach's Alpha > 0.600," the questionnaire items is reliable. Using $\alpha = 0.05$ all items of the questionnaire were proven valid and reliable. In addition, outliers and normality test have been executed. As the basis of the normality testing is if multivariate critical ratio is less than

2.58 then the data is distributed normally, and data is free from outliers if p_1 or p_2 is greater than 0.05 [19]. After the data became normal and free of outliers then conduct hypotheses testing. Hypotheses testing are conducted by comparing the t-value and t-table. If the value of t-value is greater than t-table, meaning that there is a significant effect from independent variable to its dependent variable. Conversely, if t-value is less than t-table meaning that there is no significant effect from independent variable to its dependent variable.

IV. FINDING AND DATA ANALYSIS

A. UPNVJ

1. Hypotheses Testing

Hypothesis testing is conducted using the t-value with the level of significance of 0.05. The t-value in AMOS is denoted as Critical Ratio (CR) which will be compared to the value of t-table which is 1.96. So, as the basis of calculation is if the value of $CR \geq 1.96$ or value the probability $(P) \leq 0.05$ then H_0 is rejected, meaning that it has a significant effect. As the basis for the calculation is the result of the output produced by AMOS shown on the Table 4.1 *Regression Weights* below.

Table 4.1 *Regression Weights: (Group number 1 - Default model)*

	Estimate	S.E.	C.R.	P	Label
PerU <--- PerE	.544	.070	7.767	***	par_4
Use <--- SysQ	.259	.115	2.260	.024	par_1
Use <--- PerU	.492	.100	4.935	***	par_13
Use <--- PerE	.503	.128	3.920	***	par_14
Use <--- SerQ	.369	.098	3.763	***	par_15
Use <--- InfQ	.028	.083	.339	.735	par_17
UseS <--- SerQ	.137	.041	3.299	***	par_2
UseS <--- Use	.146	.024	5.969	***	par_5
UseS <--- SysQ	.180	.048	3.768	***	par_16
UseS <--- InfQ	.039	.032	1.187	.235	par_18
EleB <--- Use	.291	.037	7.904	***	par_3
EleB <--- UseS	.607	.087	6.945	***	par_7

Based on the result shown on table 4.4, there are two hypotheses that were proven insignificant, i.e.

- 1) Hypothesis 3: Information Quality has a significant effect on the Usage & Intention to Use.
 - 2) Hypothesis 4: Information Quality has a significant effect on the User Satisfaction.
2. Coefficient of determination

The magnitude of the contribution can be calculated from the output in Table 4.2 below.

Table 4.2. Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
PerU	.220
Use	.427
UseS	.454
EleB	.538

Based on the results presented in Table 4.2 Squared Multiple Correlations can be explained as follows:

- It is estimated that the predictors of E-learning Benefit (EleB) explain 53.8% of its variance. In other words, the error variance of E-learning Benefit (EleB) is approximately 46.2% of the variance of E-learning Benefit (EleB) itself or 46.2% coming from other variables not examined.

B. ST3 Telkom Purwokerto

1. Hypotheses Testing

Hypothesis testing is conducted using the t-value with the level of significance of 0.05. The t-value in AMOS is denoted as Critical Ratio (CR) which will be compared to the value of t_{table} which is 1.96. So, as the basis of calculation is if the value of $CR \geq 1.96$ or value the probability $(P) \leq 0.05$ then H_0 is rejected, meaning that it has a significant effect. As the basis for the calculation is result of the output produced by AMOS shown on the Table 3 Regression Weights below.

Table 3. Regression Weights: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
PerU <--- PerE	.623	.060	10.302	***	par_2
Use <--- SysQ	.014	.122	.115	.908	par_1
Use <--- PerU	.501	.103	4.863	***	par_10
Use <--- PerE	.394	.134	2.947	.003	par_11
Use <--- SerQ	.481	.129	3.720	***	par_17
Use <--- InfQ	.201	.103	1.958	.050	par_18
UseS <--- Use	.203	.029	7.003	***	par_3
UseS <--- InfQ	.092	.045	2.065	.039	par_14
UseS <--- SerQ	-.008	.059	-.130	.897	par_15
UseS <--- SysQ	.198	.052	3.833	***	par_16
EleB <--- UseS	.513	.101	5.060	***	par_12
EleB <--- Use	.327	.044	7.373	***	par_13

Based on the result shown on table 4.3, there are three hypotheses that were proven insignificant, i.e.

- 1) Hypothesis 1: System Quality has a significant effect on the Usage & Intention to Use.
- 2) Hypothesis 3: Information Quality has a significant effect on the Usage & Intention to Use.
- 3) Hypothesis 6: Service Quality has a significant effect on the User Satisfaction.

2. Coefficient of determination

The magnitude of the contribution can be calculated from the output in Table 4.4 below.

Table 4.4. Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
PerU	.383
Use	.601
UseS	.596
EleB	.606

Based on the results presented in Table 4.4 Squared Multiple Correlations can be explained as follows:

- It is estimated that the predictors of E-learning Benefit (EleB) explain 60.6% of its variance. In other words, the error variance of E-learning Benefit (EleB) is approximately 39.4% of the variance of E-learning Benefit (EleB) itself or 39.4% coming from other variables not examined.

V. DISCUSSION AND CONCLUSIONS

Discussion

The results show that there are some similarities and differences between of them in the two universities. Having these similarities and differences, consequently will alternate the research model.

Based on the findings obtained from UPNVJ and ST3 Telkom Purwokerto can be explained as follows:

1 Similarities:

In term of hypothesis, there is one similarity which is in both universities has insignificant effect, i.e. hypothesis 3: Information Quality has a significant effect on the Usage & Intention to Use. This result indicated that even though there were different amount of respondents, it still produces similar output.

In addition, there are similarities in terms of influences, either direct influence, indirect influence or total influence. In two higher educational institutions, all direct effects, indirect effects and total effects on e-learning benefit indicated by similar variables only slightly different in numbers.

2 Differences:

In term of hypothesis, there are two insignificant hypotheses in UPNVJ meanwhile there are three insignificant hypotheses in ST3 Telkom Purwokerto. Based on the values of Squared Multiple Correlations, these values indicate the role of independent variables in explaining the dependent variable. So, it is estimated that the predictors of E-learning Benefit explain 53.8% of its variance in UPNVJ meanwhile 60.6% in ST3 Telkom Purwokerto.

Conclusions

Implementation of D & M IS Success Model combined with TAM on researcher's location produces a different output. There are two hypotheses proven insignificant at UPNVJ. Meanwhile there are three hypotheses proven insignificant at ST3 Telkom. Therefore this findings have proven that research model which previously been implemented correctly, it did does not always produces similar expected output. These findings have proven that quantitative research which uses different samples do not always produce similar output that was generated at the first location of the model was made or proposed. These findings could be interpreted that Information Quality is no longer an important variable in the model. This is really an unusual or peculiar finding because information is considered as a central study in information systems.

These findings have proven that there are some similarities and differences in term of hypotheses and influence from independent variables to dependents variables, in both universities. Meanwhile, even though using the same research instruments produce different output. There are several reasons that could be stated, such as: priority, perspective, and personal background that differentiate the answers provided by the respondents. The total amount of respondents also different in two universities. So that, having the same question will be answered differently by different respondents. Therefore, by having different answers produce different output.

Even though the findings of the research proven that almost all hypotheses are significant, it is worth considering some of the limitations of the study. First, in this study the researcher only measures e-learning benefit in connection with seven other variables, but in reality it is much more than that. Second, although the sample has been considered enough but a larger sample could help to reveal smaller population effects. Third, the research model was tested with a specific case study, in this case only implemented in two higher educational institutions, i.e., UPNVJ and ST3 Telkom Purwokerto. Although the similar model has been tested several times, further study is needed to test whether it can be more widely applied to other circumstances. These results can be considered as novelties of this study, so that can be used as future research.

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