Acceptance Study of Power Plant Main Control Simulator as an Operator Learning Media in Indonesia

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Abstract
The power plant control room simulator is a learning device that resembles the control system in a real power plant. There are not many power plant simulator training providers in Indonesia due to high investment, where complexity and efficacy are exchanged for cost. This research aims to determine the acceptance of the power plant main control simulator as an operator learning media in Indonesia using the Technology Acceptance Model (TAM). This research is explanatory research with perceived ease of use variable, perceptions of usefulness, attitude toward using, and actual usage. The research was performed by conducting a survey to 113 respondents (operators) from 17 power plants in Indonesia who have been trained using power plant main control simulators. The obtained data from the questionnaires are analyzed through the smartPLS. The results of this quantitative study indicate that the perceived usefulness variable has positive and strong effect on the attitude toward simulator usage, besides that it also has a moderate effect on actual usage variable. While the perceived ease of use has a positive and moderate influence on the attitude toward simulator usage. Thus, the intended use of the power plant main control simulator is influenced by the usefulness of the simulator itself.

Keywords: Simulator, Operator, Power Plant, Learning Media, Technology Acceptance Model

Introduction

Companies must prepare their human resources through skills development to remain competitive (Namada, 2018). Possible new knowledge the only remaining and one of the most critical sources of competitive advantage available to a firm organization. Companies improve their employee’s skills through training, and many companies formulate strategies and set up training development center to manage employee's knowledge. However, training is a very expensive investment. As a result, research and development of training to optimize its effectiveness and efficiency becomes very important (Sheeba & Christopher, 2020). Methods practices in companies in terms of developing employees are vary, but PJB Services owns Training Development Centre (TDC), which will have full dedication in developing employees. To each of training participants, TDC will adjust in according to business needs, one of many ways is to introduce training through simulation. Simulations are well suited for training that would be very dangerous or expensive to do in a real-life environment. This method provides training opportunities that are safe, structured, interesting, and sufficient (Raynolds, 2023). The power plant control room simulator is a learning device that resembles the control system in a real power plant. There are not many power plant simulator training providers in Indonesia due to high investment, where complexity and efficacy are exchanged for cost. The effect of simulation to increase training participants will be interesting to explore. The presence of simulator is expected to bring benefits to employee training which is facilitated by Training Development Centre.

The Technology Acceptance Model (TAM) is a model of acceptance of information technology used by users of system or technology (Jogiyanto, 2007). This model is an approach used to see the ease of a technology that is used by users. The purpose of developing a Technology Acceptance Model (TAM) is to explain the factors that determine public acceptance of a technology in general and to explain why a particular system of technology can affect public acceptance (Davis, 1993). TAM offers a powerful and simple explanation for the acceptance of technology and the behavior of its users (Venkatesh & Davis, 2000). Technology that is easy to use and useful for users will create a feeling of comfort. Users want to use the technology rather than use other technologies. User-friendliness and benefits are the main concepts as measured by the TAM model (Susanto et al., 2021). TAM was developed by Davis (1989) by using variables perceived ease of use, perceived usefulness, attitude toward using, behavioral intention, and actual usage. Previous research conducted by Gunawan (2014) and Hendra & Iskandar (2016) resulted that perceived usefulness does not have a direct positive effect on behavioral intention. So, this study only used variables perceived ease of use, perceived usefulness, attitude toward using, and actual usage. The behavioral intention variable was not used.

This study aims to determine the acceptability of the power plant main control simulator as an operator learning media in Indonesia using the Technology Acceptance Model (TAM). The results of this study can be used by management to evaluate the use of the power plant main control simulator. Subsequent changes and developments can, of course, be evaluated from the results of this study.

Materials and Methods

The study was performed by conducting a survey among 17 power plants in Indonesia. Questionnaires were submitted to 113 respondents (operators) who have been trained using power plant main control simulators. The variables for the study were measured by quantifying the responses of the respondents to the survey questions using Likert scale. The questionnaire data were analyzed using the smartPLS application and the Structural Equation Modeling (SEM) method. SEM is a powerful statistical technique that combines a measurement model or confirmatory factor analysis with a structural model into a simultaneous statistical test (Hoe, 2008).

The outer model testing was used to see the validity and reliability of the research data. Validity is an indicator to measure what indicators should be measured. Reliability is used to measure whether a dataset will show the same results from retesting the same object (Abdillah & Jogiyanto, 2009). Inner model testing was used to predict causal relationships between latent variables or variables that cannot be measured directly. To test the relationship between variables, it is done by testing the value of R^2 and the predictive value of relevance (Q^2) (Chin, 1998).

After getting valid and reliable data from the outer model test and knowing the quality of the relationship between variables from the inner model test, the next step is to determine the hypothesis. Thus, the following Maximo acceptance hypothesis conceptual model is proposed or according to Figure 1.

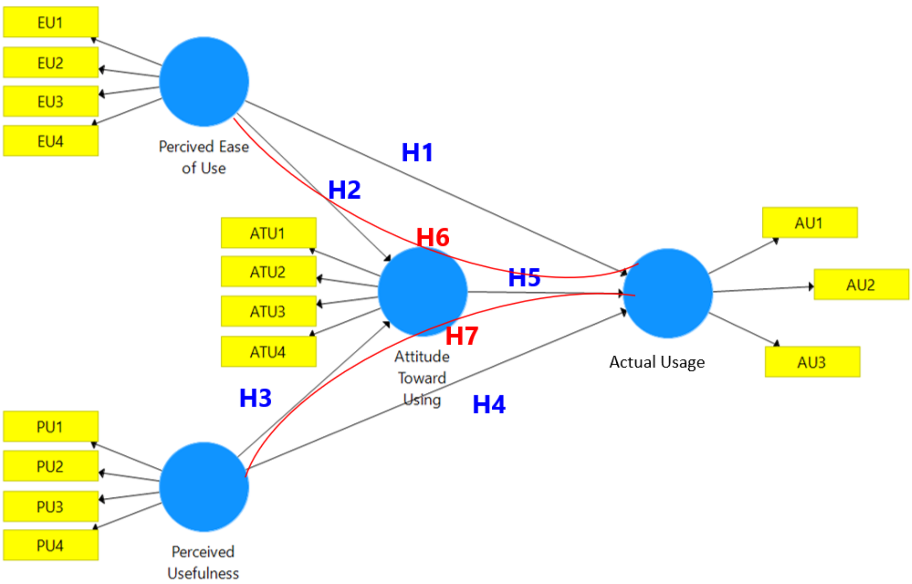

Figure 1: The Proposed of Structural Model

Simulator acceptance hypothesis are:

Hypothesis 1: Perceived Ease of Used (EU) has a significant positive effect on Actual Usage (AU)

Hypothesis 2: Perceived Ease of Used (EU) has a significant positive effect on Attitude Toward Using (AT)

Hypothesis 3: Perceived Usefulness (PU) has a significant positive effect on Attitude Toward Using (AT)

Hypothesis 4: Perceived Usefulness (PU) has a significant positive effect on Actual Usage (AU)

Hypothesis 5: Attitude Toward Using (AT) has a significant positive effect on Actual Usage (AU)

Hypothesis 6: Attitude Toward Using (AT) will mediate Ease of Used (EU) on Actual Usage (AU)

Hypothesis 7: Attitude Toward Using (AT) will mediate Perceived Usefulness (PU) on Actual Usage (AU)

Results and Discussion

1. Outer Model Testing

The first step that must be done in testing the outer model is the factor loading test. Minimum factor loading value that each indicator must have is ≥ 0.7. The expected Composite Reliability value and Cronbach's Alpha is > 0.7 and value 0.6 is still accepted (Hair et al., 2014). Average Variances Extracted (AVE) is a more conservative assessment of reliability. For adequate reliability, a given construct must reach at least a value of 0.5 (Fornell & Larcker, 1981). The results of the factor loading test from this study data are as Figure 2.

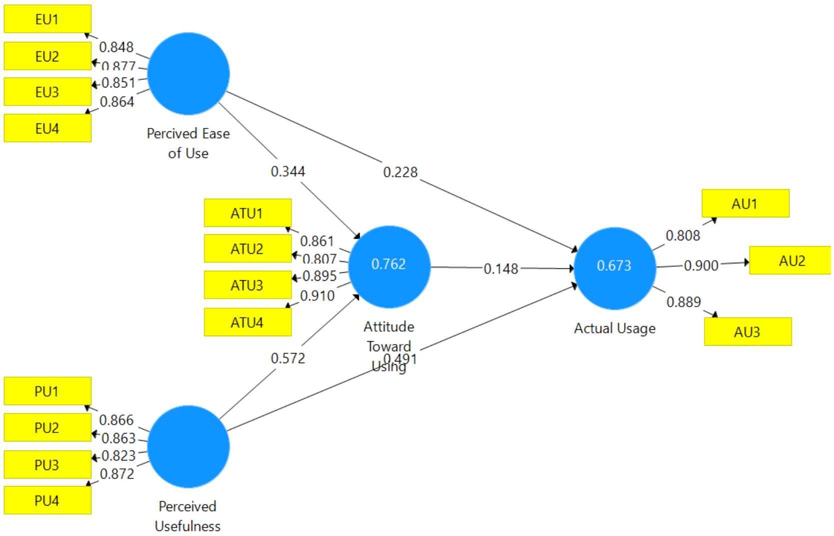

Figure 2. Convergent Validity Test Result

The results of the factor loading analysis on Figure 2 or Table 1 that all values (EU1, EU2, EU3, EU4, AT1, AT2, AT3, AT4, PU1, PU2, PU3, PU4, AU1, AU2, AU3) are greater than 0.7, then the indicator is valid to measure the construct.

Outer loading test results can be seen in the following table.

Table 1. Outer Loading Test Result

Variable	Indicator	Factor Loading	Composite Reliability	Cronbach's Alpha	Average Variances Extracted
Perceived Ease of Use (EU)	EU1	0.848	0.919	0.883	0.740
	EU2	0.877			
	EU3	0.851			
	EU4	0.864			
Perceptions of Usefulness (PU)	PU1	0.866	0.917	0.879	0.733
	PU2	0.863			
	PU3	0.823			
	PU4	0.872			
Attitude Toward Using (AT)	AT1	0.861	0.925	0.892	0.756
	AT2	0.807			
	AT3	0.895			
	AT4	0.910			
Actual Usage (AU)	AU1	0.808	0.900	0.833	0.751
	AU2	0.900			
	AU3	0.889			

The table above shows that all Composite reliability values exceeds 0.7, Cronbach's alpha exceeds 0.7 and AVE values exceed 0.5, so the results of the outer model test show that all data are valid and reliable.

2. Inner Model Testing

The value of R^2 is the coefficient of determination on the endogenous construct. R^2 values are 0.67 (strong), 0.33 (moderate) and 0.19 (weak) (Chin, 1998). Predictive relevance is useful for validating models. The values obtained are 0.02 (small), 0.15 (medium) and 0.35 (large) (Ghozali, 2016). The test results of this study can be seen in the following table:

Table 2. R^2 and Q^2 Test Result

Variable	R^2	Q^2
Attitude Toward Using (AT)	0.758	0.554
Actual Usage (AU)	0.663	0.487

The results of the R^2 test in the table above show a value of 0.758 for Attitude Toward Using (AT) and 0.663 for Actual Usage (AU). These data indicate that the model for each exogenous variable in this study is strong for explaining the intended endogenous variable. The value of 0.758 for Attitude Toward Using (AT) variable also shows that 75.8 % of Attitude Toward Using (AT) have been explained by the independent variables of Perceived Ease of Use and Perceived Usefulness, and 24.2% is influenced by other factors not explained in the research. The results of R^2 for Actual Usage (AU) of 0.663 show that the factors that influence user intentions have been explained by the factors studied by 66%.

A good predictive relevance model can be seen from the Q^2 value exceeding 0. The results of the Q^2 calculation in this study were 0.554 for Attitude Toward Using (AT) and 0.487 for Actual Usage (AU), this indicates that the variables in this study have a very good predictive relevance.

3. Hypothesis Testing

Table 3. Results of the Path Coefficient and P-Value on the Direct Effect

Hypo	Direct Influences	Coefficient	P-Value	Information
H1	Ease of Use (EU) → Actual Usage (AU)	0.228	0.055	Positive Not Significant
H2	Ease of Use (EU) → Attitude Toward Using (AT)	0.344	0.001	Positive Significant
H3	Usefulness (PU) → Attitude Toward Using (AT)	0.572	0.000	Positive Significant
H4	Usefulness (PU) → Actual Usage (AU)	0.491	0.000	Positive Significant
H5	Attitude Toward Using (AT) → Actual Usage (AU)	0.148	0.335	Positive Not Significant

The direct effect can be known by the path coefficient value and P-value. The value of path coefficients is the value of the coefficient to see the significance and strength of the relationship to test the hypothesis. The value of path coefficients is between -1 to +1. If the value is close to +1, the relationship between the two constructs is getting stronger. A relationship that is closer to -1 indicates that the relationship is negative (Sarstedt et al, 2017). The variable is declared to have a significant effect if the P-value is less than 0.05 or the 95% confidence interval (based on the percentile method) does not include zero (Hair et al, 2019).

The effect of Perceived Ease of Use (EU) on Actual Usage (AU) and Attitude Toward Using (AT) on Actual Usage (AU), from Tabel 3 above, have a coefficient value close to +1 (H1 = 0.228 and H5 = 0.148) which indicates a positive relation. The P-value of both hypotheses is greater than 0.05 (H1 = 0.055 and H5 = 0.335) that shows not significant result. The results of H1 are not in line with research conducted by Bugembe (2010), Santoso (2010), and Sudaryati et al (2017) which found that perceived ease of use and actual usage have a positive and significant relationship. However, this result (H1) confirmed and extended the research conducted by (Amin et al, 2022) stated that the perceived ease of use had no direct effect on the actual usage. The results of the fifth hypothesis (H5) are not in line with research conducted by Amin et al (2022), Davis (1993), Gunawan (2014), and Hendra & Iskandar (2016), that attitude has a positive effect on the actual usage of a technology. However, this research (H1) confirmed and extended the research conducted by Davis (1989), Karahanna & Straub (1999), and Chairina (2021) stated that the perceived ease of use had no direct effect on the actual usage.

The results of the coefficients and P-values for H2, H3, and H4 according to Table 3 are positive and significant. They have a coefficient value close to +1 (H2 = 0.344, H3 = 0.572, and H4 = 0.491) which indicates a positive relation, and the P-value is smaller than 0.05 (H2 = 0.001, H3 = 0.000, and H4 = 0.000) that shows significant result. However, H1 confirmed that a person's intention to use a technology is formed from a person's perception of a technology that is easy (Nguyen, et al., 2019). If someone feels that the information system is easy to use then he will use it (Jogiyanto, 2007). The perception of ease of use have an influence on behavioral attitudes (Umamah & Pribadi, 2017). These results indicate that a person's attitude to continue using simulator is highly dependent on the ease of using the application, so users feel that the simulator application makes it easier for them to carry out their daily activities. The results of H3 is in accordance with research conducted by Hartono (2008), Umamah & Pribadi (2017), and Latief & Nur (2019) that the perception of usefulness have an influence on behavioral attitudes. This condition indicates that respondents (simulator users) believe that using the simulator application can provide benefits or advantages in supporting their daily activities at work. The results of H4 are in line with research conducted by Rigopoulos & Askounis (2007), Priyono (2017), and Chairina (2021) which found that perceived usefulness had a positive effect on actual usage.

Table 4. Results of the Path Coefficient and P-Value on the Indirect Effect

Hypo	Indirect Influences	Coefficient	P-Value	Information
H6	Perceived Ease of Use (EU) → Attitude Toward using (AT) → Actual Usage (AU)	0.085	0.336	Positive Not Significant
H7	Perceived Usefulness (PU) → Attitude Toward Using (AT) → Actual Usage (AU)	0.051	0.381	Positive Not Significant

The test results of H6 and H7 according to table 4 above find that there is not an indirect effect of perceived ease of use on actual usage through attitude and there is not an indirect effect of perceived usefulness on actual usage through attitude. This information is obtained from the path coefficient value of H6 (0.085) and H7 (0.051) which indicates a positive relationship. While the P-value of H6 (0.336) and H7 (0.381) > 0.05 indicates not a significant result. This is different from the results of previous research conducted by Amin et al (2022), Bugembe (2010), Santoso (2010), and Sudaryati et al (2017), that perceived ease of use and actual usage have a positive relationship and attitude also has a positive correlation with actual usage.

Conclusion

The results of hypothesis testing indicate that perceived usefulness and perceived ease of use have a positive influence on attitude, while the results of the test for the effect of perceived usefulness on simulator's actual usage directly show positive and significant effect. Thus, the actual usage of the power plant main control simulator is influenced by the usefulness of the simulator itself. Simulator as one of the tools in the competency development program for operators. Agile and Adaptation are the main keys in this research where operators besides having qualified capabilities, are also able to adapt to new systems or technologies to help develop their competencies.

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