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Analysis of the Technology Acceptance Model (TAM) on the Use of Software for Students in the Building Engineering Education Program

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Abstrak

Penelitian ini bertujuan untuk menganalisis *Technology Acceptance Model* (TAM) terhadap penggunaan perangkat lunak bagi mahasiswa Program Studi Pendidikan Teknik Bangunan. Metode Penelitian yang akan digunakan adalah metode penelitian asosiatif. Populasi dalam penelitian ini adalah mahasiswa Program Studi Pendidikan Teknik Bangunan di Fakultas Keguruan dan Ilmu Pendidikan Universitas Nias yang aktif pada semester Ganjil Akademik 2023/2024. Populasi ini terdiri dari mahasiswa semester 3, 5 dan 7 dengan jumlah total 61. Metode analisis data yang digunakan adalah *Structural Equation Modelling* (SEM). Hasil penelitian disimpulkan bahwa *perceived ease of use* secara signifikan mempengaruhi *behavioral intention to use* terhadap penggunaan perangkat lunak bagi mahasiswa Program Studi Pendidikan Teknik Bangunan, *perceived usefulness* secara signifikan mempengaruhi *behavioral intention to use* terhadap penggunaan perangkat lunak bagi mahasiswa Program Studi Pendidikan Teknik Bangunan, *behavioral intention to use* secara signifikan mempengaruhi *perceived usage* terhadap penggunaan perangkat lunak bagi mahasiswa Program Studi Pendidikan Teknik Bangunan.

Kata Kunci: *Technology Acceptance Model, Structural Equation Model,* Perangkat Lunak

Abstract

This research aims to analyze the Technology Acceptance Model (TAM) regarding the usage of software among students of the Building Engineering Education Program. The research method to be used is associative research method. The population in this study consists of students of the Building Engineering Education Program at the Faculty of Teacher Training and Education, Universitas Nias, who are active in the Odd Semester of the Academic Year 2023/2024. This population comprises students in the 3rd, 5th, and 7th semesters, with a total of 61. The data analysis method used is Structural Equation Modeling (SEM). The research results conclude that perceived ease of use significantly influences behavioral intention to use regarding the usage of software for students of the Building Engineering Education Program, perceived usefulness significantly influences behavioral intention to use regarding the usage of software for students of the Building Engineering Education Program, and behavioral intention to use significantly influences perceived usage regarding the usage of software for students of the Building Engineering Education Program.

Keywords*: Technology Acceptance Model, Structural Equation Model, Software*

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Introduction

In an era continually evolving digitally, the use of software has become an integral part of daily life, including in the context of higher education. Building Engineering Education requires a profound understanding of technical principles, design, and construction of buildings. With technological advancements, software has enabled the simulation, design, and analysis of various aspects of the planning and construction processes more quickly and efficiently.

Digital technology has facilitated students' access to knowledge sources and more efficient information management (Frerich et al., 2016). Building Engineering Education students are prepared to become professionals by combining elements with scientific analysis to innovate in response to technological developments. They develop skills and require imagination, responsibility, creativity, and the ability to collaborate with individuals from various backgrounds. Students are trained in various skills, including hard and soft skills, such as effective communication and presentation skills, teamwork, leadership, research, and design. This is to apply the skills acquired in developing and realizing students' ideas.

Building Engineering Education students not only become users of digital technology but also creators and innovators by utilizing it in the learning and idea development process. Digital technology is an indispensable partner in guiding their steps towards deeper understanding and broader capabilities. With easy access to online and offline learning resources, students can explore technical concepts more flexibly (Frerich et al., 2016). They can combine online learning experiences with hands-on practice in the field, creating a more holistic and interactive learning environment. Communication among students and also with lecturers becomes smoother and more efficient, allowing for the exchange of ideas and support in facing learning challenges. On the other hand, in the context of innovation and engineering, digital technology opens opportunities for creative exploration. Students can utilize various computer-based software to generate, evaluate, and modify their ideas. From creating prototype models to simulating processes, digital technology enables better visualization and more effective communication. Through CAD-based software, they can create complex prototype models in both 3D and 2D formats without the need for the cost and time of physical prototype production.

The role of digital technology in the design process includes providing technical, economic, psychosocial, and various other types of information. In the research context, digital technology supports activities such as online surveys, data collection, processing, and sharing (Frerich et al., 2016). There are various tools that support specific tasks for Building Engineering Education students, such as AutoCAD, Revit, and SketchUp software, which allow them to design and draw detailed building designs in both 2D and 3D formats. Additionally, some Structural Analysis software such as SAP2000, ETABS, and Staad.Pro enable students to analyze and evaluate the strength and stability of building structures.

One quantitative evaluation method, the Technology Acceptance Model (TAM) developed by (Davis, 1989) and expanded by (Bagozzi & Warshaw,1989), evaluates technology acceptance by considering two main aspects: perceived usefulness and perceived ease-of-use. The TAM model is based on assumptions (Venkatesh & Davis, 2000). They argue that the TAM behavioral model is the most common and straightforward concept in explaining user behavior towards new information systems. According to Vaidyanathan, TAM is a favorite and appropriate model for describing user acceptance processes of the existence of a system. (Soomro, 2020) also explained in research by (Qomariah, 2022; Muliati, 2019) that there is a need for evidence whether perceived ease of use and perceived usefulness can influence attitude toward using and actual usage for application usage. In the TAM behavioral model, Perceived Usefulness and Perceived Ease of Use are stated to be the foundation or basis in determining acceptance and usage of various information system applications.

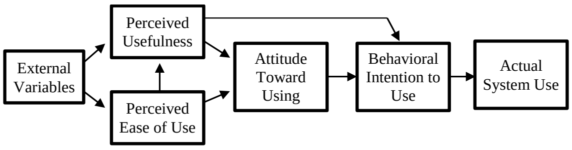
This research utilizes TAM analysis aimed to determine whether Perceived Ease of Use influences Behavioral Intention to Use, Perceived Usefulness influences Behavioral Intention to Use, and Behavioral Intention to Use influences Perceived Usage regarding the usage of software among students in the Building Engineering Education program at FKIP, Universitas Nias.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by (Davis, 1989), is one of the most renowned research frameworks for projecting how individuals will adopt and accept information systems and technology. The development of TAM continues to advance to understand the impact of user acceptance on new technologies and recent innovations (Mahande, 2023).

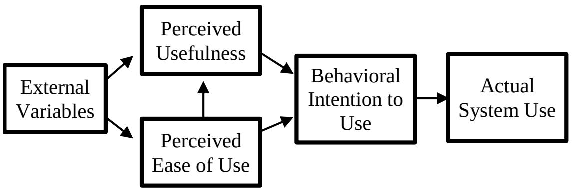
The Technology Acceptance Model (TAM) comprises five key variables used to forecast user acceptance. These variables include perceived usefulness and perceived ease of use, which impact attitude toward using, behavioral intention to use, and ultimately demonstrate the actual use of the system (Davis, 1989). The aim of TAM is to elucidate the factors influencing users' perceptions and behaviors towards the use of information technology (Dwivedi et al., 2019). Perceived usefulness and perceived ease of use are the original constructs of TAM (Cheong et al., 2005). The popularity of TAM is primarily due to its theoretically simple nature, supported by empirical evidence, and its ability to forecast the acceptance and use of new technologies in various fields (Rauniar et al., 2014).

Figure 1. Technology Acceptance Model (TAM) (Davis, 1989)



(Venkatesh & Davis, 1996) modified TAM to adapt to technological advancements. One of the modifications made was the removal of one variable, namely attitude toward using.

Figure 2. Technology Acceptance Model (TAM) (Venkatesh & Davis, 1996)



Perceived Ease of Use

Davis defines perceived ease of use as the extent to which individuals believe that using a particular system will require minimal effort. Ease is described as "the absence of difficulty or effort required." Applications perceived as easier to use than others are more likely to be accepted by users (Davis, 1989).

Indicator of Perceived Ease of Use

According to Davis (1989), indicators to measure perceived ease of use include ease of learning, controllability, clarity and

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understandability, interaction flexibility, ease of mastery, and ease of use.

Perceived Usefulness

Davis defines perceived usefulness as the extent to which an individual believes that using a particular system will enhance their job performance. An individual's decision to use or not to use an application often depends on their belief that the application will assist them in performing their tasks. The term "useful" itself is interpreted as being able to provide significant benefits (Davis, 1988).

Indicator of Perceived Usefulness

According to Davis (1989), indicators for measuring perceived usefulness include work more quickly, job performance, increase productivity, effectiveness, makes job easier, and useful.

Behavioral Intention to Use

According to (Davis et al., 1989), behavioral intention is defined as the level of an individual's willingness to engage in a particular behavior or action. People tend to engage in a behavior if they have the desire or intention to do so.

Indicator of Behavioral Intention to Use

According to (Kucukusta et al., 2015), indicators for measuring behavioral intention to use include willingness to use the system in the future, willingness to use the system routinely in the future, and willingness to recommend the system to others.

Perceived Usage (Actual Usage)

According to (Graziano & Eisenberg, 1997; Ajzen, 2008), behavioral intention is a significant predictor of behavior, but because the Technology Acceptance Model (TAM) is aimed at understanding technology usage, behavior in TAM refers to actual technology usage. However, actual usage is often replaced with the term perceived usage because actual usage cannot be directly observed by researchers using questionnaires.

Indicator of Perceived Usage

Perceived Usage utilizes measurement methods of actual usage or perceived usage by calculating the amount of time spent interacting with a technology and how frequently the technology is used by the user (Igbaria et al., 1995).

Method

The research method in this study is an associative research method, which aims to determine the relationship between two or more variables. The form of relationship in this research is causal or cause-effect relationship with a quantitative approach (Sugiyono, 2019).

The population in this study consists of students of the Building Engineering Education Program at the Faculty of Teacher Training and Education, Nias University, who are active in the Odd Semester of the Academic Year 2023/2024. This population comprises students in the 3rd, 5th, and 7th semesters, totaling 61 individuals, and they are users of software with similar experience in completing coursework tasks. The sample is taken using a saturation sampling method, assuming that the characteristics of the sample are homogeneous. Therefore, the research sample consists of 61 respondents.

Table 1. Respondent Profile

Semester	Quantity	Percentage (%)
3	22	36,07
5	21	34,43
7	18	29,51
Total	**61**	**100,00**

This research utilizes data collection technique through questionnaire (survey). Likert Scale is the method used to evaluate attitudes, opinions, and perceptions of

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individuals or groups towards social phenomena (Sugiyono, 2019). By using the Likert Scale, the variables to be measured are expressed in the form of indicators. These indicators are then used as the basis for composing instrument items, which can be statements or questions. Respondents are asked to choose from five levels of options, namely: strongly agree, agree, neutral, disagree, and strongly disagree. The assessment from respondents will be converted into numbers according to those listed in the following Table 2.

Table 2. Weight of Respondent Answers

Answer	Abbreviation	Value
Strongly Agree	SS	5
Agree	S	4
Neutral	R	3
Disagree	TS	2
Strongly Disagree	STS	1

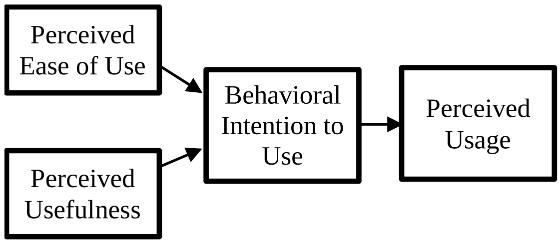
Method of Data Analysis

The method to be applied for testing hypotheses in this study is structural equation modeling. According to (Ghozali, 2008), Structural Equation Modeling (SEM) is a development from multiple regression models that originally stem from econometrics principles, then aligned with the principles of regulation from psychology and sociology. SEM has become an important part of academic research in managerial fields. (Ghozali, 2008) also identifies two general types of SEM, namely variance-based SEM and covariance-based SEM. PLS (Partial Least Squares) is one form of variance-based SEM capable of handling path models with reflective or formative constructs, or even both in one model. Therefore, in this study, the chosen SEM method is Partial Least Squares (PLS).

Research Hypotheses

In hypothesis testing, the Structural Equation Modeling analysis method conducted through the SmartPLS platform is used. More detailed information regarding TAM in the context of this research can be found in Figure 3.

Figure 3. Research Model and Hypotheses



The hypotheses to be tested in this study are as follows:

H1: Perceived Ease of Use influences Behavioral Intention to Use

H2: Perceived Usefulness influences Behavioral Intention to Use

H3: Behavioral Intention to Use influences Perceived Usage

Results and Discussion

Measurement Model (Outer Model)

The Measurement Model is a component of the SEM model that shows the relationship between latent variables and their indicators. In simpler terms, the Outer Model is a segment of the model that connects latent variables with observed variables. To assess the correlation between them, validity and reliability tests are conducted. Validity testing involves three criteria: Convergent Validity, Discriminant Validity, and AVE (Average Variance Extracted). Meanwhile, reliability testing consists of two criteria: Composite Reliability and Cronbach's Alpha.

Validity Testing

The stage of completing the equation model with a path approach involves calculating convergent validity and discriminant validity, reflected in the value of Average Variance Extracted (AVE). Convergent validity demands that the measurement instrument accurately represents the intended construct.

Convergent validity is considered adequate when the outer loading/loading factor has a value greater than 0.70. The results of outer loading obtained using SmartPLS can be seen in the following Table 3.

Table 3. Outer Loading Values

	Outer Loadings
PEU1	0.908
PEU2	0.843
PEU3	0.773
PEU4	0.702
PEU5	0.753
PEU6	0.736
PU1	0.894
PU2	0.808
PU3	0.837
PU4	0.887
PU5	0.837
PU6	0.753
BIU1	0.861
BIU2	0.798
BIU3	0.777
PUS1	0.898
PUS2	0.835
PUS3	0.709

From Table 3, it can be observed that all indicators have outer loading values greater than 0.7. Therefore, based on the convergent validity of the outer loading factor, it can be concluded that all indicators have valid validity. Furthermore, to measure discriminant validity, the output results of the average value are used, as shown in the table below. Indicators are considered discriminantly valid if the Average Variance Extracted (AVE) value is greater than 0.50. The measurement results of AVE can be found in the following Table 4.

Table 4. Results of Average Variance Extracted (AVE) Measurement

	Average Variance Extracted (AVE)
Behavioral Intention to Use	0.661
Perceived Ease of Use	0.623
Perceived Usage	0.669
Perceived Usefulness	0.701

Based on Table 4, it can be seen that the overall AVE measurement results for the variables are discriminantly valid. This is because the AVE measurement results for all variables are > 0.5.

Reliability Testing

Reliability measurement is evaluated using two criteria, namely Cronbach's alpha and composite reliability from the indicator block measuring the construct. The results of the analysis using SmartPLS can be seen in the following Table 5.

Table 5. Results of Cronbach's Alpha and Composite Reliability Values

	Cronbach's Alpha	Composite Reliability
Behavioral Intention to Use	0.744	0.854
Perceived Ease of Use	0.904	0.908
Perceived Usage	0.766	0.857
Perceived Usefulness	0.920	0.933

From Table 5, it shows that the values of Cronbach's alpha and composite reliability are above 0.70, thus it can be concluded that the constructs have good reliability.

Structural Model (Inner Model)

To assess the significance of the relationships between hypotheses, we can compare the T-statistic values with the values listed in the T-table. If the T-statistic value exceeds the value in the T-table, then the hypothesis can be accepted. According to the practical rule of PLS, with a confidence level of 95% (5 Percent Alpha), the T-table value for Two-tail is more than 1.96. The results of the structural model (inner model) can be seen in Table 6.

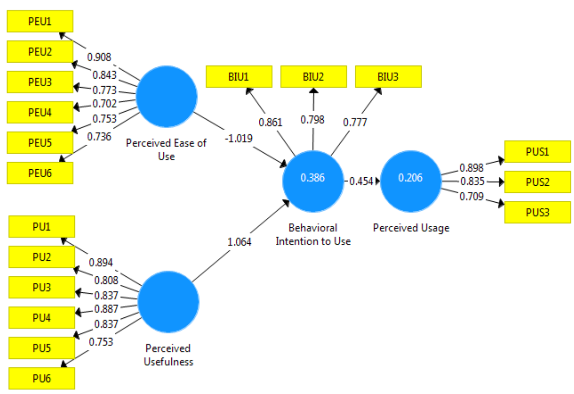
Table 6. Hypothesis Results

	Original Sample	T Statistics	P Values

Perceived Ease of Use -> Behavioral Intention to Use	-1.019	2.124	0.034
Perceived Usefulness -> Behavioral Intention to Use	1.064	2.425	0.016
Behavioral Intention to Use -> Perceived Usage	0.454	3.118	0.002

Meanwhile, the final model of the research results is as shown in Figure 4 below.

Figure 4. Final Research Model



The results from Table 6 indicate that:

1. Perceived Ease of Use significantly influences Behavioral Intention to Use, as indicated by the p-value of 0.034 < 0.05 and the t statistic value of 2.124 > 1.96.
2. Perceived Usefulness significantly influences Behavioral Intention to Use, as indicated by the p-value of 0.016 < 0.05 and the t statistic value of 2.425 > 1.96.
3. Behavioral Intention to Use significantly influences Perceived Usage, as indicated by the p-value of 0.002 < 0.05 and the t statistic value of 3.118 > 1.96.

Conclusion

The analysis of the Technology Acceptance Model (TAM) towards software usage can be summarized as follows. Based on the research calculations, all variables show influence on software users.

1. Perceived Ease of Use significantly influences the Behavioral Intention to Use of software among students of the Building Engineering Education Program at the Faculty of Teacher Training and Education, Universitas Nias.
2. Perceived Usefulness significantly influences the Behavioral Intention to Use of software among students of the Building Engineering Education Program at the Faculty of Teacher Training and Education, Universitas Nias.
3. Behavioral Intention to Use significantly influences Perceived Usage of software among students of the Building Engineering Education Program at the Faculty of Teacher Training and Education, Universitas Nias.

References

Gronlund, N.E. & Linn, R.L. (1990). *Measurement and evaluation in teaching*. *(6th ed.)*. New York: Macmillan.

Ajzen, I., & Cote, N. G. (2008). Attitudes and the prediction of behavior. *Attitudes and attitude change*, *13*, 289-305.

Cheong, J. H., & Park, M. C. (2005). Mobile internet acceptance in Korea. *Internet research*, *15*(2), 125-140.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management science*, *35*(8), 982-1003.

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information systems frontiers*, *21*, 719-734.

Frerich, S., Meisen, T., Richert, A., Petermann, M., Jeschke, S., Wilkesmann, U., & Tekkaya, A. E. (2016). Engineering education 4.0. *Cham: Springer International Publishing*.

Ghozali, I. (2008). *Structural equation modeling: Metode alternatif dengan partial least square (pls)*. Badan Penerbit Universitas Diponegoro.

Graziano, W. G., & Eisenberg, N. (1997). Agreeableness: A dimension of personality. In *Handbook of personality psychology* (pp. 795-824). Academic Press.

Igbaria, M., Guimaraes, T., & Davis, G. B. (1995). Testing the determinants of microcomputer usage via a structural equation model. *Journal of management information systems*, *11*(4), 87-114.

Kucukusta, D., Law, R., Besbes, A., & Legohérel, P. (2015). Re-examining perceived usefulness and ease of use in online booking: The case of Hong Kong online users. *International Journal of Contemporary Hospitality Management*, *27*(2), 185-198.

Mahande, R. D. (2023). *Perilaku Penerimaan E-Learning: Konstruksi Model dan Studi Empiris*. Indonesia Emas Group.

Muliati, N. (2019). Pengaruh Perceived Usefulness, Perceived Ease Of Use, Attitude Toward Using Dan Behavior Intention To Use Terhadap Actual System Use Dalam Implementasi Teknologi Enterprise Resource Planning (ERP) System (Studi Pada End User ERP System Di PT Semen Gresik). *Jurnal Manajemen Dan Inovasi (MANOVA)*, *2*(2), 31-46.

Qomariah, T. J. (2022). *Analisis penerimaan pengguna menggunakan metode Technology Acceptance Model (TAM)* (Bachelor's thesis, Fakultas Sains dan Teknologi Universitas Islam Negeri Syarif Hidayatullah Jakarta).

Rauniar, R., Rawski, G., Yang, J., & Johnson, B. (2014). Technology acceptance model (TAM) and social media usage: an empirical study on Facebook. *Journal of enterprise information management*, *27*(1), 6-30.

Soomro, T. R., Shah, M. H., & Ahmad, S. W. (2020). Investigating the adoption of mobile learning by higher education students: A perspective of theory of planned behavior integrated with the technology acceptance model. *Education and Information Technologies*, 25(4), 3073–3093.

Sugiyono. (2019). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Vaidyanathan, G., Sabbaghi, A., & Bargellini, M. (2005). User acceptance of digital library: An empirical exploration of individual and system components. *Issues in Information Systems*, *6*(2), 279-285.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, *46*(2), 186-204.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision sciences*, *27*(3), 451-481.

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