MUST: ***Journal of Mathematics Education, Science and Technology***
Vol. 10, No. 1, Juli 2025 Hal 1-12
DOI: http://doi.org/10.30651/must.v10i1.25503

ANALYSIS OF USER ACCEPTANCE OF OBJECT-ORIENTED PROGRAMMING LEARNING MULTIMEDIA BASED ON QR CODE IN VOCATIONAL EDUCATION USING THE TECHNOLOGY ACCEPTANCE MODEL (TAM) APPROACH

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Received 21 Januari 2025; revised 21 Juni 2025; accepted 26 Juni 2025.

ABSTRAK

Tujuan penelitian adalah menganalisis Technology Acceptance Model (TAM) dalam mengukur multimedia pembelajaran pemrograman berorientasi objek berbasis QR Code dalam menunjang pembelajaran siswa SMK pada materi pemrograman berorientasi objek (PBO) berbasis masalah. Variabel model TAM yang digunakan terdiri dari Perceived Effectiveness (PU), Perceived Ease of User (PEU), dan User Acceptance of IT (UA-IT). Responden penelitian terdiri dari 35 siswa SMK Negeri 1 Cimahi. Penelitian ini menggunakan pendekatan kuantitatif dengan tahapan penelitian terdiri dari pengenalan responden terhadap penggunaan multimedia, penyebaran kuesioner TAM, dan pengujian model TAM menggunakan software SmartPLS. Hasil penelitian menunjukkan bahwa nilai rata-rata angket respon pengguna terhadap multimedia pembelajaran PBO berbasis QR Code sebesar 84,95% dengan kategori "Sangat Baik". Berdasarkan analisis hubungan variabel TAM dengan menggunakan PLS diketahui bahwa variabel persepsi kemudahan pengguna mempunyai pengaruh positif terhadap penerimaan multimedia pembelajaran PBO berbasis QR Code, variabel persepsi penggunaan mempunyai pengaruh positif terhadap penerimaan multimedia pembelajaran PBO berbasis QR Code, dan variabel persepsi kemudahan penggunaan dan persepsi penggunaan. secara bersama-sama memberikan pengaruh positif terhadap penerimaan multimedia pembelajaran PBO berbasis QR Code. Penelitian ini diharapkan dapat memberikan penjelasan mengenai penggunaan analisis TAM dalam multimedia pembelajaran.

Kata kunci: Multimedia, Partial least square, Technology acceptance model, SmartPLS, vocational education.

ABSTRACT

The research objective is to analyze the Technology Acceptance Model (TAM) in measuring QR Code-based object-oriented programming learning multimedia in supporting vocational school students' learning on problem-based object-oriented programming (PBO) material. The TAM model variables used consist of Perceived Usefulness (PU), Perceived Ease of User (PEU), and User Acceptance of IT (UA-IT). The research respondents consisted of 35 students of SMK Negeri 1 Cimahi. This study uses a quantitative approach with research stages consisting of introducing respondents to the use of multimedia, distributing TAM questionnaires, and testing the TAM model using SmartPLS software. The research results show that the average value of the user response questionnaire for QR Code-based PBO learning multimedia is 84.95% in the "Very Good" category. Based on the analysis of the relationship between TAM variables using PLS, it is known that the perceived ease of user variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia, the perceived usage variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia, and the variable perceived ease of use and perceived use. together they have a positive influence on the acceptance of QR Code-based PBO learning multimedia. This research is expected to provide an explanation regarding the use of TAM analysis in learning multimedia.

Keywords: Multimedia, Partial least square, Technology acceptance model, SmartPLS, vocational education.

INTRODUCTION

Learning multimedia is one component that supports the learning process. The use of learning multimedia is used so that boredom during the learning process can be avoided and students' motivation and interest in learning can increase (Nurrita, 2018). Multimedia learning is a form of information system used in the field of education. In every use of technology or information systems, it is necessary to evaluate user acceptance of the technology or information system. This is because assessing the acceptance of use of a new information system or technology is important to help measure the extent to which users feel comfortable and satisfied with the experience of using the system (Hijriah & Irawan, 2023). Usage acceptance research is often conducted using models that have been developed in the technology acceptance literature. One model that is often used is the Technology Acceptance Model (TAM).

TAM was introduced by Davis in 1989 (Al-Gahtani, 2001). TAM is a model adapted from the Theory of Reasoned Action (TRA) which is specifically for modeling user acceptance of a technology or information system. TAM is used to provide and analyze explanations regarding the factors that influence whether a technology or information system is accepted by users (Kamal et al., 2020). TAM aims to explain and predict user acceptance of an information system or technology (Taherdoost, 2018). TAM is a theory designed to describe how users can understand and use information technology (Malatji et al., 2008). The TAM model has undergone many modifications. Venkatesh and Davis in 1996 stated the elimination of the attitude toward using variable in the original form of TAM. The construct of attitude towards users was not included because it did not have a significant impact on behavioral intentions (Venkatesh & Davis, 1996).

Currently, there is a lot of research that uses the TAM model in measuring user acceptance of a technology or information system, including the use of the TAM model in measuring user acceptance of E-Learning (Baby & Kannammal, 2020; Lattu & Jatmika, 2022), TAM analysis of acceptance and online buyers' trust in electronic markets (Prakosa & Sumantika, 2021), TAM analysis of the use of E-Money applications (Legi & Saerang, 2020), and the use of TAM analysis to improve tourist destinations through digital technology (Sari, 2023). The widespread use of TAM in measuring user acceptance of a technology and information system shows that the TAM model is still considered relevant in analyzing user acceptance of a particular technology. Therefore, this research was conducted with the aim of using TAM model analysis to measure QR Code-based object-oriented programming learning multimedia in supporting vocational school students' learning on problem-based object-oriented programming (PBO) material. Further explanation regarding QR Code-based PBO learning multimedia can be seen in our previous research (Al Husaeni et al., 2023).

The urgency of this research lies in two aspects, namely, from the vocational education side and the development of educational technology. On the vocational education side, there is a need to develop interactive and contextual learning media to increase student involvement and understanding in programming materials, especially on the topic of PBO, which is known to be complex. Second, from the

educational technology development side, integrating QR codes in learning multimedia is still relatively new and has not been empirically evaluated using theoretical approaches such as the TAM model. Therefore, this research enriches the treasury of TAM application in the context of vocational education and provides practical contributions in creating learning innovations.

RESEARCH METHOD

The TAM model was used in this research to measure students' responses to QR Code-based object-oriented programming learning multimedia. Table 1 shows the questions for each TAM item used in this research. The TAM model variables in this research consist of Perceived Usefulness (PU), Perceived Ease of User (PEU), and User Acceptance of IT (UA). Meanwhile, Figure 1 shows the development of the hypothesis formulated in this research. There are several hypotheses developed based on the TAM model variables, namely:

(i). If multimedia users learning object-oriented programming based on QR Code have the perception that it can be easily operated and makes their work easier, then the hypothesis developed is:

H1: The PEU variable has a positive influence on the acceptance of QR Code-based object-oriented programming learning multimedia.

(i). (i). If multimedia users of QR Code-based object-oriented programming learning have the perception that this technology is useful for completing learning, then users will increasingly use it to complete the learning process, so the hypothesis developed is:

H2: variable Y has a positive influence on the acceptance of QR Code-based object-oriented programming learning multimedia

(ii).If users of QR Code-based object-oriented programming learning multimedia have the perception that QR Code-based object-oriented programming learning multimedia can easily be operated and is useful for completing their learning, then users will increasingly use QR Code-based object-oriented programming learning multimedia to complete their learning, so it is hypothesized that developed is:

H3: The PEU and PU variables together have a positive influence on the acceptance of QR Code-based object-oriented programming learning multimedia.

Table 1. Indicator Model TAM

No	Question
	***Perceived of Usefulness* (PU)**
1	Using QR Code-assisted learning multimedia in learning Object-Oriented Programming allows me to complete assignments and learning faster.
2	Using QR Code-assisted learning multimedia in learning Object-Oriented Programming will improve my learning performance.
3	Using QR Code assisted learning multimedia in learning Object Oriented Programming in my learning increases my productivity.
4	Using QR Code-assisted learning multimedia in learning Object-Oriented Programming increases my effectiveness in learning.
5	Using QR Code-assisted learning multimedia in learning Object-Oriented Programming makes my learning easier
6	I think QR Code-assisted learning multimedia in learning Object-Oriented Programming is useful in my learning process
	***Perceived Ease of User* (PEU)**
7	Learning to operate QR Code-assisted learning multimedia is easy for me.
8	I feel that QR Code-assisted learning multimedia makes it easier for me to study the material I want.
9	My interaction with QR Code-assisted learning multimedia was clear and easy to understand.
10	In my opinion, QR Code-assisted learning multimedia is flexible for interaction.
11	It is easy for me to become skilled at using QR Code-assisted learning multimedia.
12	I think QR Code-assisted learning multimedia is easy to use.
	***User Acceptance of IT* (UA-IT)**
13	I use QR Code-assisted learning multimedia very often (many times a week)
14	I use QR Code-assisted learning multimedia whenever I have difficulty understanding Object-Oriented Programming material

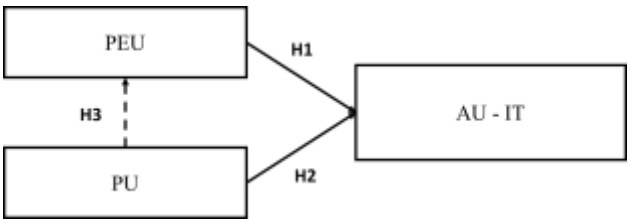

Figure 1. TAM Model Hypothesis.

Testing was carried out using SmartPLS software. Analysis of TAM results was carried out in several steps adapted from research conducted by Widodo et al. (2018):

(i). The model confirmatory test was carried out on the whole to determine the Goodness of fit for each research variable used. The Goodness of Fit test is used to determine how precisely the observed frequency is with the expected frequency.

(ii). Validity testing is carried out by calculating the loading factor value for each question item. The loading factor value is declared valid if the value obtained is above 0.5. Meanwhile, if the value obtained is less than or equal to 0.5 then the question item is invalid.

(iii). The reliability test was carried out by calculating Cronbach's Alpha on the PEU, PU and AU-IT variables. The Cronbach's Alpha value is declared reliable if the value is above 0.70, whereas if the Cronbach's Alpha value is less than 0.70 it is declared unreliable.

(iv). Significance Test by looking at the regression coefficient. The causal relationship H1 is accepted if the significance value (P) is less than 0.005 and the regression coefficient is positive, while H1 is rejected if the P value is greater than 0.005 or the regression coefficient is negative

RESEARCH RESULTS AND DISCUSSIONS

Result

This research uses a user response questionnaire that refers to the Technology Acceptance Model (TAM). The respondents who filled out the questionnaire were 35 students of SMK Negeri 1 Cimahi who interacted directly with SBPBO learning multimedia. Table 2 shows the results of data processing using the TAM model. The results show that there are three aspects assessed, namely perceived use (PU) with a total of 6 questions, perceived ease of use (PEU) with a total of 6 questions, and user acceptance (AU-IT) with a total of 2 questions. Based on the results of the questionnaire in Table 2, the highest score was obtained for the PEU aspect, namely 89.90%, while for PU it was 83.52%, and AU-IT was 81.42%. The average percentage value obtained from the results of students' responses to PBO learning multimedia is 84.95% which is included in the "Very Good" category.

Table 2. Results of Student Response Questionnaire on PBO Learning Multimedia.

No.	Assessment Aspects	Number of Items	Ideal Score	Score Acquisition	Percentage (%)
1.	Perceived of Usefulness (PU)	6	1050	877	83.52
2.	Perceived Ease of User (PEU)	6	1050	944	89.90
3	User Acceptance of IT (UA-IT)	2	350	285	81.43
	Average				**84.95**

In more detail, the results of the TAM instrument were analyzed using Partial Least Square (PLS) for an iterative estimation process involving the diversity structure of the TAM variables. Figure 2 shows the results of the model confirmatory test which contains the loading factor value, Cronbach's alpha value, and P value coefficient.

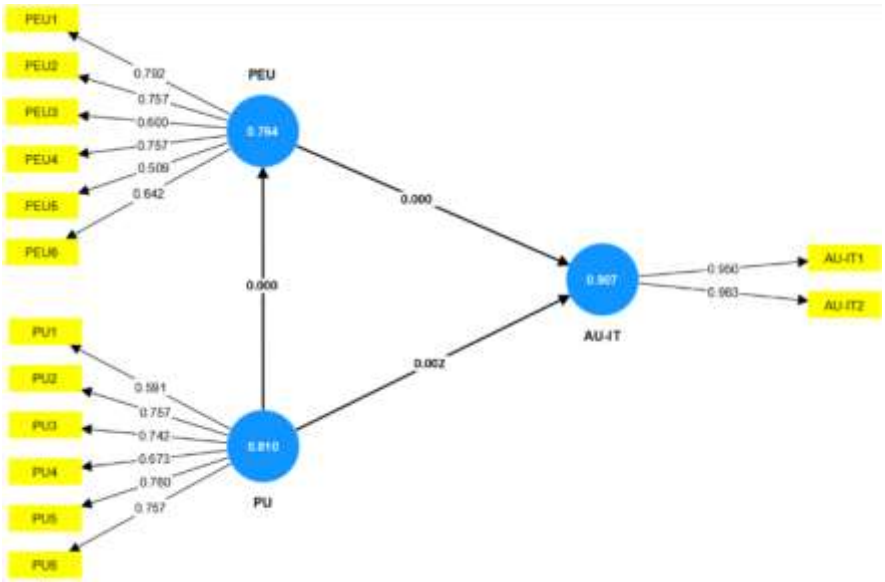

Figure 2. Model Confirmatory Test.

Table 3 shows the results of the validity test on the TAM student response instrument. The validity test results show that each variable item has a loading factor value > 0.500. Therefore, the question items on each variable have valid values. This shows that the question items are suitable as reference variables, the indicators have met convergent validity or can represent one latent variable and form the basis for the assessment of the latent variable.

Table 4 shows the reliability test on the TAM results. The TAM reliability test results show that the Cronbach's alpha value for each PEU, PU, and AU-IT variable has a value of more than 0.700. This can prove that all variables are reliable. Thus, all TAM variables used, such as perceived ease of use, perceived usefulness, and perceived acceptance of TAM in this study, can be trusted or reliable to be used as measuring instruments.

Table 5 shows the significance test of TAM results. Based on the results shown in Table 5, it is known that all P values or path analysis results to determine the relationship between each TAM variable are less than 0.005. Therefore, it can be concluded statistically that all TAM hypotheses, namely H1, H2, and H3, can be accepted. This shows that:

(i). There is acceptance of H1 where the user perception variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia

(ii). There is acceptance of H2 where the perceived usage variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia

(iii). There is acceptance of H3 where the variables perceived ease of use and perceived use together have a positive influence on the acceptance of QR Code-based PBO learning multimedia.

Table 3. TAM Validity Test.

Variable	Items	Loading Factor	Description
PEU	PEU1	0.792	Valid
	PEU2	0.757	Valid
	PEU3	0.600	Valid
	PEU4	0.757	Valid
	PEU5	0.509	Valid
	PEU6	0.642	Valid
PU	PU1	0.591	Valid
	PU2	0.757	Valid
	PU3	0.742	Valid
	PU4	0.673	Valid
	PU5	0.760	Valid
	PU6	0.757	Valid
AU-IT	AU-IT1	0.950	Valid
	AU-IT2	0.963	Valid

Table 4. TAM Reliability Test.

Variable	Alpha Cronbach	Description
PEU	0.764	Reliable

PU	0.810	Reliable
AU-IT	0.907	Reliable

Table 5. TAM Significance Test.

Causal	**P**
PEU → AU-IT	0.000
PU → AU-IT	0.002
PEU, PU→ AU-IT	0.000

Discussion

The response given by students to QR Code-based object-oriented programming (PBO) multimedia learning that applies the PBL model is good. This can be proven from the results of the student response instrument given after the entire learning series was completed with an average score percentage of 84.95% which is included in the "Very Good" category.

Based on the results of the TAM analysis in the partial least squares (PLS) test using smartPLS4, it is known that all hypotheses of student responses to QR Code-based PBO learning multimedia can be accepted. The consequence of accepting the user's perception of ease variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia (H1) is that if PBO users have the perception that PBO is easy to operate, then users can accept PBO more easily in completing the learning process. This finding is consistent with the research results of Baki et al. (2018), perceived ease of use is a key antecedent of technology acceptance, especially in educational environments.

The consequence of acceptance H2: the perceived usage variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia is that if PBO users have the perception that PBO has benefits in completing their learning, then the user can accept PBO which is utilized during the learning process. This result is reinforced by research by Prakosa and Sumantika (202), users are more likely to accept a system if it demonstrably improves their performance or task efficiency.

Meanwhile, the consequence of accepting the variable perceived ease of use and perceived use together has a positive influence on the acceptance of QR Code-based PBO learning multimedia (H3) is that if PBO users have the perception that PBO is easy to operate and has benefits for completing their learning, then users are

more easily accept PBO as part of the obligation to carry out the learning process. This confirms the results of a study by Mazan and Çetinel (2022) which concluded that the joint influence of ease of use and perceived usefulness significantly determines user behavioral intention towards adopting digital tourism platforms.

Therefore, based on the results of the TAM instrument analysis, it can be concluded that information technology, especially learning multimedia, should be able to accommodate the needs of students in accordance with the activities carried out at each school by paying attention to aspects of ease in operating the learning multimedia itself (Widodo et al., 2018). Apart from that, based on the results of a questionnaire with open questions, there are several impressions given by students while using PBO learning multimedia in studying PBO material and carrying out the entire series of learning, including:

(i). The modules and LKPD provided in the PBO learning multimedia are easy to understand and work on, thereby helping students understand the material provided.

(ii). PBO learning multimedia makes the learning process more varied, interesting, fun and not monotonous.

(iii). Learning carried out using the PBL model which is implemented in PBO learning multimedia with the help of QR Code can increase cooperation between students.

(iv). The use of PBO learning multimedia can increase enthusiasm for learning.

Learning carried out through PBO learning multimedia is considered very enjoyable. Before starting the learning process, the initial view of PBO was difficult and complicated, but after implementing it, it turned out to be fun and enjoyable. Apart from that, the benefits of teaching students to think logically in solving problems, as well as looking for the most effective and efficient way.

CONCLUSIONS

The responses given by respondents to QR Code-based PBO learning multimedia were good. Students provide their responses in the TAM instrument which contains 3 main aspects, namely the perceived usability (PU) aspect, the perceived ease of use aspect, and the user acceptance aspect. The average score

obtained from the students' responses was 84.95% in the "Very Good" category. Based on the analysis of the relationship between TAM variables using PLS, it is known that the perceived ease of user variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia, the perceived usage variable has a positive influence on the acceptance of QR Code-based PBO learning multimedia, and the variable perceived ease of use and perceived use. together they have a positive influence on the acceptance of QR Code-based PBO learning multimedia.

The limitation of this study lies in the limited scope of the sample, which only involved students from one particular school, so that the findings cannot be generalized to a wider population. In addition, this study only measured user acceptance at the post-implementation stage without conducting longitudinal observations to see changes in attitudes or adoption rates over a longer period. The instruments used also rely on respondents' subjective perceptions, so there is a possibility of perception bias that does not reflect the actual performance of the learning system. Meanwhile, the implications of the results of this study indicate that in developing technology-based learning multimedia, ease of use factors and perceptions of usefulness remain the main indicators that determine the level of technology acceptance by users. Therefore, developers of digital learning systems in vocational education environments need to seriously consider intuitive interface design, simple navigation, and feature integration that provides real benefits in supporting student learning activities. In addition, these results can be a basis for educational policymakers in adopting QR Code technology as a supporting medium for problem-based learning in programming subjects.

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