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Acceptance of E-Learning Media in Quantum Physics Learning Based on the TAM Model

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***Abstract*—The aim of the research was examining more deeply about the acceptance of e-learning media in quantum physics learning from a student perspective. The research sample involved 27 students majoring in physics education at the University of Syiah Kuala who were taking quantum physics courses. Data collection and data analysis from the survey research used the TAM model. The results showed that Cronbach Alpha for perceived ease of use, attitudes towards use, and perceived usefulness can be said to be very reliable. While the overall attitude of students strongly agrees to use e-learning media in quantum physics learning. However, the linkage between indicators in the TAM model is still very low. This study is only limited to these three variables. Therefore, it is suggested for future studies to include behavioural variables and the system of using E-Learning media.**

Keywords—e-learning media, TAM, quantum physics

I. INTRODUCTION

Many educational institutions use breakthrough-learning processes through information and communication technology. By utilizing internet technology, space and time are no longer a barrier for students to learn. Students through various sources on the internet can obtain learning materials or materials. Changes in conventional learning that prioritize the lecture method have turned into a modern learning material delivery system that prioritizes the role of learners and the use of computer and internet technology. The use of computer and internet technology for education has given birth to new breakthroughs in learning known as E-Learning media. According to Glossry in [1] states that "E-Learning is an education system that uses electronic applications to support teaching and learning using internet media, computer networks, and stand-alone computers".

The use of E-Learning in the world of education in recent years has begun to develop rapidly among students that is applied by educators in almost all subjects, including the science subject. Many previous studies that have been carried out related to the acceptance of E-learning in the learning process, including showing that the use of E-learning in the learning process is more effective [2], the education pattern has shifted from teacher-centred to student-centred [3], there are differences in acceptance. E-learning between men and women [4], and acceptance of E-learning is affected by previous education and gender [5].

Most of the research conducted to determine the acceptance of E-Learning media by students and educators uses the TAM model, namely the technology acceptance model or Technology Acceptance. This model was first introduced by Fred D. Davis [6,7] and was subsequently used and re-developed by several scientists such as Adam et al. [8], Szajna [9], Igbaria and Tan [10], and Venkatesh et.al [11]. The TAM model has developed into a key model in understanding predictors of human behaviour towards potential acceptance or rejection of technology [12]. The TAM model in line with the development of internet technology has been widely used by researchers to assess the acceptance of E-Learning as a learning medium.

The acceptance of E-Learning media technology by students in Indonesia varies, some are accepted positively, and some are negative. Among them, assessing the use of E-Learning students tend to do other things outside the subject [2]. Besides that, it was also found that there was a significant relationship between perceived ease of use, perceived usefulness, attitudes, behaviours towards users and actual use of E-Learning media [13]. Other studies have suggested that system quality, self-confidence in computers and usability of

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computers have a significant impact on the ease of use of E-Learning. In addition, information quality, fun, and ease of access have a positive influence on the ease of use and usability of e-learning systems [14]. Other research results show that E-Learning media has been accepted and widely used for the ease of implementing learning, especially for the development of Moodle E-Learning-based independent modules [15], development of diagnostic exams [16,17], and thematic video development [18].

The use of E-Learning media for teach Science subjects, especially advanced physics, such as Modern Physics, Solid Physics, Material Physics, Quantum Physics, etc. has been widely used. E-Learning-based STEM approach has been used to improve students' high-level skills (HOTS) in the Quantum Physics course [19]. E-Learning media is also used to improve student cognitive activity in the Quantum Physics subject [20]. E-Learning media is used for the implementation of experiments in Quantum Physics learning [21] and virtual laboratory practicum to train metacognitive skills [22] and the use of Jigsaw techniques in E-Learning practical classes in Quantum Physics subject [23].

Based on the research results that have been described in the paragraph above, the conditions of quantum physics learning during the Covid-19 pandemic need to be studied. The study focused on the level of acceptance of E-Learning media by students and lecturers in learning Quantum Physics in the Department of Physical Education, Faculty of Teacher Training and Education, Syiah Kuala University in 2019-2020. The results of this study provide feedback for decision makers or policies in the field of education and learning as one of the three principles of higher education.

II. Research Methods

A. Approach and Types of Research

Research using a quantitative approach, survey methods and research design selected non-experimental type. Research subjects for data collection were students of the Department of Physical Education, Faculty of Teacher Training and Education, Syiah Kuala University. While the object is the acceptance of E-Learning media in the implementation of Quantum Physics learning by students or research subjects.

B. Population and Sample of Research

The study population was all students at the Department of Physics Education, Faculty of Teacher Training and Education, Syiah Kuala University who are currently taking and have attended the Quantum Physics course. While the research sample is all students who are taking or taking Quantum Physics courses in 2019-2020 or in 2017 as many as 27 students.

C. Instrument, Hypothesis and Variable of Research

The research objective was to determine the level of acceptance of E-Learning media in quantum physics learning by students taking quantum physics courses. The instrument used for data collection is the TAM (Technology Acceptance Model) model. This model consists of four measured variables, namely: perceived ease of use, perceived usefulness, attitudes toward use, behavioural intention to use, and actual system use. The four variables are related to each other as shown in Figure 1.

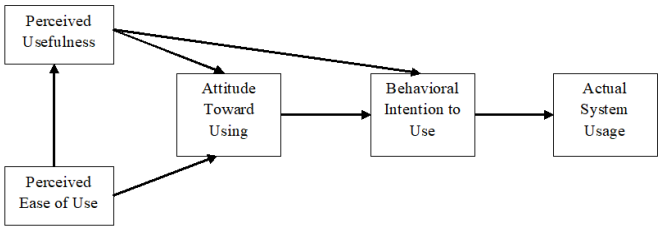

Fig. 1. The chart of the relationship between the TAM variables [6,7].

Practically the research objective is to measure or answer questions (i) what the value of the correlation coefficient between variables is, (ii) what percentage of the contribution between one variable to another variable, and (iii) whether the formulated hypothesis is rejected or accepted. For the convenience of achieving the research objectives, it is necessary to formulate six hypotheses according to the TAM model, namely:

- H_1: Perceived Ease of Use has a positive effect on perceived usefulness in the use of E-Learning in physics education.
- H_2: Perceived Ease of Use has a positive effect on attitudes towards using (Attitude towards Using) E-Learning in physics education.
- H_3: Perceived Usefulness has a positive effect on attitudes towards use (Attitude towards Using) E-Learning in the physics education department.
- H_4: Perceived Usefulness has a positive effect on Behavioural Intention to Use E-Learning in the physics education department.
- H_5: Attitudes towards use (Attitude towards Using) have a positive effect on intention to use behaviour (Behavioural Intention to Use) E-Learning in the physics education department.
- H_6: Behavioural Intention to Use has a positive effect on the actual system usage (Actual System Usage) of the E-Learning media in the physics education department.

In the study, only 3 hypotheses were proven, namely hypotheses (1), (2), and (3). Based on the three hypotheses, several items were adopted according to the indicators of each variable in the TAM model to be used as an instrument or questionnaire for data collection. Therefore, of the 3 variables, namely perceived usefulness (PU), perceived ease of use (PE) and attitude toward using (AU), 9 items were compiled for the

PU variable, 8 items for the PE variable and 11 items for the AU variable.

D. Analysis of Data

The research data were collected using a 4-point Likert scale questionnaire, namely 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agree (A), and 4 = Strongly Agree (SA). Data analysis used the percentage formula used by Halim et.al [24] and the decision based on the analysis results referred to table 1.

TABLE I. CATEGORIES OF RESPONDENT ANSWERS

Scale	Percentage (P)	Category of answer
1.	0 – 25%	Strongly Disagree
2.	26 – 50%	Disagree
3.	51 – 75%	Agree
4.	76 – 100%	Strongly agree

Respondents only tick (√) on a Likert scale (1, 2, 3, 4) on each questionnaire item distributed. Based on the percentage that has been obtained, it is used to find the correlation between the items with the total percentage or known as the corrected item-total correlation. Then based on the percentage is also used for decision making with reference to the category in table 1.

III. RESULTS AND DISCUSSION

A. Validity and Reliability Instrument

Before using the non-test instrument or questionnaire, the validity and reliability tests were conducted on a limited sample. The results of the calculation of the validity test by calculating the correlation coefficient between items and the total or c_{ount} (corrected item-total correlation) are shown in table 2.

TABLE II. THE VALIDITY OF QUESTIONNAIRE ITEMS

No	Statement Items	Corr. Item-total Corr. (r_{hasil})	Cat.
1PE.	I think using the E-Learning system in learning makes learning easy.	0,627	VALID
2PE.	Doing Quiz or assignments through E-Learning media can be anywhere and anytime.	0,786	VALID
3PE.	The procedure for using E-Learning media is one thing	0,712	VALID
4PE.	which is easy to do	0,611	VALID
5PE.	The steps to use Learning are easy and fast	0,410	VALID
6PE.	Understood	0,488	VALID
7PE.	Collecting tasks is easy to do through E-Learning media.	0,761	VALID
8PE.	Resources for reading quantum physics in E-Learning media are complete and easy to open	0,407	VALID
1AU.	Doing quizzes or assignments through e-learning media is easy and can be done anywhere within a certain time	0,519	VALID
2AU.	Watching videos through e-learning media is easy	0,620	VALID
3AU.	I feel happy using E-Learning media	0,793	VALID
4AU.	I feel comfortable using E-Learning media	0,555	VALID
5AU	I often open E-Learning media outside of class hours	0,833	VALID
6AU	I like to do anything related to E-Learning media	0,620	VALID
7AU	I like to acquire new knowledge	0,482	VALID
8AU	in E-Learning media	0,766	VALID
9AU	I like to read about E-Learning media	0,468	VALID
10AU	I can explain why learning using E-Learning media is more fun than learning using a blackboard.	0,662	VALID
11AU	I like to follow Quiz by using E-Learning.	0,573	VALID
12AU	I like watching videos using E-Learning media.	0,440	VALID
1PU	I like to have discussions using E-Learning media.	0,562	VALID
2PU	I often open E-Learning outside of quantum physics lessons.	0,503	VALID
3PU	I like to take reading sources (MS. Word, PDF and PPT) using E-Learning media.	0,623	VALID
4PU	E-Learning media can be used for data collection,	0,843	VALID
5PU	E-Learning media can be used to watch videos.	0,758	VALID
6PU	E-Learning media can be used to do Quiz.	0,489	VALID
7PU	E-Learning media can hold discussions.	0,496	VALID
8PU	E-Learning media can improve IT in learning	0,790	VALID
9PU	E-Learning media can support classroom learning.	0,835	VALID

Based on the data in table 2, 29 items out of three variables for measuring E-Learning media acceptance in quantum physics learning are declared valid with the lowest correlation coefficient between items and total is 0.410 and the highest is 0.843. The average correlation coefficient per variable is 0.591 for the PE variable, 0.619 for the AU variable, and 0.655 for the PU variable.

The reliability test of the questionnaire in this study was carried out using the Cronbach alpha technique. The Cronbach

alpha technique is a technique that provides an accurate, fast, and economical internal consistency index. The instrument is said to meet reliability if the Cronbach alpha value is greater than 0.60. The results of the questionnaire reliability testing are presented in table 3.

Based on table 3, each variable of the TAM model, namely perceived ease of use, user attitudes and perceived usefulness, has met the reliability criteria or has been reliable. This is evidenced by the Cronbach alpha value as a reliability index of the perceived ease of use variable of 0.999, the attitude toward use variable of 0.790 and the perceived usefulness variable of 0.802. Overall, the reliability index obtained was 0.936. The results of the Cronbach alpha calculation show a value greater than 0.60. So, it can be said that the research instrument is reliable.

B. Relationship between Variables

Correlation analysis between variables or constructs needs to be done to know the extent of the relationship between variables (r) and information about how much contribution one variable has to another variable (R2). The calculation results are shown in Figure 2. In the figure, it is shown that each variable of the TAM model has a validity index and a reliability index. The variable PE has a reliability index of 0.99 and a validity index of 0.59 with a very reliable and valid category, the PU variable has a reliability index of 0.80 and a validity index of 0.66 with a very reliable and valid category. The AU variable has a reliability index of 0.79 and a validity index of 0.62 with a very reliable and valid category.

TABLE III. RELIABILITY OF INSTRUMENT

No	Variable	Cronbach Alpha
1.	Perceived Ease Of Use (PE)	0.999
2.	Attitude Toward Using (AU)	0.790
3.	Perceived Usefulness (PU)	0.802

Based on the data in table 3 and Figure 2 it can be understood that the PE (Perceived Ease of Use) variable has a very high level of stability and consistency (0.99) and is also a very influential factor in measuring the acceptance of E-Learning media in quantum physics learning (0.59). The same variable as the PE variable is the PU (Perceived Usefulness) variable, where the consistency and stability of the results are also relatively high (0.80) and a very influential factor in measuring the acceptance of E-Learning media in quantum physics learning. (0.66). The results or outcomes in the study are like the results obtained by Masron [2] and are also the same as the results of Salloun's research [24].

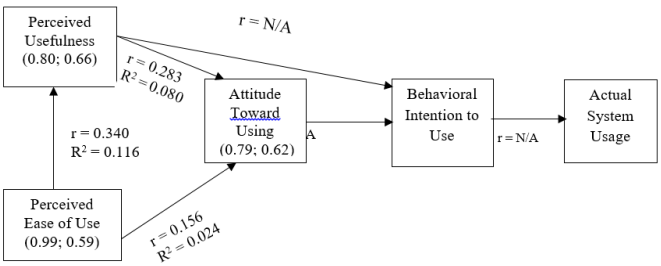

Fig. 2. Correlation coefficient and Cronbach alpha between TAM model variables [6,7].

The relationship or correlation between variables of the acceptance of E-Learning media as a medium for learning quantum physics is generally relatively low, but the relationship is still positive. For example, the correlation between the PE and PU variables is 0.34 with the contribution of the PE variable to PU around 11.6%. Likewise, the correlation between the PU and AU variables is around 0.28 with the contribution of the PU variable in AU around 8%.

Overall, the results of measuring the acceptance of E-Learning media in quantum physics learning have more contribution by sequential variables starting from the perceived usefulness, the attitude of the user, and the perceived ease of use. Meanwhile, behavioural factors and system usage were not included in this study. As evidence that the E-Learning media has been accepted and is often used by lecturers and students in universities in learning Basic Physics and Advanced Physics, including the use of the internet media to train student skills as a provision for facing economic competition in the future [25,26]. In addition, E-Learning media has been used for the development of an integrative E-Learning module with Edu Plaza animation media and PhET simulations [24,27,28] as well as the development of E-Learning based diagnostic tests for identification of conceptions in quantum physics learning [29].

IV. CONCLUSION

Overall, the results of measuring the acceptance of E-Learning media in quantum physics learning are mostly contributed by variables of perceived usefulness, user attitudes, and perceived ease of use. The correlation between variables in the TAM model on the acceptance of E-Learning media as a medium for quantum physics learning is generally low, but the relationship is still positive. This study is only limited to these three variables. Therefore, it is suggested for future studies to include behavioural variables and the system of using E-Learning media.

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