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Technology Acceptance Model: An Analysis of Human-Computer Interaction in The UASBN Educational Game

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Abstract— The *Ujian Akhir Sekolah Berstandar Nasional* (UASBN) educational game is designed as a means of training for students to face school final exams in 6th grade. Before implementing this educational game, it must be tested first related to user acceptance of the technology created or from the human-computer interaction (HCI) side. A total of 173 students tested this educational game, and then data was collected based on the criteria from the Technology Acceptance Model (TAM). The measurement criteria include Perceived Usefulness (TPU) and Perceived Ease of Use (TPE) variables, each of which has aspects of functionality (TFL), accessibility (TAC), and Learning Goal Orientation (TLGO). In contrast, the dependent variable is Behaviour Intention (TBI). The SEM (AMOS) and SPSS statistical packages were used to analyze this HCI evaluation study. A questionnaire with 21 questions was used to collect the necessary data for analysis. The findings of the estimation demonstrate that each component of TAM contributes pretty significantly. In total, user acceptance of the UASBN educational game is a TPE variable contributing 39% to the UASBN human-computer interaction game. Meanwhile, the TPU variable and its variants contributed 73% to the human-computer interaction game UASBN, and Meanwhile, TBI gave a role of 50.4% to the human-computer interaction game UASBN education. This shows that human-computer interaction with educational games through the technology acceptance model criteria contributed 50.4%, while 49.6% was contributed by other variables not raised in this research. This demonstrates that the educational requirements for student gaming training can be satisfactorily met by users and produce favorable outcomes.

Keywords— Educational Game, UASBN, SE, Technology Acceptance Model, TAM, Human-Computer Interaction (HCI)

I. INTRODUCTION

Students' success in the learning process depends on students absorption of the material presented. In a learning process, a value is used as a standard measure to assess how much students understand the learning process. Measures that are used as standards regarding student learning outcomes by giving students questions to work on starting from daily tests, end-of-semester exams, school exams, and so on. The use of technology in education will increase the effectiveness of the learning process to improve the quality of education. Learning continues to develop in various ways, including the methods used in learning, what kind of models are used in learning, and the media used in learning. [1], [2].

Evaluation can encourage students to be active in learning, encourage teachers to improve the quality of the learning process and encourage education managers to improve facilities and the quality of student learning [3], [4]. The importance of evaluation of education, government, through the ministry of education and culture, set a test to measure students' level of understanding with national standards. The development of technology made a breakthrough in 2017; the ministry of education and culture implemented a new system for the national standard graduation exam. The government applies the digitalization method to its exam system so that the distribution of questions becomes faster [5], [6]. Assessment of learning outcomes by the government aims to achieve graduates nationally in certain subjects. Before the joint national school final exam (USBN) was adopted, various strategies were used, beginning with elementary school and continuing through high school. One of these strategies was the tutoring program that schools carried out. No exemptions were made for pupils in grade 6 at *MI Miftahul Ulum* who participated in tutoring sessions that lasted from the time the final bell of the school day rang until 13.00 WIB. The implementation itself does not always run smoothly, and some students experience a decrease in learning motivation because they feel tired because the break time is reduced. According to the homeroom teacher of class 6, *MI Miftahul Ulum*, the extra-long hours and lots of practice questions make students less enthusiastic about learning.

In 2020 the school examination scores for grade VI students had an average score of 7.02 for all subjects, far from the teacher's target score of 8.3. Because it is required for students to be provided with an overview and practice in working on questions, and because increasing student motivation requires the development of new methods to

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engage students' interest in learning, it is necessary to design these new methods. The role of technology presented in this research is in the form of educational games, which are considered to have a special attraction for students to learn [6].

The development of the UASBN educational game application has been carried out in previous research. Educational games are learning media that bridge the educational needs of students with technology. Acceptance of students as users of educational games is an integral part of the technology implementation stage. Evaluation of technology acceptance is part of human-computer interaction (HCI) [7].

II. Research Methodology

In this research, HCI testing will be carried out based on the Technology Acceptance Model (TAM) characteristics. The research model based on HCI with TAM can be seen in Figure 3.

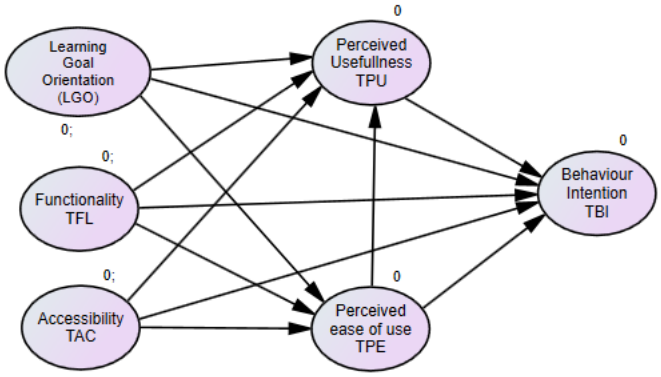

Figure 3. Research Model with TAM

The variables that will be measured in this study are taken in part by TAM, which can be seen in Table I. The research variables include aspects of Perceived Usefulness (TPU) and aspects of Perceived Ease of Use (TPE), where each has indicators of Learning Goal Orientation (LGO), functionality (TFL), and accessibility (TAC), which are connected to the dependent variable Behaviour Intention (TBI). The variables that were considered in this investigation are listed in Table I. There are four indications for the TFL variable, three indicators for the TAC variable, three indicators for the TCP variable, three indicators for the TPU variable, three indicators for the TPE variable, three indicators for the TPE variable, and three indicators for the TBI variable. In this investigation, one question is represented by each sign.

Table I
Variable and Indicator of TAM

Variable	Symbol	Variables measured in questions
Functionality (TFL)	FL1	The UASBN educational game responds quite quickly
	FL2	The UASBN educational game provides enough features that I need
	FL3	The UASBN educational game allows me to access the content I need
	FL4	Overall, the UASBN educational Game feature allows me to achieve my learning goals
Accessibility (TAC)	A1	The UASBN educational game allows quick access to information
	A2	The UASBN educational game makes information very accessible
	A3	The UASBN educational game makes information easily accessible
Learning Goal Orientation (TLGO)	LGO1	I am willing to take on more challenging study assignments where I can learn more.
	LGO2	I often look for opportunities to develop new skills and knowledge
	LGO3	I enjoy challenging and difficult study assignments
	LGO4	For me, developing my learning ability is important enough to take risks
	LGO5	I am willing to take on more challenging study assignments where I can learn more.
Perceived Usefulness (TPU)	PU1	Using UASBN educational games can improve my learning performance
	PU2	Using the UASBN educational game makes my learning more effective
	PU3	I found UASBN educational game useful for me
Perceived Ease of Use (TPE)	PE1	Learning how to use the UASBN educational Game is easy for me
	PE2	I found the UASBN educational Game easy to use
	PE3	It is very easy to become skilled in using UASBN educational game
Behavioural Intention (TBI)	BI1	I intend to increase the use of my UASBN educational game in the future
	BI2	I intend to use the UASBN educational game in the future
	BI3	For future studies, I will use the UASBN App

Source: TAM questionnaire [8]

This study is an evaluation study assessing the results of the development of the UASBN educational game. The development of the UASBN game application has been carried out and implemented for elementary school students. This research was used to determine the feedback/response of students to educational games, which were analyzed and modeled using SEM (AMOS) version 22 [9]–[11]. The implementation of educational games was carried out on 173 sixth-grade elementary school students in 3 schools. Modeling and research indicators use the framework of the Technology Acceptance Model (TAM) [11]–[13] by taking several indicators that follow research needs. In Figure 4, the flow of the stages of research development is divided into six steps:

1) Literature Study: At this point in the process, we will be conducting a review and summary of the prior research on the creation of the UASBN game application. In addition, the review will involve a critical analysis of the existing technology acceptance model to bring up the limitations and problems of the research.

2) Problem definition: The research will clearly define the research problem and how the study is planned to address this problem.

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3) Model and Hypothesis Development: This study will develop a new technology acceptance model to test student acceptance of the UASBN game application. The methods and considerations for identifying external variables for the research model will be explained at this stage. In addition, research hypotheses will be proposed for each variable because it will regulate the relationship between external variables.

4) Data collection: Data will be collected to test the research model; data collection tools will be developed and checked for reliability.

5) Analysis: at this stage, the data will be processed using SEM AMOS.

6) Model testing and evaluation: At this stage, the analysis results will be used to test the developed model and evaluate if deficiencies exist in the UASBN Game application system.

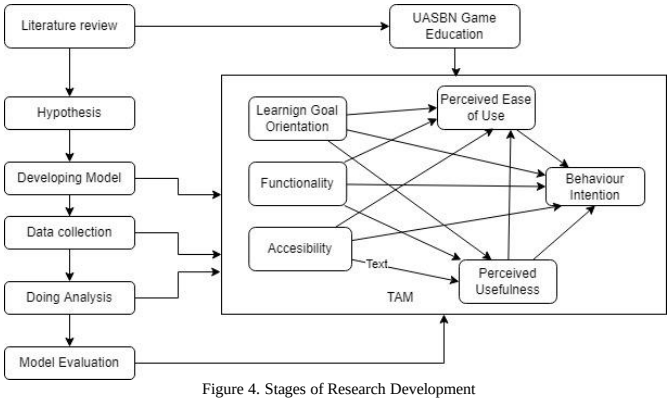

Figure 4. Stages of Research Development

III. Result and Discussion

The research framework that has been compiled is then modeled using SEM when the modeling has been completed (IBM-AMOS) [9], [14]. Data from 173 students who have been obtained are then entered into the IBM-SPSS. The data in SPSS then linked to IBM-AMOS.

The UASBN instructional game level is demonstrated in Figure 1, for example. The action that takes place in the game is depicted in figure 2. This instructional game by UASBN is a role-playing game (RPG). This educational game needs to go through some evaluation and improvement processes before it can be made available to a wider audience.

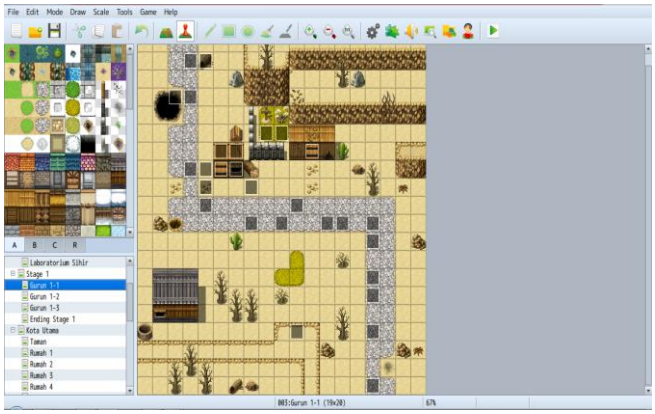

Figure 1. The UASBN Educational Game

Figure 2. Game Run and Checkpoint

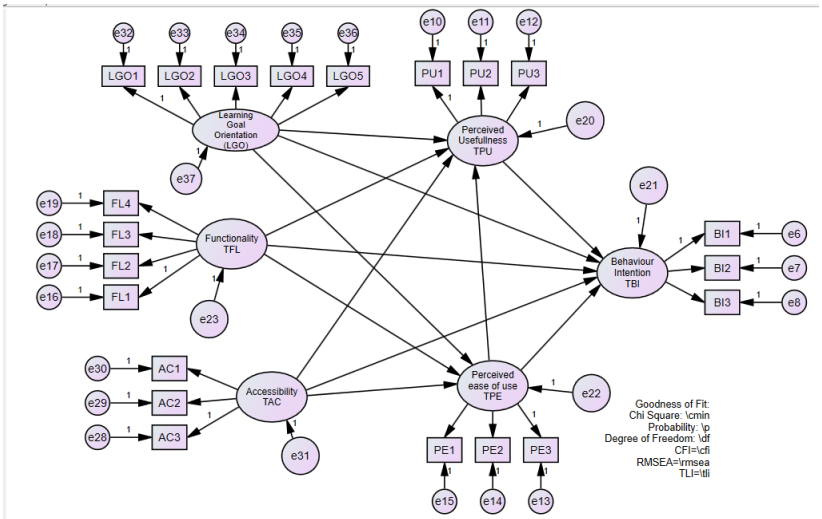

Figure 5. Design Model Using AMOS

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The modeling using IBM AMOS. After the data is complete and connected to the research model presented in Figure 5. The data is calculated and estimated, scalar estimate (S.E.), and critical ratio (C.R.) to produce standardized values, as shown in Figure 6. Based on Figure 6, the standard coefficient value of the model is obtained. The estimation results from Figure 2 can be seen in Table II. It should be noted that the coefficient value of the *P* column must be below 0.05 so that the model can be said to be Fit / Valid. Based on Table II, it is known that the significant value in column (P) there is one relation value whose magnitude is more than 0.05, namely TBI<-TAC, which is 0.445>0.05, and TBI<-TPE (0.178>0.05). This indicates that the model is still not fit or cannot be analyzed. The model must be changed by removing the relation line between TBI<-TAC and then recalculating. So, the model changes, as shown in Figure 7.

TABLE II
REGRESSION WEIGHT

	Estimate	S.E.	C.R.	P	Label
TPE<-TFL	,733	,155	4,736	***	par_14
TPE<-TAC	,175	,062	2,826	,005	par_15
TPE<-TLGO	,467	,142	3,287	,001	par_22
TPU<-TAC	,219	,055	4,008	***	par_10
TPU<-TPE	,672	,117	5,720	***	par_16
TPU<-TFL	-,231	,126	-1,836	,066	par_23
TPU<-TLGO	,378	,124	3,058	,002	par_26
TBI<-TPU	,486	,222	2,187	,029	par_13
TBI<-TLGO	,484	,154	3,153	,002	par_21
TBI<TFL	,402	,154	2,610	,009	par_24
TBI<-TAC	-,054	,071	-,764	,445	par_25
TBI<-TPE	-,270	,200	-1,346	,178	par_27

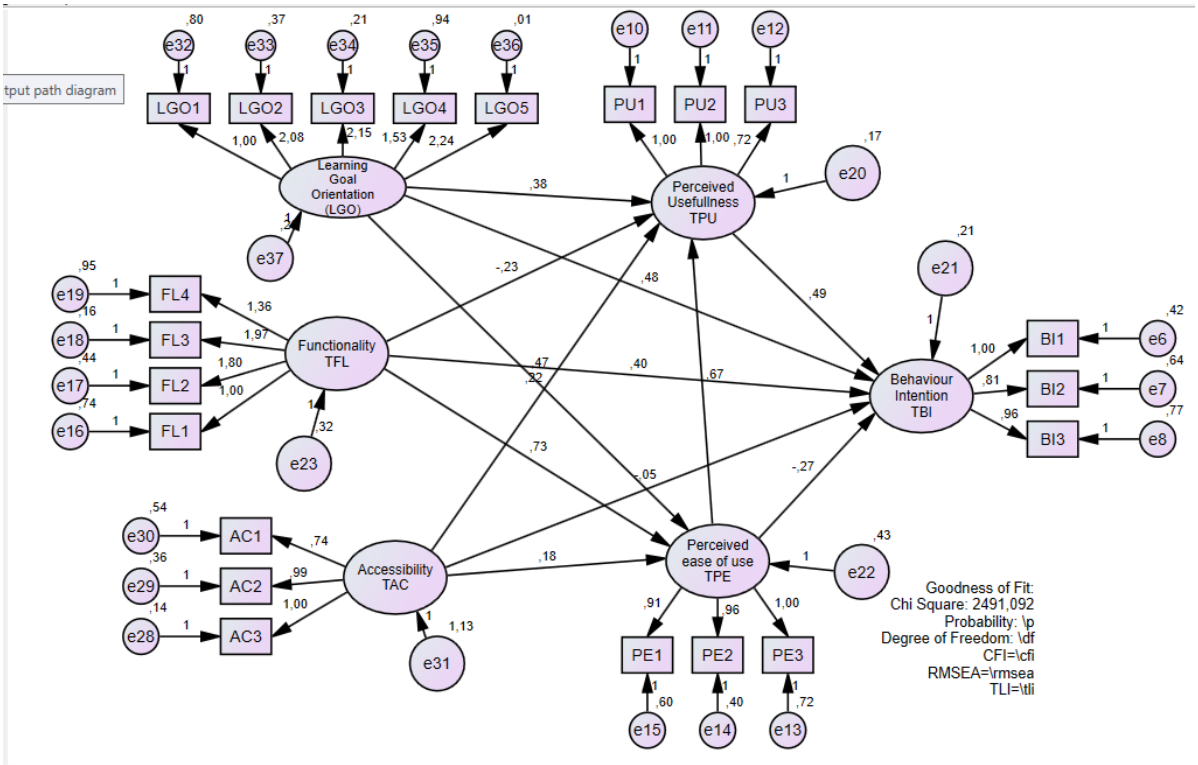

Figure 6. Model calculation results

The model in Figure 7 is then calculated and produces an estimate, scalar estimate (S.E.), and critical ratio (C.R.), as shown in Table III. Based on the estimation results in Table III, it is found that a significant value in column (P) still has a value of more than 0.05, namely TBI<-TPE 0.218>0.05 and TPU<-TFL is the value 0.105>0.05. Therefore, the model needs to be modified by eliminating the relation line connecting TBI<-TPE.

TABLE III
REGRESSION WEIGHT MODEL REVISION

	Estimate	S.E.	C.R.	P	Label
TPE<-TFL	,739	,155	4,758	***	par_14
TPE<-TAC	,177	,062	2,871	,004	par_15
TPE<-TLGO	,460	,141	3,251	,001	par_22
TPU<-TAC	,211	,054	3,907	***	par_10
TPU<-TPE	,668	,117	5,685	***	par_16
TPU<-TFL	-,204	,125	-1,623	,105	par_23
TPU<-TLGO	,358	,122	2,924	,003	par_25
TBI<-TPU	,401	,169	2,375	,018	par_13
TBI<-TLGO	,538	,145	3,699	***	par_21
TBI<-TFL	,340	,145	2,345	,019	par_24
TBI<-TPE	-,217	,176	-1,232	,218	par_26

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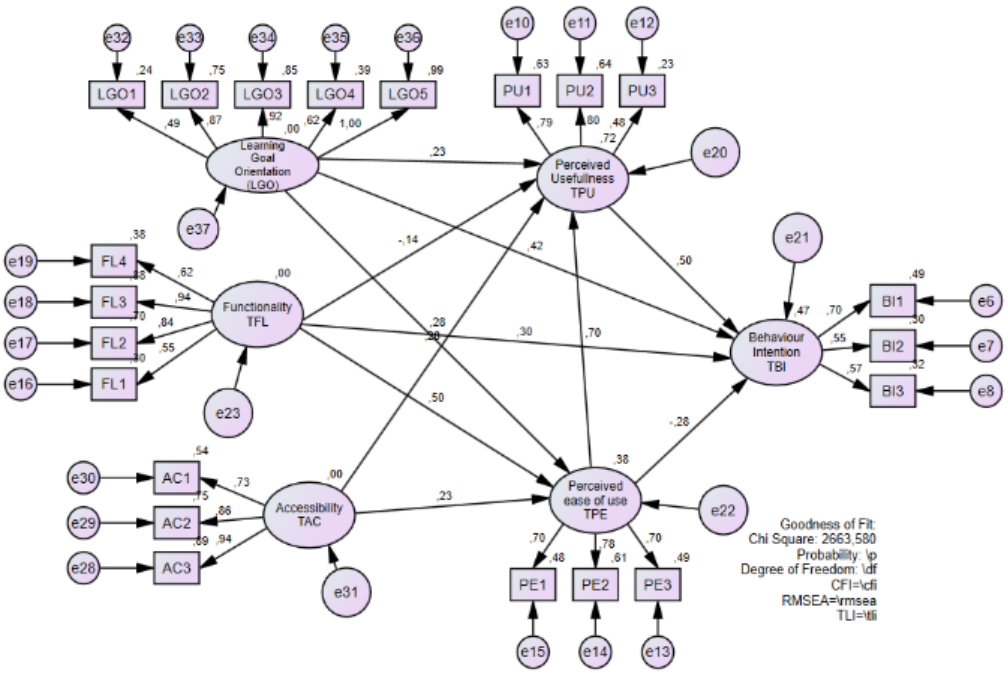

Figure 7. Revision Model 1

After several calculations, several lines must be removed again to obtain the final model, as shown in Figure 8. The lines/ relationships that are omitted are TPU<-TLGO, TBI<-TFL, and TPU<-TFL because the coefficients of the estimated value/significance of the three are still above 0,05 (Table III, see P column). Following the elimination of several relationship lines, the findings that provide the best possible fit are achieved, as shown in Figure 8. The estimations and significance levels for each variable and indicator are all lower than 0.05, as demonstrated by the calculation results presented in Table IV that correspond to Figure 8. It is possible to conclude that the relationship between the six variables is accurate and reliable and satisfies the criteria necessary for interpretation. The *** sign means the significance value is 0.00 or has been fit.

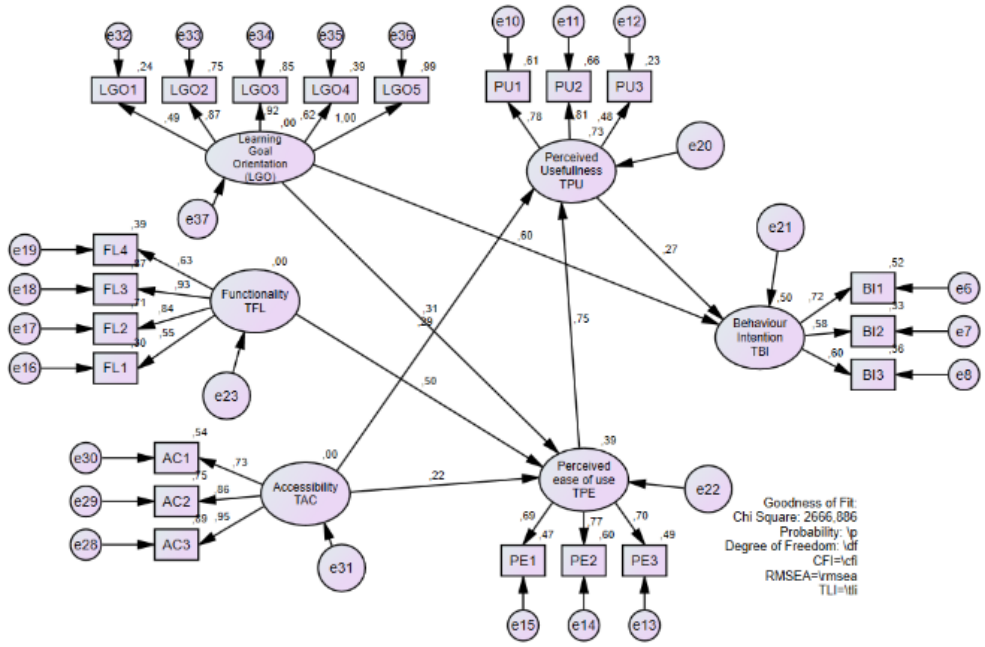

Figure 8. Model Fit

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TABLE IV
REGRESSION WEIGHT MODEL FIT

	Estimate	S.E.	C.R.	P	Label
TPE<-TFL	,723	,150	4,821	***	par_14
TPE<-TAC	,167	,061	2,729	,006	par_15
TPE<-TLGO	,505	,141	3,592	***	par_21
TPU<-TAC	,211	,053	4,000	***	par_10
TPU<-TPE	,712	,100	7,133	***	par_22
TBI<-TPU	,230	,077	2,998	,003	par_13
TBI<-TLGO	,805	,161	5,012	***	par_20

After knowing that the model is fit/valid (Table IV, see P column), the influence of the relationship between each variable/role of each variable can be seen. The total effect on each variable can be seen in Table V. The magnitude of the effect on each variable shows its effect on the dependent variable, namely behavior intention/behavioral intention of UASBN educational game users.

TABLE V
TOTAL EFFECTS-ESTIMATES

	TLGO.	TAC	TFL	TPE	TPU	TBI	AVG
TPE	0,505	0,167	0,723	0	0	0	0,465
TPU	0,359	0,329	0,515	0,712	0	0	0,479
TBI	0,887	0,076	0,118	0,163	0,23	0	

Based on Table V, the total effect (direct and indirect) of TLGO on TBI is 0.887. The direct (unmediated) and indirect (mediated) effects of TLGO on TBI showed that if TLGO increased by 1, TBI also increased by 0.887. TAC's total effect (direct and indirect) on TBI was 0.076. TAC's direct and indirect effects on TBI showed that if the TAC increased by 1, TBI also increased by 0.076. In comparison, the total effect (direct and indirect) of TFL on TBI is 0.118. The direct and indirect effects of TFL on TBI show that if the TFL increases by 1, TBI also increases by 0.076.

In comparison, TPE's total effect (direct and indirect) on TBI is 0.23. TPE's direct and indirect effects on TBI show that if the TPE increases by 1, TBI also increases by 0.23. In comparison, the total effect (direct and indirect) of TPU on TBI is 0.23. The direct and indirect effects of TPU on TBI show that if the TPU increases by 1, TBI also increases by 0.23.

Table V also shows that the average effect of TPE on TBI is 0.465 or 46.5%. Meanwhile, the effect of TPU on TBI is 0.479 or 47.9%. In comparison, the remaining 5.6% is influenced by other variables that do not exist in this study. Based on the results of the analysis, it can be said that the level of acceptance of UASBN educational game users is (46.5% +47.9%) = 94.4%. These results indicate that the UASBN educational game received a positive response from users from the perceived ease of use (TPE) and perceived usefulness (TPU) categories. Although directly the relationship between TPE and TBI is not established, the relationship is well connected through other supporting variables.[12], [15]–[18].

TABLE VI
SQUARED MULTIPLE CORRELATION

	Estimate
TPE	,390
TPU	,730
TBI	,504

Based on Table VI, it is known that the role of the TPE variable contributes 39% to the UASBN human-computer interaction game. Meanwhile, the TPU variable and its variants contributed 73% to the human-computer interaction game UASBN. Meanwhile, TBI gives a role of 50.4% to the human-computer interaction game UASBN education. This shows that human-computer interaction educational games through the technology acceptance model criteria contributed 50.4% while 49.6% was contributed by other variables that were not raised in this research.

IV. CONCLUSION

The use of the UASBN educational game for class XI elementary school students is quite good. Viewed from the functional (TFL) side, this variable contributes 0,118 points to the user's behavior intention, which is quite good in supporting learning. The accessibility aspect gives a role of 0,76 points. The learning goal orientation aspect of this variable contributed the most, namely, 0,886 points to the behavior intention to use the UASBN educational game in daily learning. This indicates that user acceptance based on the Technology Acceptance Model in learning goals is the best result in this model. For this educational game to be used and for its content to be expanded further following the education requirements, TPE is a variable that contributes 39% to the UASBN human-computer interaction game, and user acceptability of the UASBN educational game is one of those variables.

Meanwhile, the TPU variable and its variants contributed 73% to the human-computer interaction game UASBN, and Meanwhile, TBI gave a role of 50.4% to the human-computer interaction game UASBN education. This shows that human-computer interaction educational games through the technology acceptance model criteria contributed 50.4% while 49.6% was contributed by other variables not raised in this research. This shows that the learning needs for student game training can be well received by users and show positive results.

The results of this evaluation are needed as material for consideration in developing further educational games. The suggestions for developing UASBN educational games are to be used more widely by adding more questions or story scenarios that are more attractive. Development can also be done by integrating other thematic subjects into educational games [16]–[18].

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