Investigation of Adoption of Smartphone Technology for Learning

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Abstract—**In this study, we will investigate the adoption of smartphones for learning. The 160 respondents are fulfill the questionnaires to test the proposed model. UTAUT and ECM (Expectation-Confirmation Model) models was employed to predict the Behavioral Intention. The findings reveal that Social Influence, Innovativeness, Effort Expectancy, Performance Expectancy, Perceived Performance, Satisfaction, and Behavioral Intention have significantly relation to each other. Surprisingly, the Performance Expectancy is the main variable on the adoption of smartphone technology for learning and Perceived Performance is variable determining the user can satisfy in using smartphone technology for learning. Behavioral variables naming Age and Experience have important role in the relationship of variables in the study. The older and experienced users of smartphone for learning have highly concern with performance of smartphone and more satisfy with their learning application on smartphone.**

Keywords— Adoption, Technology, Smartphone, Learning

I. INTRODUCTION

The smartphone users in Indonesia increased every years. On 2016 the smartphone users was 65.2 million, they increase to 74.9 million on 2017 and 83.5 million on 2018 and they was predicted up to 92 million [1]. Similarly, the adoption of smartphone for learning in Indonesia was increased. According to [2] Indonesian students who use smartphones to do their homework are 81%, they who use smartphones during their lessons are 67%, and they who study Computer Science are 39%. Some special applications used by students for learning in Indonesia are "Ruang Guru" and "Ruang Belajar".

The studies of technology adoption in general has been widely investigated by Harnadi [3], Chen [4], Hamidi and Chavoshi [5], Alalwan et al [6], and Venkatesh et al [7]. The specific study on technology adoption also investigated on smartphone usage for learning [4], [3], [8], [9], and [10]. The related study on e-learning has also been investigated by Tarhini et al [11], Chow and Shi [12], Al-Adwan et al [13], and Prieto et al [14]. This study is based on the UTAUT conducted by Venkatesh et al [7] and ECM model conducted by Ghan and Akkoyunlu [10] and Chow and Shi [12].

The UTAUT model employed variables naming Social Influence, Performance Expectancy, Export Expectancy, Facilitating Conditions, Hedonic motivation, Price Value and Habit, whereas in the ECM Model employed Satisfaction as confirmation variable prior to the Behavioral Intention. All variables such as Perceived Value, Expectations Outcome, Confirmation, Utilitarian Value, Information Quality, System Quality and Service Quality have direct effect on Satisfaction.

This Study have purposed to investigate adoption of smartphone technology for learning employing UTAUT and ECM model. The study examines the behavioral variables such as experience and age regard to theirs relationship to others variables in the proposed model. The relationship will test using Pearson Correlation to establish the statistically significant correlation among variable.

II. PROPOSED MODEL AND HYPOTHESIS

Reviewing several related literature on adoption of e-learning, mobile learning, and adoption technology in general for six years are discussed to obtain the proposed model.

A. Social Influence and Innovativeness on Behavioural Intension

Social Influence is "the extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology" [11]. Innovativeness means "the willingness of an individual to accept innovation earlier than others in terms of a certain product, technology, lifestyle, or consumption pattern" [8].

The study conducted by Akbar [16], Venkatesh et al [7] reveal that Social Influence was strong variable to predict Behavioral Intention to use technology. Social Influence also verified as strong predictor to e-learning adoption [11].

Research conducted by Kim et al [8] and Alalwan et al [6] shows that Innovativeness variables correlate with Behavioral Intention to use technology and e-learning. So as, we proposed: *Social Influence will have a significant correlation on Behavioral Intention (H1) and Innovativeness will have a significant correlation on Behavioral Intention (H2).*

B. Performance Expectancy and Effort Expectancy on Behavioural Intention

Performance Expectancy is defined as "the degree to which using a technology will provide benefits to consumers in performing certain activities" [11]. Effort Expectancy "is the degree of ease associated with consumers' use of technology" [11]. Behavioral Intention the extent to which the user intends to use smartphone for learning in the future

The study conducted by Alalwan et al [6], Joo and Sang [9], Ing and Degoulet [15], Akbar [16], and Venkatesh at al [7] reveal that Performance Expectancy was strong variable to predict Behavioral Intention to use technology. Variable Performance Expectancy also verified as strong predictor to e-learning adoption [5], [11], [13].

Research conducted by Hamidi and Chavoshi [5], Alalwan et al [6], Venkatesh et al [7], Joo and Sang [9], Tarhini et al [11], and Akbar [16] shows that Effort

Expectancy variables correlate with Behavioral Intention to use technology and e-learning. So as, we proposed: *Effort Expectancy will have a significant correlation on Behavioral Intention (H3) and Performance Expectancy will have a significant correlation on Behavioral Intention (H4a).*

C. Performance Expectancy and Perceived Performance on Satisfaction

Perceived Performance is "a key performance index in mobile communication and an important antecedent to satisfaction"[10].

Satisfaction is ''the affective attitude towards a particular computer application by an end user who interacts with the application directly'' [17].

Research conducted by Guao et al [18], Oghuma et al [17], Ghan and Akkoyunlu [10] shows a strong relationship between variable Performance Expectancy and Satisfaction in the use of technology and also in e-learning. While the research conducted by Oghuma et al [17] and Ghan and Akkoyunlu [10] also shows a strong relationship between Perceived Performance variables, especially the Perceived Service Quality with Satisfaction variables. So as, we proposed: *Performance Expectancy will have a significant correlation on Satisfaction (H4b) and Perceived Performance will have a significant correlation on Satisfaction (H5).*

D. Satisfaction on Behavioural Intension

The study conducted by Ing and Degoulet [15], Guoa et al [19], Oghuma et al [17] reveal that Performance Expectancy was strong variable to predict Behavioral Intention to use technology. Variable Performance Expectancy also verified as strong predictor to e-learning adoption [18], [12], [10]. So as, we proposed: *Satisfaction will have a significant correlation on Behavioral Intention (H6).*

The Proposed model employed Social Influence, Effort Expectancy, Innovativeness, and Performance Expectancy to have direct effect on Behavioral Intention and employed Perceived Performance and Performance Expectancy to have direct effect on Satisfaction and Satisfaction have direct effect on Behavioral Intention. The proposed model can be look at Fig.1.

III. METHODOLOGY

This study used data from 160 respondents from students on Senior High School and College/University in Semarang, Indonesia. This data was examined using statistical techniques using SPPS software after passing the data preparation stage.

The variables employing in the model was tested using validity and reliability tests. The correlations analysis of the variables naming Social Influence, Innovativeness, Effort Expectancy, Performance Expectancy, Perceived Performance, Satisfaction, and Behavioral Intension are done by the Pearson correlation analysis. The last causal effect analysis using AMOS-SPSS was done to get the finding on the adoption of smartphone technology for learning.

IV. DATA ANALYSIS

A. Demographic of Respondents

The data used in this study were 160 students consisting of 115 male and 45 female. The 160 students were categorized into 70 students of Z generation (15-19 years old) and 90 student of Y generation (20-25 years).
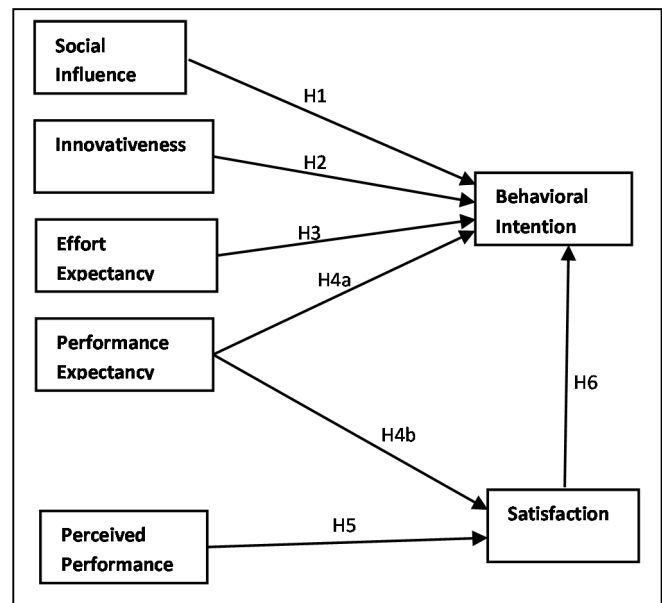

Fig. 1. Model of Research

The distribution of the experience in using smartphone for learning is described follows: 12 students have experience less than or equal to 1 year, 17 students have experience more than 1 year and less than or equal to 2 years, 21 students have experience more than 2 year and less than or equal to 3 years, and 110 students have experience more than or equal to 4 years.

B. Validity Test of Variables

The results of the validity test of variables was shown on Table I. The table shows that all indicators grouped in certain it's variable column is convergent and valid.

TABLE I. VALIDITY TEST OF VARIABLES

	Component				
	PP-SI	*I*	*SI*	*EE-PE*	*In*
SI1	-.012	.261	.772	.049	.152
SI2	.146	.145	.823	.125	.056
SI3	.046	.196	.480	.297	.055
In1	.073	.075	.096	-.003	.799
In3	-.061	.036	.007	.110	.821
EE1	.183	.057	-.007	.793	.233
EE2	.298	-.002	.127	.602	.483
EE3	.356	.128	.266	.507	.437
PE1	.099	.397	.312	.637	-.123
PE2	.095	.521	.294	.431	.030
PE3	.258	.354	.344	.502	-.018
PP3	.454	.112	.441	.132	.279
PP4	.587	.133	.405	.138	.109
PP5	.612	.101	.410	.286	.062
S1	.799	.064	.042	.166	.137
S2	.712	.237	.013	.209	.137
S3	.706	.323	.021	.204	-.106
I1	.237	.774	.166	-.016	.213
I2	.105	.826	.195	.148	.134
I3	.149	.819	.175	.214	-.042

C. Reliability Test of Variables

Variable reliability test using Cronbach alpha analysis, the result can be look at Table II.

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TABLE II. RESULT TEST RELIABITY

Variable	Cronbach's Alpha	Comment
SI	.709	Acceptable
In	.652	Questionable
EE	.791	Acceptable
PE	.770	Acceptable
PP	.772	Acceptable
S	.795	Acceptable
I	.843	Good

The results of the test reliability variable indicate that the variable Social Influence, Effort Expectancy, Performance Expectancy, Perceived Performance, and Satisfaction are "Acceptable" meaning that the reliability is acceptable. For the Behavioral Intention reliability variable "Good" means Good, while the Innovativeness variable is "Questionable" which means it is feasible in the questionnaire.

D. Correlation Analysis of Variables

Correlation Analysis using Pearson correlation can be look at Table III.

TABLE III. RESULT TEST CORRELATION VARIABLE

	Age	Edu	Exp	RSI	RIn	REE	RPE	RPP	RS	RI
Age	1	.172*	.069	-.073	.172*	-.018	-.096	.156*	.175*	.001
Edu	.172*	1	.187*	.062	-.037	-.004	-.079	.040	.029	.029
Exp	.069	.187*	1	.182*	-.009	.177*	.229**	.160*	.226**	.133
RSI	-.073	.062	.182*	1	.198*	.382**	.524**	.479**	.299**	.464**
RIn	.172*	-.037	-.009	.198*	1	.415**	.111	.217**	.130	.157*
REE	-.018	-.004	.177*	.382**	.415**	1	.544**	.551**	.503**	.346**
RPE	-.096	-.079	.229**	.524**	.111	.544**	1	.531**	.437**	.607**
RPP	.156*	.040	.160*	.479**	.217**	.551**	.531**	1	.564**	.437**
RS	.175*	.029	.226**	.299**	.130	.503**	.437**	.564**	1	.409**
RI	.001	.029	.133	.464**	.157*	.346**	.607**	.437**	.409**	1

The test results show that all variables are Social Influence, Innovativeness, Effort Expectancy, Performance Expectancy, Perceived Performance, and Satisfaction correlate with Behavioral Intention variables according to hypothesis 1 to 6.

E. Causal Effect Analysis

The causal effect analysis of model was done by AMOS-SPSS and the result was shown on Figure 2. According to the Figure, the statistically significant direct effects were only on the relation of Performance Expectancy on Behavioral Intention and Perceived Performance on Satisfaction. The other relations were not statistically significant.

V. FINDING AND DISCUSSION

From correlation analysis, the variables Social Influence, Innovativeness, Effort Expectancy, Performance Expectancy, Perceived Performance, and Satisfaction have significantly correlation to Behavioral Intention. It is surprisingly that the variables Innovativeness, and Perceived Performance, and Satisfaction coming from ECM model are significant.

The user experience in using smartphone for learning is the important behavioral variable in the relation to other variables except to Age, Innovativeness and Behavioral Intention. It means that users of smartphone for learning with high experience are more influence with their friends and

family, perceive more ease in using smartphone, more helped in take personal gain, have high concern with performance of smartphone, and more satisfy with their learning application on smartphone.
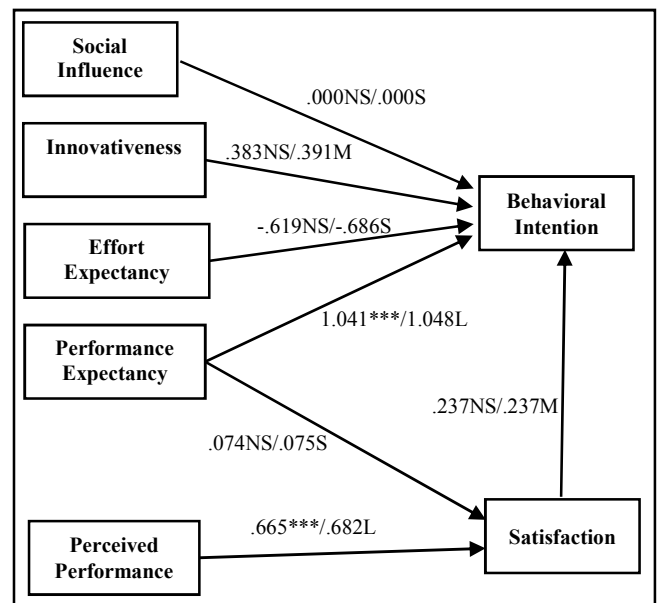

Fig. 2. The Result of Causal Effect Analysis of the model

All of variables (Social Influence, Innovativeness, Effort Expectancy, Performance Expectancy, Perceived Performance, Satisfaction, and Behavioral Intention) are significant correlate to each other. The age ranges of users are on 14 – 25 years old. The Age variable is significant correlation to Innovativeness, Perceived Performance, and Satisfaction. It means that the older users of smartphone for learning are more innovative, have highly concern with performance of smartphone, and more satisfy with their learning application on smartphone.

This study reveals that two behavioral variable naming Age and Experience have significantly correlation with perceive performance and Satisfaction. It means that older and experienced users of smartphone for learning have highly concern with performance of smartphone and more satisfy with their learning application on smartphone.

Based on correlation and causal effect analysis, the hypotheses H1, H2, H3, H4a, and H6 are partially support. Only two hypotheses H4b and H5 are fully support. It means that Performance Expectancy is main variable deciding the adoption of smartphone technology for learning and Perceived Performance is variable determining the users satisfy to smartphone technology.

The findings shows that the variables employed in this study and behavioral variable including Age and Experience have an importance role in supporting the adoption of smartphone for learning.

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