Influence of Technology Readiness and Flow Theory toward the Acceptance of Augmented Reality among Students in Private University in Jakarta, Indonesia

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***Abstract*—Augmented Reality has recently gained popularity in the sphere of education. Unfortunately, most augmented reality research in private university in Indonesia is focused solely on software development. This will affect how ready and willing the student is to implement augmented reality. This research investigated the impact of readiness attitude and flow theory on augmented reality acceptance in a private university in Jakarta, Indonesia. This research was founded upon the Technology Acceptance Model and modified by adding the technology readiness index and flow to measure the influence of the readiness and the motivation among students' acceptance of augmented reality technology. A quantitative methodology utilizing online questionnaire for data collection was designed to capture a wide range of responses efficiently, allowing for comprehensive analysis using SmartPLS3 by employing purposive sampling with 602 student respondents located in Jakarta. The results show that in terms of Technology Readiness, two variables, Innovativeness toward Perceived Usefulness ($t = 5$, $p = 0$) and Perceived Ease of Use ($t = 3.613$, $p = 0$) Insecurity toward Perceived Usefulness ($t = 9.9$, $p = 0$) and Perceived Ease of Use ($t = 10.298$, $p = 0$)) are accepted and two variables Optimism toward Perceived Usefulness ($t = 0.475$, $p = 0.635$) and Perceived Ease of Use ($t = 0.260$, $p = 0.795$), Discomfort toward Perceived Usefulness ($t = 0.050$, $p = 0.960$) are rejected; In terms of Flow Theory and Technology Acceptance, all items were accepted. It is concluded that students are ready and accept augmented reality and showed no significant issues. However, there remains a lack of optimism among students regarding the feasibility of implementing AR and its benefits in classroom.**

***Keywords*—technology acceptance, technology readiness, flow theory, augmented reality, private university**

I. INTRODUCTION

Augmented reality is a rapidly developing technology that is becoming increasingly prevalent in the current setting [1, 2]. It creates an optical illusion that enables the virtual model to appear elevated in the actual environment. Due to the significant increase in cell phone usage and advancements in search engines, augmented reality technology is poised to become one of the most revolutionary of the current decade. In Indonesia, the focus of augmented reality research is primarily on application development [3, 4]. This is because technology in the country is still in its early stages, particularly in higher education.

Augmented reality (AR) has been utilized to enhance learning experiences within educational contexts. Various forms of multimedia, including text, photos, videos, and music, can be overlaid in a learner's real-time environment. When viewed through an AR device, this technology provides learners with multimedia information. Related work on the use of AR in education [5], highlighted the use of Google Glass with AR, which can potentially replace traditional classrooms. AR adds extra elements for students to explore their real-world surroundings. Additionally, AR technology has been extensively applied in physical education training in schools, demonstrating significant improvements in teaching physical education to children through its implementation [6].

Insufficient study has been conducted on the development of augmented reality (AR) in online learning settings. Consequently, it is still being determined whether this technology will influence student utilization, affecting their learning motivation to learn. A previous study investigated the impact of students' technological preparedness level has on their ability to learn independently [7]. Their findings indicate that students with inferior technology readiness also exhibit lower levels of independence, limiting their educational progress [8]. Hence, the development of AR applications without considering the student's level of readiness and willingness to accept can result in a dearth of utilization of the installed technology and a loss of motivation in learning [9, 10]. Online learning has been prevalent for a significant period and has mostly been employed to improve the educational experience for students, where motivation has a substantial impact on learners' determination to successfully complete a course [11]. However, traditional education may not equip students with the necessary skills to maintain a high level of motivation in online learning. Online learning offers students greater flexibility in scheduling, geographical location, and pace of learning. Flow Theory (FT) is employed as a method for assessing student motivation, specifically by considering the degree of Optimism (OPT), the degree of Innovativeness (INN), the degree of Discomfort (DIS), and the degree Insecurity (INS) [12]. An essential element of online learning is cultivating students' motivation and enjoyment in their studies [13, 14].

Prior studies have demonstrated that student disengagement in online courses is mainly associated with two primary factors: inadequate time and inadequate motivation [11]. Encouraging the desire to gain knowledge is crucial in supporting successful teaching methods [15]. Moreover, researchers have hypothesized that students with greater of study motivation may face reduced likelihood of

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success in online educational environments [16, 17]. Moreover, it is crucial to evaluate the degree of readiness and acceptance of students utilizing this technology.

Previous research has investigated the elements that affect the intention of students to adopt augmented reality in higher educational institutions. This investigation utilizes the Technology Acceptance Model (TAM) [18]. Research that examined the variables related to augmented reality in the educational learning system using the TAM model [19].

The study investigates the adoption of augmented reality by students in higher education institutions. Using statistical techniques like Pearson's correlation coefficient and structural equation modeling, the results demonstrate the internal consistency of various variables related to technology acceptance. Consequently, the TAM model for AR in higher education proves suitable for understanding the technology's acceptability and predicting users' future intentions to use it.

This research aimed to measure the impact of the readiness and flow theory on augmented reality acceptability among students at Jakarta's higher education institutions. The Technology Acceptance approach (TAM) is a foundational approach for investigating the variables affecting users' intentions to adopt augmented reality. In this study, TAM model is utilized to assess the degree of acceptance among users towards implementing a technology. These two models can be integrated to concurrently evaluate a user's preparedness and acceptance of a novel technology. In addition, the model incorporates Flow Theory (FT) [20] to examine students' motivation when utilizing augmented reality technology, taking into account characteristics such as Enjoyment (ENJ), Concentration (CN), and Control (CTRL).

This research utilizes a quantitative analysis approach, beginning with an examination of technological readiness, technology acceptance, and flow theory based on the conceptual model using SmartPLS3. The study aims to delve into the Technology Readiness Index (TRI) and Flow Theory (FT) for deeper insights and to uncover new information. Data is collected via an online questionnaire from students at higher education institutions in Jakarta.

A. Problem Statement

Previous studies have determined that neglecting technology preparation has a direct impact on academic performance, leading to a decrease in overall achievement [21].

The lack of technological skills and competencies among students impedes their effective use of digital learning materials and resources [22].

This can lead to lower academic performance, diminished understanding of the subject matter, and a weakened educational experience. Insufficient technological literacy may disadvantage students in courses that rely heavily on digital technologies and online resources.

Therefore, it is crucial to conduct this research to investigate the factors influencing students' readiness to use augmented reality for educational purposes.

Moreover, the Technology Readiness Index (TRI) is as a metric to assess pupils' preparedness for AR Technology. The TRI comprises crucial aspects, such as technological optimism, innovativeness, discomfort, confidence, and resistance. Evaluating students' technological preparedness can provide educators and institutions with valuable insights on successfully integrating augmented reality (AR) technologies into the higher education setting. In order to evaluate students' preparedness for augmented reality (AR) technologies in higher education, TRI encompasses four key aspects. The factors being measured are as follows: Optimism, which evaluates that the students believe that AR technology can enhance their learning experiences; Innovativeness, which assesses students' willingness to explore and experiment with AR technologies; Discomfort, which measures the level of unease or apprehension when using AR; and Security, which gauges the level of confidence in the correct functioning of AR technologies.

Student motivation in online learning has emerged as a significant challenge in modern education. While online courses offer convenience and flexibility, they also present unique difficulties in maintaining student engagement and motivation. Without the physical presence of teachers and classmates, students often struggle to sustain the same level of enthusiasm and focus. Distractions, lack of structure, and the absence of face-to-face interactions can diminish motivation. Additionally, the flexible nature of online learning can lead to procrastination and isolation, further reducing students' drive to participate actively and succeed academically. Addressing this issue requires innovative approaches to course design, technology integration, and support systems to help maintain student motivation and engagement in online learning environments.

To address the issue of student motivation, it is essential to first understand the concept of motivation within the context of online education. Flow theory (FT) has profound ramifications for student motivation and the process of learning. When students achieve a state of flow in their academic pursuits, they are more inclined to exhibit motivation, active involvement, and optimal performance. FT is measured using three factors: Enjoyment (ENJ), Concentration (CN), and Discomfort (DIS). Motivation is a multifaceted psychological concept that compels learners to begin, maintain, and finish learning activities. Online learning motivation can be impacted by self-determination, goal orientation, and the perceived value of the learning experience. Furthermore, students can exhibit intrinsic motivation, which stems from their interests and curiosities, or extrinsic motivation, which arises from external rewards or pressures [23]. In addition, the modified model, considers the Readiness and Flow experience, is built upon the Technology Acceptance Model. This modified model examines the impact of Technology Readiness and Flow Theory on the acceptance of augmented reality among students in private university in Jakarta.

II. Research Model and Hypotheses

The research model in this research consists of 3 models, namely TRI, TAM and FT, where this research was carried out to find the influence technology readiness and flow toward acceptance of AR, which can be seen in the Fig. 1. The following items variable and the 16 hypotheses and their explanations are described in the following discussion.

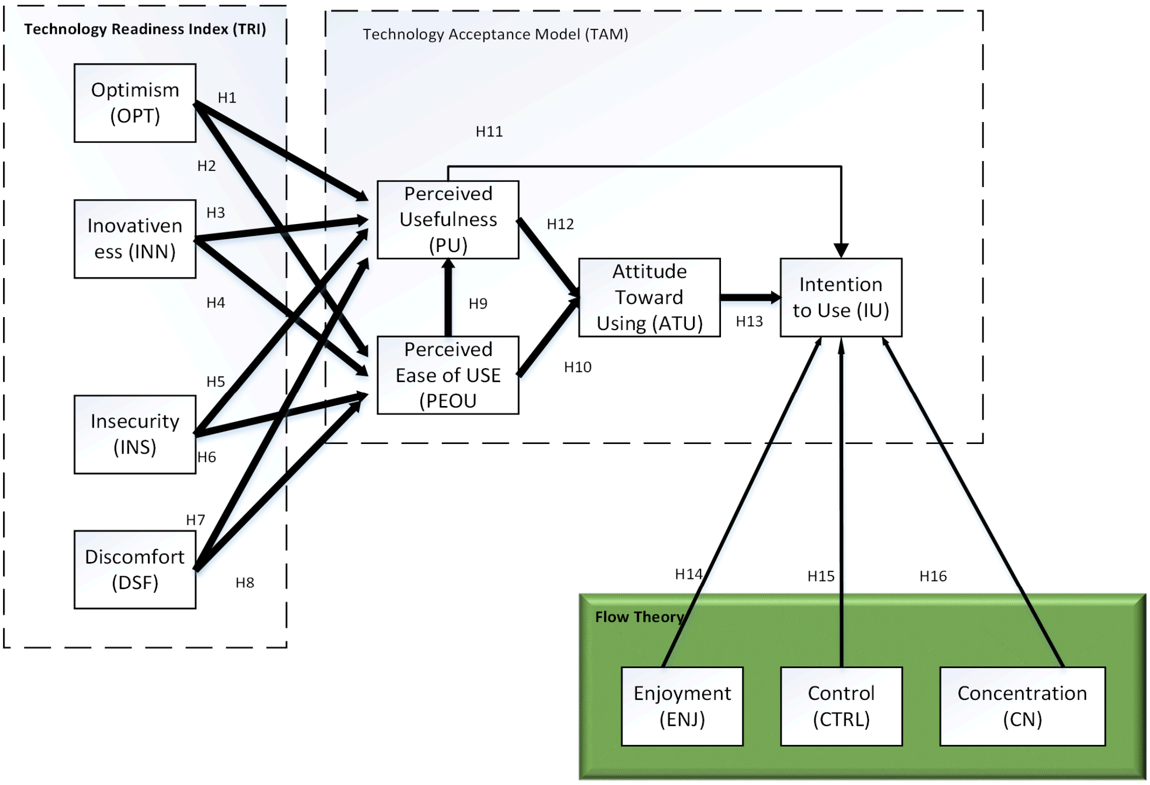

Fig. 1. Proposed research model.

A. Technology Readiness Index

The Technology Readiness Index measures how open a person is to adopting and using new technology in order to accomplish their personal and professional goals [24]. When individuals possess the necessary technological skills and knowledge, they are enthusiastic about utilizing emerging technology to achieve their objectives [25, 26]. The four variables of TRI can be seen as follows:

1) Optimism (OPT)

Optimism is a way of looking at technology that believes it can make people's lives better by giving them more agency, adaptability, and efficiency. Optimism about technology is a common component.

2) Innovativeness (INN)

Innovativeness is characterized as a proclivity to be at the forefront of technology and a guiding force in shaping new ideas. This component primarily assesses the extent to which individuals view themselves as being at the forefront.

3) Discomfort (DIS)

Discomfort is characterized as a subjective sense of inadequate mastery over technology and a sensation of being inundated by it. This dimension typically quantifies the level of apprehension and anxiety individuals have when faced with technology.

4) Insecurity (INS)

Insecurity is characterized by a lack of faith in technology and a skeptical attitude towards its reliability.

B. Technology Acceptance Model (TAM)

TAM is a well-established paradigm that aims to elucidate and forecast users' willingness to accept and embrace technology. TAM, developed by Fred Davis in the late 1980s, proposes that Users' attitudes and intentions toward using technology are influenced by their perceptions of its ease of use and usefulness. Researchers have progressively expanded and adapted the model by incorporating many variables that augment its capacity to explain phenomena [27–29].

1) Perceived Ease of Use (PEOU)

The ease of using a technology is essential in the Technology Acceptance Model (TAM), indicating the dimensions of the user's perceptiveness that adopting a new technology requires minimal effort. It includes elements such as the ease of acquiring knowledge, interfaces that are easy for users to navigate, and the straightforwardness of interactions. Users are more inclined to adopt a technology that they consider user-friendly.

2) Perceived Usefulness (PU)

PU is an essential component of TAM, which assesses how customers think a technology may boost their efficiency and effectiveness. Users presumably accept and utilize technology if it is as helpful for accomplishing certain tasks or goals.

3) Attitude Toward Usage (ATU)

The attitude toward using technology is a reflection of how people feel about technology and how thoroughly they evaluate it. The acceptance rate tends to rise when people have positive sentiments.

4) The Intentions of Use (IU)

The Intention of Use pertains to users' behavioral inclinations of users, indicating their propensity or willingness to utilize a technology. This characteristic is seen as a direct precursor to the actual acceptance of technology. Strong behavioral intentions suggest a high probability of technology acceptance.

C. Flow Theory (FT)

The Flow Theory is characterized by three phenomena: Concentration, control, and enjoyment [30] The correlation between meaningful learning, characterized by cognitive processing depth and academic performance, and focus or absorption is essential to flow theory [31, 32]. The variables employed in this research, based on flow theory, are as follows:

1) Enjoyment (ENJ)

Enjoyment within the framework of Flow extends beyond simple pleasure; a deep sense of satisfaction arises from the activity itself. It is observed that the inherent benefits of the activity are enough to inspire ongoing participation. The internal gratification experienced in the act, whether a demanding chore, a creative project, or a physical activity, becomes the primary motivation, overshadowing any external rewards.

2) Control (CTRL)

Control in the Flow experience pertains to the perception of persons having complete command and independence over their activities while engaging in an activity. The work must be appropriately matched to one's degree of expertise, achieving a careful equilibrium between its level of difficulty and the individual's level of proficiency. When individuals believe they possess the requisite abilities to confront a task, they experience a state of Flow, which grants them a feeling of mastery and pushes their progress.

3) Concentration (CN)

Concentration is critical to achieving both enjoyment and control in the Flow experience. It requires complete immersion in the task, where external distractions disappear, and profound attention takes over. This condition is defined by total immersion, temporal loss, and effortless movement through the action. Concentration boosts performance, enjoyment, and control.

D. Research Hypotheses

Based on the model proposed given in Fig. 1, the following:

H1: The degree of optimism have a substantial impact on the perceived utility of augmented reality.

H2: The degree of optimism significantly impacts the perceived simplicity of utilizing augmented reality.

H3: The degree of Innovativeness influences the perceived ease of using of augmented reality in a substantial way.

H4: The degree of Innovativeness greatly affects augmented reality's perceived ease of usage.

H5: The degree of Insecurity has a substantial impact on the perceived usefulness of augmented reality.

H6: The degree of Insecurity has a substantial impact on the perceived ease of use of augmented reality.

H7: The degree of Discomfort significantly influence the perceived of usefulness of augmented reality

H8: The degree of Discomfort significantly influence the perceived of ease of use of augmented reality

H9: The degree of Perceived Ease of Use of Augmented Reality significantly influence the Perceived of Usefulness Augmented Reality.

H10: The degree of Perceived Ease of Use of Augmented Reality significantly influence the Attitude toward Using in Augmented Reality.

H11: The degree of perceived usefulness of the use of Augmented Reality significantly influence the intention to use Augmented Reality.

H12: The degree of perceived usefulness of the use of Augmented Reality significantly influence the Attitude Toward Using Augmented Reality.

H13: The degree of Attitude Toward Using Augmented Reality significantly influence the intention to use of Augmented Reality.

H14: The degree of Enjoyment in utilizing Augmented Reality significantly influence the intention to use Augmented Reality.

H15: The degree of Control in utilizing Augmented Reality significantly influence the intention to use Augmented Reality.

H16: The degree of Concentration in using Augmented Reality significantly influence the intention to use Augmented Reality

III. Research Method

The focus of this research is to investigate the readiness and flow theory toward the acceptance of augmented reality (AR) technology, which this technology is a virtual technology that creates the illusion of virtual objects existing in the real world. This is achieved through the use embedded AR applications mechanism as illustrated in the example in Fig. 2.

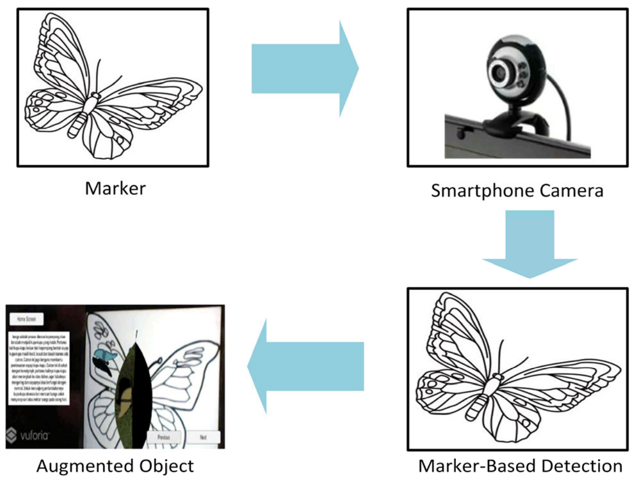

Fig. 2. Augmented reality application sample.

According to Fig. 2, smartphones with AR applications can display virtual objects that appear to exist in the real world, allowing users to interact with them. Fig. 2 illustrates the development of an AR application for educational purposes, specifically to explain the process of metamorphosis of butterflies [33]. When the smartphone camera scans the marker, a virtual object will appear, making it useful for learning.

Quantitative research study is a fundamental approach used to investigate different phenomena empirically. It involves the use of systematic and structured procedures to gather, analyze, and interpret numerical data. This type of research is distinguished by its focus on objectivity, accuracy, and statistical rigor. The initial stage of this study involves conducting a quantitative investigation that examines the essential characteristics and importance of quantitative design. There are four steps to an investigation of a measurement model: inferential validity, discriminant validity, convergent validity, and construct reliability.

A. Data Collection and Measurement

Questionnaires were directly shared to respondents via email, WhatsApp, and social media platforms of reputed higher education institutions in Jakarta. A total of 619 data raw of respondents were acquired using the questionnaire from Table 1. The 619 entries have undergone data redundancy checks, which have revealed no instances of duplicate data. This is possible due to the initial requirement of the form, which requires respondents to input their email addresses first. According to data verification, 17 were eliminated resulting in a grand total of 602 participants have met the criteria for the sample. Among them, a minimum of 30 from 20 different universities in Jakarta completed the survey.

Table 1. Variables and questionnaire items

Criteria	Items	Questionnaire Items
Optimism	OPT 1	AR Technology makes you more efficient in your learning activities
	OPT 2	Augmented reality enhances people's standard of living
	OPT 3	Augmented reality allows me greater mobility.
Innovativeness	INN 1	Others seek my counsel regarding AR technology.
	INN 2	Typically, when it comes to learning AR, I am usually one of the first in my network of friends.
	INN 3	You stay up to date on the newest technical breakthroughs in your areas of interest, such as AR Technology.
	INN 4	Generally, you are capable of figuring out new advanced technologies (AR Technology) on your own.
Insecurity	INS 1	AR does not reduce my attention in learning Traditionally
Discomfort	DIS 1	Occasionally, you may believe that AR is not for the average person.
	DIS 2	It is humiliating to experience difficulties with augmented reality while others are observing.
Perceived of Usefulness	PU 1	The implementation of this augmented reality system will enhance my academic performance and learning.
	PU 2	I consider the AR to be beneficial for learning.
	PU 3	I believe that augmented reality is excellent for learning.
	PU 4	Using Augmented Reality allows me to complete chores more rapidly.
Perceived Ease of Use	PEOU 1	In my opinion, AR is user-friendly.
	PEOU 2	I have no difficulty in acquiring proficiency in utilising AR technologies.
	PEOU 3	I find it effortless to get expertise in augmented reality (AR).
	PEOU 4	I find it effortless to manipulate augmented reality (AR) to achieve my desired objectives.
Attitude Toward Using	ATU 1	Utilising augmented reality enhances the appeal of the learning experience.
	ATU 2	I enjoy utilising Augmented Reality (AR).
	ATU 3	I believe that utilizing augmented reality (AR) for educational purposes is highly advantageous.
	ATU 4	Utilizing augmented reality (AR) offers numerous advantages.
Intention To Use	IU 1	Augmented reality is going to be a tool that I study with.
	IU 2	It is worth employing augmented reality
	IU 3	I plan to use AR in some courses
	IU 4	I intend to use Augmented Reality to better my study.
	IU 5	If given the possibility, I would like to employ the augmented reality system in the future.
Enjoyment	ENJ 1	Using the AR Technology gives enjoyment to me.
	ENJ 2	I Found AR interesting
	ENJ 3	I Found AR exciting
	ENJ 4	I Found AR fun
Control	CTRL 1	I am able to skilfully use AR Technology
	CTRL 2	I felt can using AR
Concentration	CN 1	When using the AR Technology, I do not realize the time elapsed
	CN 2	My attention was focused while using AR
	CN 3	I concentrated fully while using AR
	CN 4	I was deeply engrossed while using AR

B. Respondent Demographic

The target demographic consists of undergraduate students from 20 private universities in Jakarta, Indonesia, out of a total of 62 private higher education institutions in Jakarta. As respondents, 600 undergraduate students (30 from each higher education school) were chosen. Based on previous studies, several campuses in the Jakarta area have a research article on augmented reality from 2017 to 2022, with the majority of the research still in the development stages, to provide more relevant insights pertaining to their intention to use of AR.

This study collected data using a web-based survey form produced with Google Forms. Undergraduate students from a private higher education institution in the Jakarta area used Google forms to complete the questions used in the study. Because of the multiple advantages of online survey platforms provide, researchers have favored them over traditional paper-based surveys in recent years to ensure that the data gathering process is carried out exactly as planned. These techniques include emailing and using social media platforms. The result of data gathering is visible in Table 2, where from the point view of gender, there are more respondents that are female (57.4%) than man (42.6%), and most respondent have a knowledge of AR.

Table 2. Respondent demographic profile

Characteristic	Group	Number of Respondents N=602	Percentage (%)
Gender	Men	262	42.6%
	Women	340	57.4%
Marital Status	Single	599	99.5%
	Married	3	0.5%
Age	17-19	540	89.7%
	20-29	46	7.6%
	30-49	16	2.7%
AR Knowledge	Strongly Understand	291	48.3%
	Understand	282	46.8%
	Neutral	14	2.3%
	Misunderstand	10	1.6%
	Strongly Misunderstand	5	1%

IV. Result and Discussion

The quantitative analysis results signify the completion of a meticulous and methodical investigation of numerical data, offering a full summary of the study's discoveries. After carefully gathering data and applying statistical methods, the results provide valuable information about the connections, patterns, and trends present in the dataset. Descriptive statistics, such as means, standard deviations, and frequencies, offer a concise summary of the average values and spread of data. On the other hand, inferential statistics, such as regression analysis or hypothesis tests, enable us to make more general inferences about entire populations.

A. Reliability and Validity Measurement

All of the indicators' loading values were assessed and determined to be adequate for measuring construct validity and reliability because they exceeded the minimum criterion of 0.70. Fig. 3 and Table 3 illustrate the structural model of the study model in SmartPLS, where the model developed has minimized several invalid variables.

Every variable in Table 3 has met the construct reliability criteria, according to the SmartPLS study.

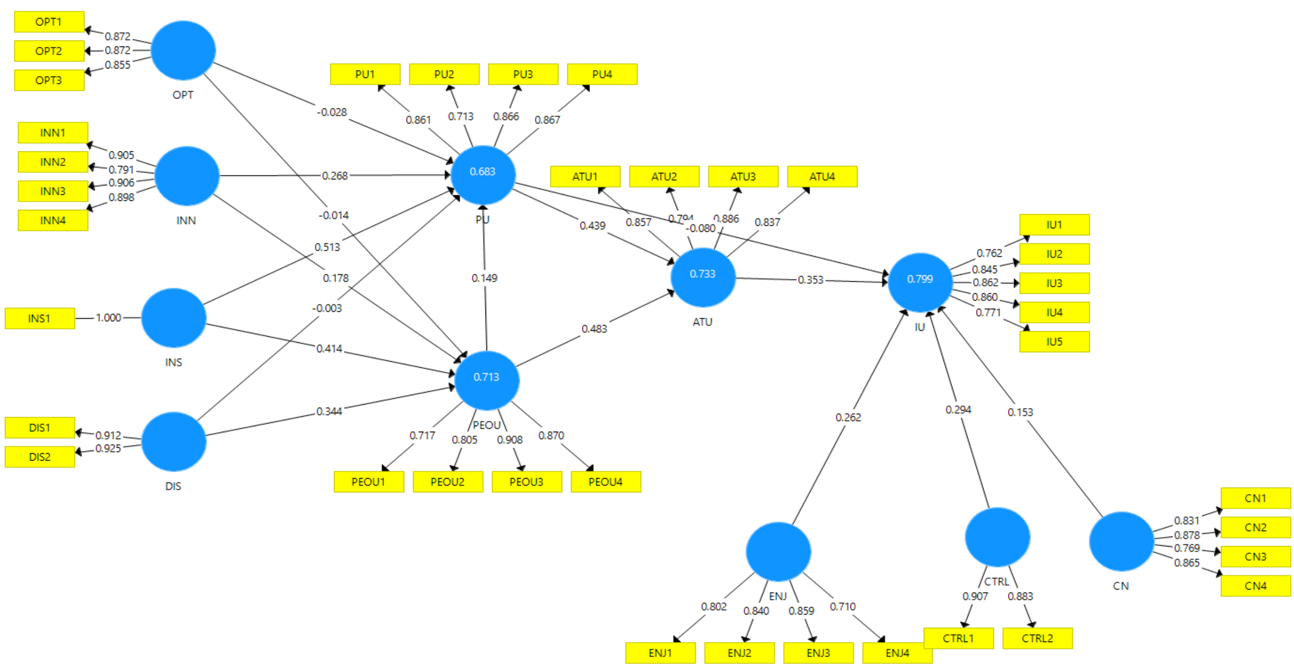

Fig. 3. Research Model Measurement in SmartPLS3.

Table 3. Reliability and validity measurement results

Construct	Cronbach's Alpha	rho_A	Composite Reliability (CR)	AVE	Indicators	Outer Loading	P Value
ATU	0.865	0.867	0.908	0.713	ATU1	0.857	<0.001
					ATU2	0.794	<0.001
					ATU3	0.886	<0.001
					ATU4	0.837	<0.001
CN	0.857	0.864	0.903	0.701	CN1	0.831	<0.001
					CN2	0.878	<0.001
					CN3	0.769	<0.001
					CN4	0.865	<0.001
CTRL	0.753	0.759	0.890	0.801	CTRL1	0.907	<0.001
					CTRL2	0.883	<0.001
DIS	0.814	0.817	0.915	0.843	DIS1	0.912	<0.001
					DIS2	0.925	<0.001
ENJ	0.818	0.830	0.880	0.648	ENJ1	0.802	<0.001
					ENJ2	0.840	<0.001
					ENJ3	0.859	<0.001
					ENJ4	0.710	<0.001
INN	0.898	0.899	0.930	0.768	INN1	0.905	<0.001

					INN2	0.791	<0.001
					INN3	0.906	<0.001
					INN4	0.898	<0.001
INS	1.000	1.000	1.000	1.000	INS1	1.000	<0.001
IU	0.878	0.880	0.912	0.674	IU1	0.762	<0.001
					IU2	0.845	<0.001
					IU3	0.862	<0.001
					IU4	0.860	<0.001
					IU5	0.771	<0.001
OPT	0.834	0.834	0.900	0.751	OPT1	0.872	<0.001
					OPT2	0.872	<0.001
					OPT3	0.855	<0.001
PEOU	0.844	0.851	0.897	0.686	PEOU1	0.717	<0.001
					PEOU2	0.805	<0.001
					PEOU3	0.908	<0.001
					PEOU4	0.870	<0.001
PU	0.847	0.862	0.897	0.688	PU1	0.861	<0.001
					PU2	0.713	<0.001
					PU3	0.866	<0.001
					PU4	0.867	<0.001

This is supported by Cronbach alpha values where all items are above the minimum level of 0.70. Furthermore, the composite reliability metric, rho_A, has a minimum value of 0.913, greater than the lowest acceptable value of 0.70. Similarly, the CR values fulfill the predefined rules, as seen by the lowest values reaching 0.70 and the highest values being less than 1. Regarding construct validity, all variables reached the minimum acceptable level of 0.50, as evidenced by the AVE values. Since all three prerequisites for convergent validity were satisfied in this study, it can be assumed that the construct's validity and reliability were demonstrated. The loadings of each indicator are more than 0.70, satisfying all three conditions. The measured construct reliability (CR) scores, range from 0.880 to 1, and indicate a high degree of internal consistent dependability. Additionally, with values ranging from 0.648 to 1, the Average Variance Extracted (AVE) values surpass the recommended criterion of 0.50. Overall construct validity is shown by the construct's factor loadings, which can take on values between 0.710 and 1.

B. Discriminant Validity

This study's Discriminant Validity test used SmartPLS3, one of many methods for assessing a measurement model's convergent and discriminant validity. Indicator cross-loadings and the criteria analysis proposed by Farnell and Larker are two examples of such methods. Table 4, which may be found below, shows the factors examined in this study and how they were cross-loaded.

Table 4. Cross loading measurement

Variable	ATU	CN	CTRL	DIS	ENJ	INN	INS	IU	OPT	PEOU	PU
ATU1	**0.857**	0.590	0.519	0.608	0.621	0.670	0.687	0.630	0.670	0.673	0.782
ATU2	**0.794**	0.593	0.595	0.650	0.650	0.588	0.566	0.648	0.579	0.663	0.567
ATU3	**0.886**	0.623	0.610	0.710	0.672	0.678	0.760	0.692	0.726	0.721	0.696
ATU4	**0.837**	0.614	0.625	0.753	0.647	0.782	0.674	0.745	0.784	0.646	0.611
CN1	0.581	**0.831**	0.632	0.564	0.585	0.534	0.519	0.619	0.528	0.632	0.489
CN2	0.569	**0.878**	0.727	0.591	0.589	0.561	0.561	0.647	0.547	0.632	0.511
CN3	0.597	**0.769**	0.573	0.567	0.657	0.569	0.593	0.615	0.580	0.609	0.627
CN4	0.647	**0.865**	0.774	0.663	0.677	0.615	0.641	0.746	0.620	0.765	0.574
CTRL1	0.625	0.790	**0.907**	0.689	0.679	0.601	0.661	0.762	0.613	0.778	0.521
CTRL2	0.621	0.661	**0.883**	0.750	0.642	0.672	0.616	0.682	0.685	0.654	0.566
DIS1	0.736	0.634	0.712	**0.912**	0.636	0.718	0.702	0.731	0.788	0.668	0.629
DIS2	0.745	0.679	0.758	**0.925**	0.718	0.704	0.682	0.774	0.750	0.765	0.627
ENJ1	0.635	0.737	0.737	0.701	**0.802**	0.597	0.666	0.739	0.615	0.754	0.548
ENJ2	0.611	0.597	0.538	0.533	**0.840**	0.559	0.632	0.618	0.530	0.623	0.686
ENJ3	0.687	0.579	0.566	0.621	**0.859**	0.629	0.694	0.676	0.637	0.645	0.708
ENJ4	0.518	0.468	0.505	0.493	**0.710**	0.431	0.512	0.522	0.427	0.513	0.497
INN1	0.689	0.606	0.627	0.673	0.611	**0.905**	0.599	0.625	0.755	0.625	0.641
INN2	0.800	0.585	0.588	0.698	0.612	**0.791**	0.668	0.713	0.756	0.619	0.597
INN3	0.661	0.600	0.623	0.678	0.607	**0.906**	0.595	0.628	0.759	0.635	0.622
INN4	0.679	0.601	0.642	0.664	0.609	**0.898**	0.590	0.626	0.743	0.650	0.618
INS1	0.798	0.694	0.714	0.753	0.785	0.699	**1.000**	0.760	0.753	0.787	0.794
IU1	0.676	0.530	0.572	0.653	0.581	0.646	0.582	**0.762**	0.663	0.572	0.493
IU2	0.672	0.599	0.678	0.808	0.611	0.634	0.599	**0.845**	0.685	0.648	0.520
IU3	0.605	0.724	0.736	0.617	0.618	0.546	0.580	**0.862**	0.569	0.711	0.489
IU4	0.625	0.714	0.718	0.657	0.680	0.573	0.621	**0.860**	0.592	0.735	0.544
IU5	0.724	0.657	0.606	0.633	0.793	0.638	0.728	**0.771**	0.657	0.674	0.714
OPT1	0.729	0.597	0.635	0.743	0.610	0.685	0.659	0.680	**0.872**	0.647	0.597
OPT2	0.707	0.590	0.636	0.736	0.595	0.699	0.664	0.683	**0.872**	0.648	0.578
OPT3	0.693	0.584	0.608	0.695	0.603	0.850	0.633	0.640	**0.855**	0.625	0.633
PEOU1	0.575	0.508	0.544	0.551	0.606	0.489	0.574	0.560	0.507	**0.717**	0.532
PEOU2	0.706	0.566	0.541	0.601	0.632	0.640	0.709	0.604	0.637	**0.805**	0.698
PEOU3	0.687	0.763	0.783	0.715	0.694	0.632	0.651	0.763	0.649	**0.908**	0.577
PEOU4	0.671	0.775	0.784	0.714	0.705	0.613	0.660	0.767	0.638	**0.870**	0.574

Variable	ATU	CN	CTRL	DIS	ENJ	INN	INS	IU	OPT	PEOU	PU
PU1	0.720	0.639	0.576	0.641	0.781	0.671	0.716	0.680	0.661	0.671	**0.861**
PU2	0.514	0.451	0.459	0.490	0.535	0.444	0.525	0.475	0.460	0.478	**0.713**
PU3	0.700	0.540	0.499	0.570	0.593	0.604	0.689	0.536	0.583	0.623	**0.866**
PU4	0.658	0.531	0.466	0.555	0.585	0.600	0.683	0.530	0.582	0.605	**0.867**

All indicators for the corresponding variable are either equal to or larger than the indications for the other variables, as indicated in Table 4. Farnell and Larker criterion is the second measurement to validate the proposed model. The study also confirms that all variables fulfilled Farnell and Larker's criteria. The evidence for this can be seen in Table 5, where each variable's Average Variance Extracted (AVE) exceeded its correlation value with all other variables.

Table 5. Farnell and lacker discriminant validity

Variable	ATU	CN	CTRL	DIS	ENJ	INN	INS	IU	OPT	PEOU	PU
ATU	**0.844**										
CN	0.716	**0.837**									
CTRL	0.695	0.814	**0.895**								
DIS	0.806	0.715	0.802	**0.918**							
ENJ	0.767	0.751	0.738	0.739	**0.805**						
INN	0.807	0.683	0.708	0.774	0.696	**0.876**					
INS	0.798	0.694	0.714	0.753	0.785	0.699	**1.000**				
IU	0.805	0.789	0.809	0.820	0.803	0.739	0.760	**0.821**			
OPT	0.819	0.681	0.723	0.836	0.696	0.860	0.753	0.771	**0.867**		
PEOU	0.800	0.793	0.803	0.782	0.798	0.722	0.787	0.817	0.739	**0.828**	
PU	0.788	0.657	0.605	0.684	0.759	0.707	0.794	0.675	0.696	0.723	**0.829**

C. Structural Model Analysis

SmartPLS3 was used in this study to analyses the route analysis among the many variables of the research framework, while bootstrapping was used to do path analysis and test the research utilizing the resampling approach. A systematic strategy for evaluating the structural model was given. The procedure was separated into four stages: structural model collinearity diagnosis, path coefficient significance testing, R2 assessment, and explanation effect value f2 evaluation. At the same time, the VIF values of every indicator in the structural model are below 10. Indicators and dimensions in the measurement model and structural model are not significantly collinear since their VIF values are less than the cutoff value of 10. Consequently, future path coefficient estimates in the structural model should be unaffected by the collinearity problem. Table 6 exhibit the test results.

As shown in Table 6, the multicollinearity has been ruled out as a cause for worry in this inquiry. This is because all of the reported VIF values are less than the preset threshold of 10. As a result, concludes that the model does not lack multicollinearity and that the regression model is adequate [34]. Furthermore, the VIF values obtained in this study are lower than 6, with the highest number recorded being 5.606, and it lies between the values of Optimism (OPT) and Perceived Ease of Use (PEOU), as well as between the values of Perceived Usefulness (PU). The VIF study revealed that the variables Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) have the lowest VIF value (2.096) when compared to Attitude Toward Using (ATU).

Table 6. Variance Inflation Factor (VIF) : Construct collinearity

Variable	ATU	IU	PEOU	PU
ATU		3.563		
CN		3.645		
CTRL		3.417		
DIS			3.865	4.279
ENJ		3.665		
INN			4.029	4.139
INS			2.638	3.236
IU				
OPT			5.606	5.606
PEOU	2.096			3.488
PU	2.096	3.156		

Table 7. Hypotheses path coefficient result

Hypotheses	Relationship	Original Sample	Sample Mean	Standard Deviation	t Values >1.96	p Values < 0.05	F2	Status
H1	OPT -> PU	−0.028	−0.034	0.059	0.474	0.635	0	**Insignificant**
H2	OPT -> PEOU	−0.014	−0.013	0.055	0.260	0.795	0	**Insignificant**
H3	INN -> PU	0.268	0.275	0.054	5.000	0.000	0.055	Significant
H4	INN -> PEOU	0.178	0.181	0.049	3.613	0.000	0.027	Significant
H5	INS -> PU	0.513	0.512	0.051	9.990	0.000	0.256	Significant
H6	INS -> PEOU	0.414	0.412	0.040	10.298	0.000	0.227	Significant
H7	DIS -> PU	−0.003	−0.004	0.057	0.050	0.960	0	**Insignificant**
H8	DIS -> PEOU	0.344	0.344	0.046	7.521	0.000	0.107	Significant
H9	PEOU -> PU	0.149	0.149	0.043	3.503	0.001	0,02	Significant
H10	PEOU -> ATU	0.483	0.486	0.037	13.043	0.000	0.417	Significant
H11	PU -> IU	−0.080	−0.081	0.031	2.554	0.011	0.01	Significant
H12	PU -> ATU	0.439	0.437	0.037	11.864	0.000	0.344	Significant
H13	ATU -> IU	0.353	0.353	0.036	9.919	0.000	0.174	Significant
H14	ENJ -> IU	0.262	0.261	0.037	7.042	0.000	0.093	Significant
H15	CTRL -> IU	0.294	0.295	0.037	7.938	0.000	0.125	Significant
H16	CN -> IU	0.153	0.154	0.037	4.129	0.000	0.032	Significant

Consequently, sixteen hypotheses (H1 to H16) were tested that can be seen in Table 7. The hypothesis were analyzed for their association using path coefficients where a value is considered significant and accepted if it meets the criteria of t-values > 1.96 and p-values < 0.05. If either of these conditions is not met, the variable is deemed insignificant and rejected, as shown as follows:

H1: Aspects of optimism have a substantial impact on the perceived utility of augmented reality.

There was no statistically significant relationship between optimism and perceived usefulness (t=0.477, p=0.635). The hypotheses is rejected, if the path coefficient is negative, then there is a negative correlation between the two variables; that is, if you raise your optimism, your perceived usefulness will fall, and if you lower it, your perceived usefulness will rise.

H2: The degree of optimism significantly impacts the perceived simplicity of utilizing augmented reality.

Results indicated a non-significant relationship between optimism and perceived usability (t-value = 0.260, p-value = 0.759). Changes in the magnitude of Optimism cause changes in the Perceived Ease of Use in the other direction, the negative path coefficient indicates that the link is negative.

H3: Innovativeness influences the perceived ease of using of augmented reality substantially.

A strong correlation between innovativeness and perceived usefulness was found in the results, as confirmed by the t-value of 5.000 and p-value of 0.000. The hypothesis is approved, when the path coefficient is positive, it means that the relationship is positively associated, which means that a change in the level of Innovativeness will affect the perceived usefulness in the same direction.

H4: Innovativeness greatly affects augmented reality's perceived ease of usage.

In terms of statistical significance, the relationship between innovativeness and perceived ease of use is strong (t = 3.613, p = 0.000). Hence, the hypothesis is proven correct. With a positive path coefficient, we can see a relationship between the two variables; changing the amount of Innovativeness changes the perceived ease of use in the other direction.

H5: Insecurity substantially impacts on the perceived usefulness of augmented reality.

Perceived usefulness and insecurity are substantially associated, according to the data (t-value: 9.990, p-value: 0.000). Hence, the hypothesis is proven correct. There is a positive association between the variables in question, as indicated by the positive path coefficient of 0.513. To be more precise, changes in the degree of insecurity in one direction will cause a matching change in the perceived utility.

H6: Insecurity substantially impact on the perceived ease of use of augmented reality.

The results show that perceived ease of use and security are statistically correlated (t-value: 10.298; p-value: 0.000). This proves the hypothesis correct. With a positive path coefficient of 0.414, we can see that there is a positive association between the two variables; that is, if we change the level of insecurity in one direction, the perceived ease of use will change in the other direction.

H7: Discomfort significantly influences the perceived of usefulness of augmented reality

There does not appear to be a statistically significant correlation between perceived usefulness and discomfort (t = 0.050, p= 0.960). It follows that the hypothesis is rejected. Changes in Discomfort level have an opposing effect on Perceived Usefulness, as shown by a negative path coefficient of -0.003. This suggests the existence of a negative link between the variables.

H8: Discomfort significantly influences the perceived of ease of use of augmented reality

A high degree of association between user pain and reported ease of use was found (t-value = 7.521, p-value = 0.000). Thus, the hypothesis is accepted. The perceived ease of use will alter in response to changes in the degree of discomfort, as shown by the positive path coefficient of 0.344, which suggests a positive correlation.

H9: The perceived Ease of Use of Augmented Reality significantly influences the Perceived of Usefulness in Augmented Reality.

According to the data, there is a robust correlation between the two measures of perceived ease of use (t-value = 3.503, p-value = 0.001). This proves the hypothesis is accepted. A positive correlation, as shown by the path coefficient of 0.419, means that increases in Insecurity will cause changes in Perceived Usefulness in the same direction.

H10: The Perceived Ease of Use of Augmented Reality significantly influences the Attitude toward Using in Augmented Reality.

The findings indicate that there is a significant link between the perceived ease of use and the attitude toward using, as shown by a t-value of 13.043 and a p-value of 0.000 according to the statistical analysis. It can be concluded that the hypothesis is correct. The path coefficient of 0.483 indicates a positive link, meaning that an increase in Insecurity will lead to a corresponding increase in Attitude Toward Using.

H11: The perceived usefulness of the use of Augmented Reality significantly influences the intention to use Augmented Reality.

The results indicate that there is a relationship between perceived usefulness and intention to use, which is supported by the t-value of 2.554 and the p-value of 0.011, which both indicate that the relationship is statistically significant. As a consequence, the hypothesis is validated. A negative relationship exists, as indicated by the positive path coefficient of -0.008. This implies that alterations in the magnitude of Perceived Usefulness in one direction will result in a corresponding change in the Intention to Use in the opposite direction.

H12: The perceived usefulness of the use of Augmented Reality significantly influence the Attitude toward Using Augmented Reality.

A t-value of 11.864 and a p-value of 0.000 were found to indicate that the results showed that there is a significant relationship between Attitude toward Usage and Perceived Usefulness. As a consequence, the hypothesis is validated. The presence of a positive path coefficient of 0.439 indicates that the relationship is positive, such that alterations in the magnitude of Perceived Usefulness in one direction will result in an equivalent change in the Attitude Towards Using.

H13: The Attitude Toward Using Augmented Reality significantly influences the intention to use of Augmented Reality.

The outcome demonstrated a statistically significant relationship between Attitude Towards Use and Intention of Use, as evidenced by the t-value of 9.919 and the p-value of 0.000. As a consequence, the hypothesis is validated. The presence of a positive path coefficient of 0.353 indicates that the relationship is positive, such that alterations in the magnitude of Attitude Towards Use in one direction will result in a corresponding change in the Intention to Use.

H14: The Perceived Enjoyment of the use of Augmented Reality significantly influences the intention to use Augmented Reality.

The findings revealed a statistically significant correlation between Perceived Enjoyment and Intention of Use, as evidenced by the t-value of 7.042 and p-value of 0.000. As a consequence, the hypothesis is validated. The presence of a positive path coefficient of 0.262 indicates that the relationship is positive, such that alterations in the magnitude of Perceived Enjoyment in one direction will result in a corresponding change in the Intention to Use.

H15: Control in using Augmented Reality significantly influences the intention to use Augmented Reality.

The result showed that there was a statistically significant association between Control and Intention of Use. This was indicated by the t-value of 7.938 and the p-value of 0.000, which both represent statistically significant results. For this reason, the hypothesis can be considered to be correct. The presence of a positive path coefficient of 0.294 indicates that the relationship is positive, as alterations in the magnitude of Control in one direction result in a corresponding change in the Intention to Use in the opposite direction.

H16: Concentration in using Augmented Reality significantly influences the intention to use Augmented Reality.

The outcome demonstrated a statistically significant association between concentration and intention to use, as evidenced by the t-value of 4.129 and the p-value of 0.000. As a consequence, the hypothesis is validated. The presence of a positive path coefficient of 0.533 indicates that the relationship is positive, such that alterations in the concentration magnitude in one direction will result in a corresponding change in the intention to use.

D. Hypotheses Analysis Findings Summarization

The results indicate that out of the 16 hypotheses examined, 13 were accepted and 3 were rejected. Respondents exhibiting the characteristic of optimism tend to regard perceived usefulness and perceived ease of use as having no substantial impact on the correlations between the two variables. The respondent's rejection is mainly directed towards the perceived usefulness and perceived ease of use of Optimism. Similar results were observed among respondents who exhibited the attribute of Discomfort, as they tended to disregard the perceived usefulness of the relationship. This suggests that the respondent specifically rejects optimism, particularly in relation to the perceived usefulness. In contrast, individuals who possess the trait of Discomfort tend to attribute significant importance to Perceived Ease of Use in the relationship. This suggests that the respondent is willing to tolerate discomfort, particularly regarding to the perceived ease of use. All other items have a strong and positive link with the targeted items, such as INN, INS, and DIS having a major positive impact on PEOU. The correlation between PEOU and PU is strongly positive towards ATU. The variables PU, ATU, ENJ, CTRL, and CN have a strong positive correlation with IU. Finally, the data indicate that three items in the TRI Model were rejected: Optimism towards both PU and PEOU, and one item rejected regarding Discomfort towards PU. Additionally, three factors are accepted: Innovativeness towards PU (Perceived Usefulness) and PEOU (Perceived Ease of Use), Insecurity towards PU and PEOU, and Discomfort towards PEOU. Additional findings demonstrated that all three components of the TAM Model were accepted, namely, Perceived Usefulness (PU) towards Attitude Towards Use (ATU), Perceived Ease of Use (PEOU) towards ATU, and ATU towards Intention to Use (IU). The latest discovery in the FT model indicates that three components, namely ENJ, CN, and CTRL, are accepted in relation to IU.

The research findings indicate that in terms of technology readiness for AR use, students believe that AR's innovations can benefit their learning. Despite encountering initial challenges, they are willing to use AR as long as it proves useful. However, they are less optimistic about the widespread adoption of AR in learning due to its novelty and potential for becoming uninteresting. If AR applications fail to engage them, they may abandon the technology. Overall, technology readiness significantly influences students' acceptance of AR. Regarding the influence of flow theory toward AR acceptance, students reported that they thoroughly enjoy using AR technology and can maintain self-control while using it. Even if they face interruptions, they intend to continue using AR in the future. Thus, flow theory significantly influences the acceptance of augmented reality technology among students at private universities in Jakarta.

V. Conclusion

We conclude that the readiness of students are significantly positive in the innovativeness and Insecurity of Using augmented reality toward the acceptance of AR, but has no effect on the optimism of using AR, which means that Discomfort has two different results, namely discomfort toward Perceived Ease Of Use is accepted by respondents while not toward Perceived Usefulness. This suggests that students perceive augmented reality as a significant innovation in their learning methods. They are not discouraged by initial difficulties in using AR, as long as it ultimately benefits their education. Therefore, readiness influences the acceptance of augmented reality. All the Flow theory variables such as enjoyment, concentration and control toward the Intention of use of AR are accepted by the respondent which means that Flow theory has a significant impact toward the acceptance of augmented reality. All the variable of the technology acceptance significantly influence the intention of using augmented reality among students. The proposed model by combining the Technology Readiness index and Technology Acceptance has been proven to have a significant impact on the acceptance of AR among student in Private universities in Jakarta, with the exception of Optimism and discomfort in the TRI Model.

Future studies ought to elaborate upon the current findings by doing a more thorough validation with respondents utilizing a qualitative approach. Likewise it would be beneficial to compare the results acquired in this research with quantitative data to gain a better insight.

Conflict of Interest

The authors of this manuscript declare that there is no conflict of interest.

Author Contributions

Budi Arifitama, developed the Research Model, Instruments Development, Data Collection, and Data Analysis; Titik Khawa Abdul Rahman, supervised the whole research, evaluate the research model that has been developed and evaluate the hypotheses of the research.

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