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Students' Acceptance of Applying Cyber–Physical Integration Technique in an Automation Platform

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Abstract: This study applied the technology acceptance model to the cyber–physical integration technique in an automation platform. A total of 34 students from a technological university in central Taiwan responded to a survey following the completion of a six-week teaching course. The course helps students develop cyber–physical integration concepts and improve their learning outcomes. Data were collected to examine the path relationships among all variables (i.e., perceived enjoyment, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use) influencing the acceptance of the automation platform learning. Noteworthily, there is a correlation between the dimensions of the technology acceptance model, and all hypotheses are valid.

Keywords: automation technology; cyber–physical integration technology; cyber–physical system; technology acceptance model

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1. Introduction

The traditional development process of industrial automation systems (IASs), constructed with the integration of constituent parts, such as mechanics, electronics, and software, is criticized [1] for its incapacity to address the increasing complexity of original systems.

In Industry 4.0, the communication network and equipment between people have been built on the cyber–physical system (CPS) of the Internet of Things, bringing a new wave of revolution [2]. Cyber–physical integration technology (CPIT) is the key technology of Industry 4.0. It connects various devices, machines, and digital systems through computers, sensors, and network technology so that they can communicate with each other and integrate the physical and virtual worlds. In particular, it can integrate cyberspace with physical space and achieve intelligent manufacturing.

With the development of the digital learning theory and action learning technology, many new learning models and subject matters have emerged [3,4]. Davis [5] proposed the technology acceptance model (TAM) and successfully explored user acceptance of various information systems in many fields, which has been widely verified. Scholars commonly use the TAM to examine the impact of attitudes and behavioral intentions. For instance, perceived usefulness and perceived ease are important predictors of internet adoption [6].

Teaching strategies are teacher–student-oriented systems. They generally refer to the methods, procedures, and technologies of teachers' use of textbooks, which use various procedures and technologies. Moreno and Flowerday [7] proposed that computer-based teaching can draw students' attention. Teaching strategies refer to how teachers consider various teaching models to achieve teaching goals. They are specific, diverse, and task-oriented and consist of direct and indirect teaching and connections among the evaluations of oriented teaching strategies, questioning strategies, and class management strategies. Direct teacher-oriented teaching and indirect student-oriented teaching are used as teaching strategies. Consistency between teaching strategies and students' achievements can arouse students' learning motivations and interests, build students' confidence and expression, strengthen students' abilities to solve problems independently, and improve teaching and learning efficiencies.

Furthermore, this study developed an automation platform system to teach technological university students how to use the cyber–physical integration technique. This study used the technology acceptance model to identify the factors affecting students concerning the proposed system. TAM was used to investigate the perceived usefulness (PU), perceived ease of use (PEOU), attitude toward using (ATU), and behavioral intention to use (BIU) of students with respect to their participation in the teaching course. In this study, the automation platform is used as the teaching equipment, and TAM is imported to explore the purposes and outcomes of the students in using teaching modules. Based on the above-mentioned background and motivations, the novelty of this study aims to explore students' acceptance of applying cyber–physical integration techniques in an automation platform.

2. Literature Review

2.1. Automation Technology

Electromechanical integration technology is a necessary skill for modern automation control, beneficial for product quality improvement and labor shortage. The development of electromechanical integration technology and the promotion of automation in the manufacturing industry can help the industry move towards technological integration, high-precision, and automated production. Electromechanical integration technology focuses on practice and integration. Practice refers to recognition and experience through hands-on operation, while integration gets the best effect of mechanical, motor, electronics, and computer hardware coordination and solving interface problems during the connection.

Bradley et al. [8] pointed out that the environmental elements constituting electromechanical integration mainly took mechanical engineering, electronic engineering, and computing as the core, covering manufacturing technology, financial control, management, education and training, job and industry-related training, marketing, and other aspects. On the other hand, Hunt [9] pointed out that electromechanical integration was mainly applied in factory automation, office automation, and home automation. The electromechanical integration system consists of an interface module, software module, processor module, communication module, measurement module, combination module, and environment module.

2.2. Cyber–Physical Integration Technique (CPIT)

CPIT mainly uses 3D teaching materials for situational simulation learning, and students acquire knowledge from the situation that teachers construct. Situational simulation learning emphasizes that students learn by doing. It mainly combines situational learning with simulated teaching, allowing students to make judgments after careful thinking based on their own logic, cognition, and observation. They immediately receive different feedback generated by different choices. Chau et al. [10] suggested that not only did situational simulation receive high satisfaction from students, but it also aroused their interest in courses more than the traditional learning model and reduced truancy among students. Safaei and Shafieiyoun [11] pointed out that virtual learning environments have gradually been widely applied in various fields, such as medical treatment and business, especially in education. Teachers can provide students with a sense of presence similar to personal experience through a virtual learning environment. Moreover, situational simulation can improve students' interest in learning.

CPIT combines computer operations, sensors, and the use of Internet technology to connect equipment and digital systems, enabling software and hardware to communicate with each other to integrate virtual and physical worlds. The characteristics of CPIT include (1) preventing machines from getting crashed because of students writing wrong programs or logical errors; (2) preventing students from getting injured for failing to follow safe operations; (3) fending off worrying about buying insufficient process equipment and training materials because of the lack of funding; (4) having teaching innovation, which can attract students' interests and improve their learning motivation. In this study, CPIT was applied to the automation platform. By integrating the control system, the computing power of the computer, and the connection between each physical device and the computer computing network were emphasized. Giorgio et al. [12] proposed to take unity software as the development basis of the virtual reality platform, established the mechanical arm model through drawing software and integrated it into the virtual reality platform, and achieved the integration of software and hardware by writing scripts and combining the controller of the real mechanical arm. Meanwhile, Dumitrache and Borangiu [13] constructed an arm simulation environment for teaching and research. Further, CPIT can allow students to interact with learning materials and provide them with an immersive experience and opportunities to practice repeatedly. The key technologies of Industry 4.0 can be integrated to build a smart factory. Lee et al. [14] pointed out that information analysis and calculation could be used for more efficient execution, collaborative cooperation, and flexibility—a trend that would change the manufacturing industry.

2.3. Technology Acceptance Model (TAM)

TAM is a powerful, robust, and commonly applied model derived from the theory of reasoned action (TRA), used to predict the behavior of users and the adoption of new technologies [15]. Paimin et al. [16] investigated the motivational factors necessary to succeed in engineering. The TRA model was used to guide the suggested paths from learning strategy, interest, and intention to academic performance.

Further, TAM was developed to explain computer usage behavior and factors associated with the acceptance of various technologies or software used in teaching and learning [17]. In short, TAM demonstrates that perceived ease of use and perceived usefulness both influence users' attitudes toward the use of technology and their intention to use technology.

In TAM, perceived usefulness and perceived ease of use are independent variables, while users' attitudes and behavioral intention to use are dependent variables. It claims that perceived usefulness and perceived ease of use will affect a user's attitude to using technology, thereby affecting specific behaviors. In addition, it also claims that the use of information technology is affected by behavioral intention to use. Perceived usefulness and perceived ease of use are mainly applied to explain and infer user attitudes and behavioral intention to use. Noteworthily, these two are affected by external variables [18,19].

3. Methodology

The technology acceptance model (TAM) is constructed according to the relevant literature, as shown in Figure 1. The variables include the perceived ease of use, perceived usefulness, and the behavioral intention of students to use the system, as well as the background characteristics of the students.

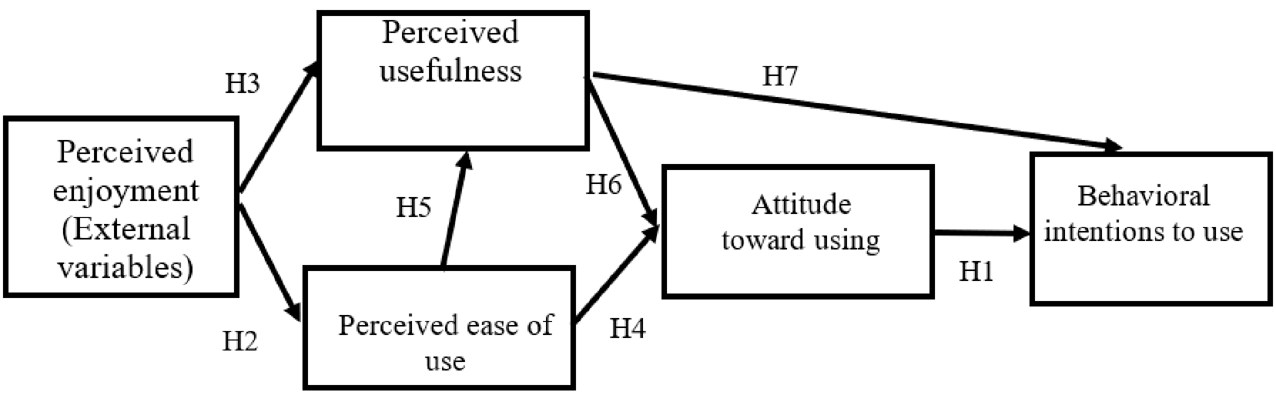

Figure 1. Technology acceptance model (TAM).

Figure 2 presents the research structure of this study. This study conducted extensive research with a substantial numerical analysis. Some experimental results were also presented in Shyr et al. [20]. Students use automation technology and CPIT on the presented automation platform and use the technology acceptance model to evaluate the proposed technology.

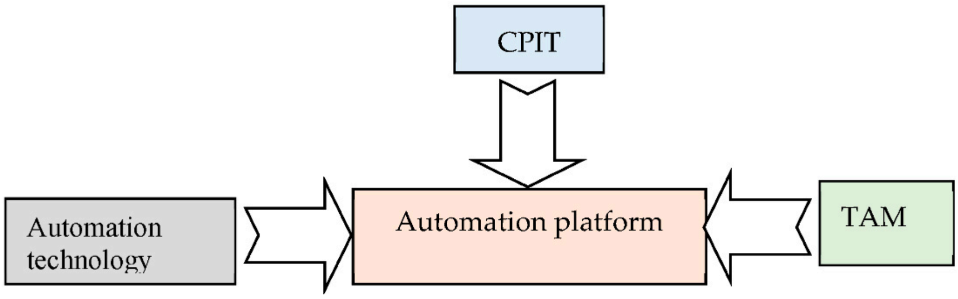

Figure 2. Research structure.

3.1. Participants

A total of 34 students from a technological university in central Taiwan were taken as subjects.

3.2. Research Implementation

The teaching outcomes of the cyber–physical integration technique in an automation platform were explored using TAM. The teaching duration of the course was six weeks, with 3 h per week and 18 h in total. A quantitative questionnaire based on TAM was used as the main test tool.

3.3. Research Tools

The questionnaire was conducted according to the revised scales provided by references for the research tools, indicating good scale reliability [21,22]. The measurement was based on a 5-point Likert scale, ranging from 5 (strongly agree), 4 (agree), 3 (unsure), 2 (disagree) to 1 (strongly disagree).

After the questionnaire was completed, scholars and experts in education and technology were invited to review the questionnaire and suggest corrections in order to construct expert content validity. A TAM scale was developed and divided into five dimensions: perceived enjoyment, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use. There are 4 items for each dimension and 20 items in total.

3.4. Reliability and Validity Analysis of the Scale

The pretest scale of TAM and the Cronbach's α coefficient was 0.959, which shows internal consistency. In addition, inappropriate questions were deleted after the scale items were analyzed. The KMO value was 0.935 after item analysis by SPSS. Further, the factor analysis was conducted to build scale validity.

4. Data Analysis

A questionnaire survey on the automation platform teaching course was conducted with students, and statistical analysis software SPSS and SmartPLS 2.0 were used for data analysis and processing. In order to solve the explored problems, independent sample t-testing, regression analysis, and path equation were adopted in this questionnaire for analysis. The results are summarized as follows:

4.1. Descriptive Statistics for the Questionnaire Scale of TAM

Table 1 shows the data collected from the TAM scale of this questionnaire.

Table 1. Descriptive statistics of the TAM questionnaire.

Dimension	Item	Mean	SD
Perceived enjoyment	1. When learning CPIT, I forget the passing of time.	3.89	0.81
	2. When learning CPIT, I take no particular notice of whether my surroundings are noisy.	3.79	0.86
	3. The CPIT is fun to use.	4.16	0.77
	4. The CPIT can trigger my interest in learning.	4.17	0.73
Perceived usefulness	5. I think CPIT can improve my learning outcomes.	3.96	0.82
	6. I think CPIT can improve my learning ability.	4.12	0.78
	7. I think it is useful to learn CPIT.	4.30	0.72
	8. I think CPIT can increase my learning efficiency.	3.92	0.84
Perceived ease of use	9. The interfaces of CPIT are clear and understandable.	3.71	0.89
	10. The software of CPIT is easy to use.	3.23	1.02
	11. The hardware of CPIT is easy to use.	3.19	0.98
	12. The links between the software and hardware of CPIT are easy to learn.	3.26	0.98
Attitude toward using	13. I think CPIT is a great system to use.	4.31	0.71
	14. CPIT is satisfactory.	4.08	0.75
	15. CPIT is a good way to learn.	4.08	0.83
	16. I love the course using CPIT for learning.	3.91	0.81
Behavioral intention to use	17. I am willing to use CPIT for learning.	4.06	0.84
	18. I feel happy when using CPIT for learning.	3.87	0.87
	19. I would like to increase the frequency of using CPIT for learning.	3.93	0.82
	20. I hope I still can use CPIT for learning in the future.	4.06	0.79

N = 34.

(1) In the perceived enjoyment dimension of this TAM scale, the maximum average mean is 4.17, and the minimum average mean is 3.79, indicating that students are interested and motivated to learn CPIT;

(2) Regarding the perceived usefulness dimension, the maximum average mean is 4.30, and the minimum average mean is 3.92, indicating that students generally agree that it is beneficial for the learning performance of CPIT and future development;

(3) Regarding the perceived ease of use dimension, the maximum average mean is 3.71, and the minimum average mean is 3.19, indicating that students can accept and learn CPIT operation and are willing to learn;

(4) Regarding the attitude toward using dimension, the maximum average mean is 4.31, and the minimum average mean is 3.91, indicating that students generally agree that the evaluation of CPIT learning is positive;

(5) Regarding the behavioral intention to use dimension, the maximum average mean is 4.06 and the minimum average mean is 3.87, indicating that students are generally interested in and willing to use CPIT.

4.2. Questionnaire Reliability Analysis

4.2.1. Reliability Analysis of Perceived Enjoyment

The reliability analysis of perceived enjoyment in this questionnaire shows that Cronbach's α value is 0.878, indicating that this questionnaire meets the high-reliability standards. The reliability analysis results are shown in Table 2.

Table 2. Reliability analysis of perceived enjoyment.

	Items of the Scale	**Correlation to the Total Score of the Scale**	**Cronbach's α after This Item Is Deleted**	**Cronbach's α**
1	When learning CPIT, I forget the passing of time.	0.740	0.842	0.878
2	When learning CPIT, I take no particular notice of whether my surroundings are noisy.	0.753	0.838	
3	CPIT is fun to use.	0.727	0.847	
4	CPIT can trigger my interest in learning.	0.732	0.846	

4.2.2. Reliability Analysis of Perceived Usefulness

The reliability analysis of perceived usefulness in this questionnaire shows that Cronbach's α coefficient is 0.840, indicating that this questionnaire meets the high-reliability standards. The reliability analysis results are shown in Table 3.

Table 3. Reliability analysis of perceived usefulness.

	Items of the Scale	**Correlation to the Total Score of the Scale**	**Cronbach's α after This Item Is Deleted**	**Cronbach's α**
5	I think CPIT can improve my learning outcomes.	0.716	0.777	0.840
6	I think CPIT can improve my learning ability.	0.650	0.807	
7	I think it is useful to learn CPIT.	0.650	0.808	
8	I think CPIT can increase my learning efficiency.	0.794	0.794	

4.2.3. Reliability Analysis of Perceived Ease of Use

The reliability analysis of perceived ease of use in this questionnaire shows that Cronbach's α coefficient is 0.903, indicating that this questionnaire meets the high-reliability standard. The reliability analysis results are shown in Table 4.

Table 4. Reliability analysis of perceived ease of use.

	Items of the Scale	**Correlation to the Total Score of the Scale**	**Cronbach's α after This Item Is Deleted**	**Cronbach's α**
9	The interfaces of CPIT are clear and understandable.	0.590	0.936	0.903
10	The software of CPIT is easy to use.	0.837	0.954	
11	The hardware of CPIT is easy to use.	0.853	0.848	
12	The links between the software and hardware of CPIT are easy to learn.	0.861	0.845	

4.2.4. Reliability Analysis of Attitude toward Using

The reliability analysis of attitude toward using in this questionnaire shows that Cronbach's α coefficient is 0.901, indicating that this questionnaire meets the high-reliability standards. The reliability analysis results are shown in Table 5.

Table 5. Reliability analysis of attitude toward using.

	Items of the Scale	Correlation to the Total Score of the Scale	Cronbach's α after This Item Is Deleted	Cronbach's α
13	I think CPIT is a great system to use.	0.742	0.886	0.901
14	CPIT is satisfactory.	0.823	0.857	
15	CPIT is a good way to learn.	0.774	0.876	
16	I love the course using CPIT for learning.	0.786	0.870	

4.2.5. Reliability Analysis of Behavioral Intention to Use

The reliability analysis of behavioral intention to use in this questionnaire shows that the Cronbach's α coefficient is 0.912, indicating that this questionnaire meets the high-reliability standard. The reliability analysis results are shown in Table 6.

Table 6. Reliability analysis of behavioral intention to use.

	Items of the Scale	Correlation to the Total Score of the Scale	Cronbach's α after This Item Is Deleted	Cronbach's α
17	I am willing to use CPIT for learning.	0.803	0.885	0.912
18	I feel happy when using CPIT for learning.	0.784	0.893	
19	I would like to increase the frequency of using CPIT for learning.	0.837	0.873	
20	I hope I still can use CPIT for learning in the future.	0.780	0.893	

4.3. Regression Analysis of the TAM Scale

4.3.1. Regression Analysis between Perceived Enjoyment and Perceived Usefulness

The relationship between the independent variable "perceived enjoyment" and the dependent variable "perceived usefulness" is explored using SPSS regression analysis. The results are shown in Table 7. The results show that the significance is $p = 0.000 < 0.001$, implying a significant difference. Hence, the hypothesis is supported, and the valid hypothesis indicates that perceived enjoyment has significant effects on perceived usefulness.

Table 7. Regression analysis between perceived enjoyment and perceived usefulness.

	Unstandardized Coefficient		Standardized Coefficient	t	Significance
	Estimated Value of B	Standard Error	Beta Distribution		
Perceived enjoyment	0.740	0.217		3.409	0.001
	0.801	0.053	0.765	15.213	0.000 ***

*** $p < 0.001$, F = 231.45, $R^2 = 0.583$.

4.3.2. Regression Analysis between Perceived Enjoyment and Perceived Ease of Use

The relationship between the independent variable "perceived enjoyment" and the dependent variable "perceived ease of use" is explored using SPSS regression analysis. The results are shown in Table 8, where the significance is $p = 0.000 < 0.001$, implying a significant difference. Hence, the hypothesis is supported, and the valid hypothesis indicates that perceived enjoyment has a significant effect on perceived ease of use.

Table 8. Regression analysis between perceived enjoyment and perceived ease of use.

	Unstandardized Coefficient		Standardized Coefficient	t	Significance
	Estimated Value of B	Standard Error	Beta Distribution		
Perceived enjoyment	2.506	0.178		14.092	0.000
	0.447	0.051	0.561	8.683	0.000 ***

*** $p < 0.001$, F = 75.402, $R^2 = 0.315$.

4.3.3. Regression Analysis between Perceived Usefulness and Attitude toward Using

The relationship between the independent variable "perceived usefulness" and the dependent variable "attitude toward using" is explored using SPSS regression analysis. The results are shown in Table 9. The results show that the significance is $p = 0.000 < 0.001$, implying a significant difference. Hence, the hypothesis is supported, and the valid hypothesis indicates that perceived usefulness has a significant effect on attitude toward using.

Table 9. Regression analysis between perceived usefulness and attitude toward using.

	Unstandardized Coefficient		Standardized Coefficient	t	Significance
	Estimated Value of B	Standard Error	Beta Distribution		
Perceived usefulness	0.811	0.170		4.782	0.000
	0.797	0.041	0.836	19.492	0.000 ***

*** $p < 0.001$, F = 379.926, $R^2 = 0.698$.

4.3.4. Regression Analysis between Perceived Ease of Use and Attitude toward Using

The relationship between the independent variable "perceived ease of use" and the dependent variable "attitude toward using" is explored using SPSS regression analysis. The results are shown in Table 10, where the significance is $p = 0.000 < 0.001$, implying a significant difference. Hence, the hypothesis is accepted. Further, the valid hypothesis indicates a significant difference between perceived ease of use and attitude toward using.

Table 10. Regression analysis between perceived ease of use and attitude toward using.

	Unstandardized Coefficient		Standardized Coefficient	t	Significance
	Estimated Value of B	Standard Error	Beta Distribution		
Perceived ease of use	0.484	0.337		1.437	0.153
	0.699	0.081	0.558	8.615	0.000 ***

*** $p < 0.001$, F = 74.222, $R^2 = 0.312$.

4.3.5. Regression Analysis between Attitude toward Using and Behavioral Intention to Use

The relationship between the independent variable "attitude toward using" and the dependent variable "behavioral intention to use" is explored using SPSS regression analysis. The results are shown in Table 11. The results indicate that the significance is $p = 0.000 < 0.001$, implying a significant difference. Hence, the hypothesis is accepted. Further, the valid hypothesis indicates that attitude toward using has a significant effect on behavioral intention to use.

Table 11. Regression analysis between attitude toward using and behavioral intention to use.

	Unstandardized Coefficient		Standardized Coefficient	t	Significance
	Estimated Value of B	Standard Error	Beta Distribution		
Attitude toward using	1.028	0.161		6.402	0.000
	0.771	0.040	0.835	19.434	0.000 ***

*** $p < 0.001$, F = 377.690, $R^2 = 0.697$.

4.4. TAM Validation

The significance testing was conducted on the structural model using the SmartPLS 2.0 software to explore the validity of the hypotheses. In PLS, the R^2 values are mainly used to test the forecasting abilities of the structural paths. The R^2 values refer to the percentage of the variations that dependent variables can explain after independent variables are inserted. They also represent the forecasting ability of the study model. The resampling frequency was set at 2000 to test the significance of all paths. The TAM validation results are shown in Figure 3.

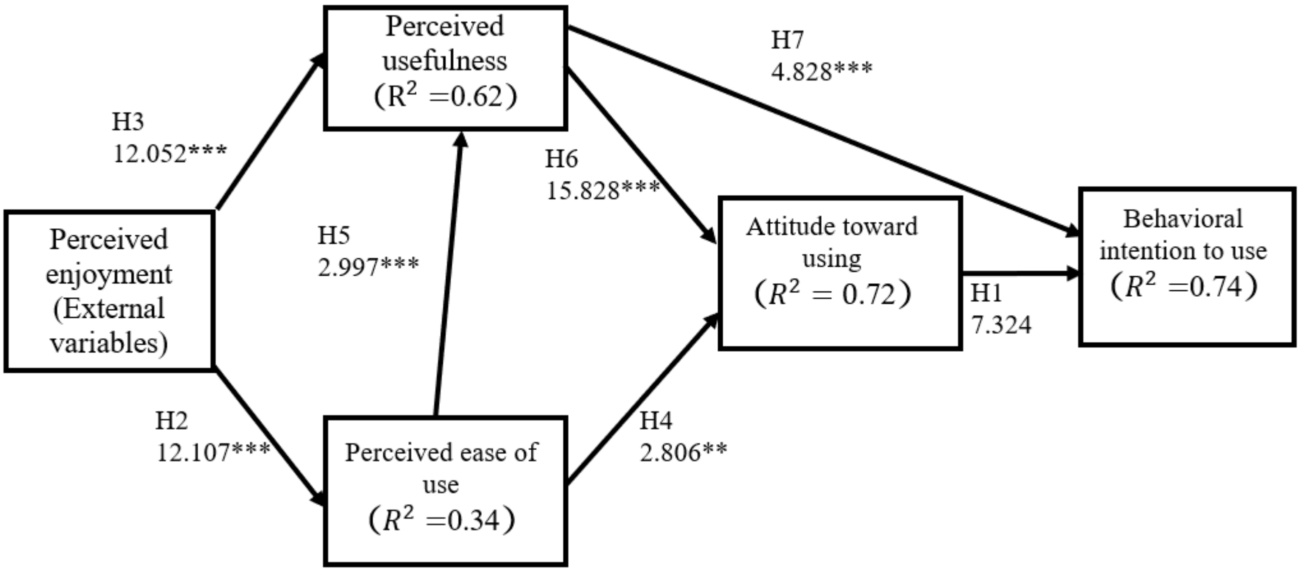

Figure 3. TAM validation results (** $p < 0.01$, *** $p < 0.001$).

The results indicate that perceived usefulness and perceived ease of use have strong explanatory power regarding attitude toward using ($R^2 = 0.72$), and attitude toward using also has strong explanatory power regarding behavioral intention to use ($R^2 = 0.74$). In addition, perceived enjoyment (external variables) has strong explanatory power regarding perceived usefulness ($R^2 = 0.62$) and perceived ease of use ($R^2 = 0.34$).

The relationship among all variables is shown in Table 12. In the seven hypotheses, except for H1, the other variables reached a significant level. The hypothesis report shows that attitude toward using has no significant positive effect on behavioral intention to use (H1) ($\beta = 0.526$, $p > 0.05$). Meanwhile, the perceived enjoyment has a significantly positive effect on perceived ease of use (H2) ($\beta = 0.583$, $p < 0.001$) and perceived usefulness (H3) ($\beta = 0.664$, $p < 0.001$). Perceived ease of use has a significantly positive effect on attitude toward using (H4) ($\beta = 0.140$, $p < 0.01$) and perceived usefulness (H5) ($\beta = 0.190$, $p < 0.001$). Finally, perceived usefulness has a significantly positive effect on attitude toward using (H6) ($\beta = 0.757$, $p < 0.001$) and behavioral intention to use (H7) ($\beta = 0.368$, $p < 0.001$).

Table 12. Test results of relationships among variables.

Hypothesis/Relationship between Variables	Path Coefficient (β)	*t* Value	Test Result
H1: Attitude toward using→Behavioral intention to use	0.526	7.324	unsupported
H2: Perceived enjoyment→Perceived ease of use	0.583	12.107 ***	supported
H3: Perceived enjoyment→Perceived usefulness	0.664	12.052 ***	supported
H4: Perceived ease of use→Attitude toward using	0.140	2.806 **	supported
H5: Perceived ease of use→Perceived usefulness	0.190	2.997 ***	supported
H6: Perceived usefulness→Attitude toward using	0.757	15.828 ***	supported
H7: Perceived usefulness→Behavioral intention to use	0.368	4.828 ***	supported

** $p < 0.01$, *** $p < 0.001$.

5. Discussions

The cyber–physical systems approach has been employed in other industry sectors. According to Crenshaw et al. [23], cyber–physical systems can control and monitor the physical world with component-based, real-time systems. Lee [24] concluded that dynamic and cyber–physical systems integrate physical processes with computation, with the former and the latter affecting each other in feedback loops. Rajkumar et al. [25] proposed that the operations of cyber–physical systems, which are physical and engineered, are activated and coordinated by a computing and communication core. Tang et al. [26] also regarded cyber–physical systems as a situation-integrated analytical system that responds intelligently to the dynamic changes in real-world scenarios with the integration of physical devices (e.g., sensors, cameras) and cyber components.

This study used TAM by incorporating the cyber–physical integration technique in an automation platform and integrating technology acceptance and learner satisfaction. The overall results supported the influence of the teaching module in contributing to the critique of this psychological education theory.

In the TAM questionnaire, as developed and built, the dimensions consist of perceived enjoyment (external variable), perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use. The study results are as follows:

(1) Attitude toward using has no significant effect on behavioral intention to use;
(2) Perceived enjoyment has a significantly positive effect on perceived ease of use;
(3) Perceived enjoyment has a significantly positive effect on perceived usefulness;
(4) Perceived ease of use has a significantly positive effect on attitude toward using;
(5) Perceived ease of use has a significantly positive effect on perceived usefulness;
(6) Perceived usefulness has a significantly positive effect on attitude toward using;
(7) Perceived usefulness has a significantly positive effect on behavioral intention to use.

Learning through the use of the cyber–physical integration technique in an automation platform was more effective than some other activities at supporting a higher cognitive presence. Two variables identified as significant factors in TAM (perceived usefulness and perceived ease of use) were shown to have a significant influence on the intention of learners to use the automation platform. This study's findings that TAM can be used to predict behavioral intention to use are consistent with the findings of previous studies [27,28]. Perceived usefulness had indirect and direct effects on learners' acceptance of the proposed automation platform system. Noteworthily, some researchers have obtained similar findings [29–31].

In future studies, test samples can be expanded, and TAM can be further imported in order to explore the behavioral intention to use and efficiencies of students applying the cyber–physical integration technique to relevant courses. Future work would be to explore possible differences indicated in the corresponding attitudinal measurements used before and after course attendance.

6. Conclusions

This study aimed to explore students' acceptance of applying the technology acceptance model to the cyber–physical integration technique in an automation platform. Technological university students were taken as subjects, and the automation platform was used as a learning medium to make the teaching activities lively and smooth. The results of our statistical analysis demonstrate that the students in this study were willing to use the cyber–physical integration technique in an automation platform.

Furthermore, students are highly satisfied with the automation platform. Observations during this study and the analysis report of the study questionnaire show that most learners had positive evaluations of perceived enjoyment, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use. Most students also agreed that the cyber–physical integration technique in an automation platform was beneficial to improving their learning outcomes.

Moreover, this study analyzed technological university students' adoption of the cyber–physical integration technique. Firstly, ease of use is the primary factor that must be taken into consideration in the design, followed by usefulness. Likewise, perceived usefulness may be able to predict attitudes toward use. Secondly, the path analysis demonstrated that the acceptance of the proposed system was directly influenced by perceived usefulness and indirectly influenced by perceived ease of use. Therefore, ease of use should be a priority in designing the proposed platform. When designing a cyber–physical integration technique in an automation platform for students, teachers should pay attention to enriching learning content and ease of use to improve students' behavioral intention.

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