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A DISCRIMINANT ANALYSIS OF ACTUAL USE OF CLOUD TECHNOLOGY FOR VOCATIONAL AND TECHNICAL EDUCATION

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ABSTRACT

The objectives of this research are 1) to study the independent variables that are used in the stepwise discriminant analysis of the actual use of cloud technology, 2) to create a discriminant function of the actual use of cloud technology. The sample consists of 1,620 Thai vocational and technical students who have used cloud technology. The data collection tool used in this study is a questionnaire. The statistical analysis used in this research is 'Stepwise Discriminant Analysis (SDA)'. The results indicate that 1) the t-test results with regard to seven independent variables (Perceived Usefulness, Perceived Ease of Use, System Quality, Information Quality, Service Quality, Perceived Security, and Social Cloud) were at a significance level of .05. This could be used to classify the groups in terms of 'Actual Use of Cloud Technology', and 2) the accuracy of the set of these seven variables that were used to predict the 3 groups was at 88.1 percent.

Keywords: Technology Acceptance Model, Social Cloud, Information System Success Model, Perceived Security.

1. INTRODUCTION

Cloud technology is considered to be one of the technologies in the 21st Century. [21] that is applied in learning, teaching, business, industry, and medicine [5]. The cloud provides the services available in terms of hardware, software, infrastructure and storage space via the internet, anywhere and anytime, according to the user's desire [17, 22]. Additionally, cloud technology has helped to reduce the cost of system establishment and the maintenance of the system's efficiency and flexibility in such a way as to satisfy the demands of the user [23, 34]. At present, various firms are interested in the services associated with cloud technology including such companies as Microsoft and Google [34]. The Technology Acceptance Model (TAM) was a theory that was created by Davis in 1989. This theory was developed from the 'Theory of Reasoned Action' (TRA). TAM was an information technology acceptance model that studied the factors that affect actual technology. It consists of external variables through perceived usefulness variables(PU) and perceived ease of use (PEOU) variables [12].

The Information System Success Model (IS Success Model) was designed by DeLone and McLean in 1992. This model aimed to identify factors that could lead to the success of information technology systems. The main factors were 1) System Quality: this is the existence of a flexible system that could respond to system operations rapidly and effectively, 2) Information Quality: this satisfies the needs of the user thoroughly,

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accurately, reliably and efficiently, 3) Service Quality: this is a service provided in the form of information and operations that were quick and effective, such as error checking and suggestion giving [14], and 4) User satisfaction: It is the level of the success dimension of the successful interaction between an information system users [36] and it is defined as the extent to an information system can meet the needs of the user.[30]

Perceived security is a set of operating procedures that deal with information technology complexity in such a way as to protect the information associated with different transactions from being revealed to the public. This makes the user confident about the reliability of the service provided. Moreover, the user may check and examine different kinds of services in his or her system [6, 26].

The social cloud is an infrastructure that is a part of the cloud computing system and social networks [18] that relates to the relationships of members [7,9] linked via online social networks instead of having an actual relationship in the real world [8] to help these members interact with one another easily [25]. Moreover, the members can choose to share and exchange resources [7, 32], and to be able to cooperate [8].

Vocational and technical education aims to elevate 21st Century learning and teaching and comply with the policy of 'The Office of the Vocational Education Commission (OVEC)' which focused on digital appliances [35] by increasing the skills and expertise of students about communication and information technology. Hence, education could fulfill the requirements of different jobs in the digital era [27].

As mentioned above, the researcher studied journals and research related to the actual use of cloud technology in order to learn about the variables that could affect the actual use of cloud technology, in the form of system quality, perceived usefulness, perceived ease of use, information quality, social cloud, service quality, and the perceived security. To create a discriminant function that will discriminate among students in vocational and technical education in the actual use of cloud technology and the researcher used stepwise discriminant analysis.

2. RESEARCH QUESTION

1) What are the independent variables that were used in Stepwise Discriminant Analysis with regard to the 'Actual Use of cloud technology'? 2) How was the discriminant function of 'Actual Use of cloud technology'?

3. RESEARCH OBJECTIVES

1) To study the independent variables that were used in the Stepwise Discriminant Analysis of 'Actual Use of cloud technology'.

2) To create a discriminant function with regard to the 'Actual Use of cloud technology'.

4. CONCEPT FRAMEWORK

The researcher defined a conceptual framework by synthesizing variables of which were identified in 10 journal articles [1,2,3,4,10, 24,28,29,31,33].

5. RESEARCH METHODOLOGY



Figure 1: Research Framework.

5.1 Research Hypothesis

1) System Quality, Perceived Usefulness, Perceived Ease of Use, Information Quality, Social Cloud, Service Quality and Perceived Security could be used to classify students into different groups according to their actual use of cloud technology.



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2) The discriminant function with regard to the actual use of cloud technology could be classified as the correct group more than the criteria.

5.2 Population and Samples

The sample that was used in this study consisted of vocational and technical school students in Thailand who have used cloud technology. Discriminant analysis was implemented to set the size of the sample. For example, the sample size should be 20 times that of the predictor variables [20]. The researcher chose the size of the sample to be 81 times the independent variables. Thus, 1,620 students participated in this study. However, the researcher could only collect 1,442 questionnaires from the respondents (89.01%) from 27 institutes by the use of multistage random sampling to obtain data. Cluster random sampling was used to select 9 vocational and technical education networks from the data of the Office of the Vocational Education Commission in Thailand. For each vocational and vocational and technical education networks from the data of the Office of the Vocational Education Commission in Thailand. For each vocational and

6. RESEARCH FINDINGS

6.1 The results of undamental data analysis

The results of the basic demographic data analysis of the sample are shown below.

The results of the frequency distribution of the demographic data are presented in terms of sex, internet experience, and activity usage. The findings revealed that 55.22 percent of the students who participated in this study were female. The respondents who had had more than 6 years of internet experience made up 65.46 percent of the total. Those who had internet experience of between 5 and 6 years made up 16.85 percent. Those with 3 to 4 years internet experience made up 14.70 percent. Finally, 2.98 percent of the participants had internet experience of between 1 and 2 years. Some 1,291 of the students used the internet to play games, watch movies, and listen to music, whereas 1,033 students used the internet to participate in social networks. There were 769 students who used the internet to study, and 459 respondents who used the internet to send and

Demographic factors	Group	Amount	Percent
1. Gender	1. Male	646	44.80
	2. Female	796	55.22
	SUM	1,442	100.00
2. Internet experience	1. 1-2 years	43	2.98
	2. 3-4 years	212	14.70
	3 .5-6 years	243	16.85
	4. More 6 years	944	65.46
	SUM	1,442	100.00
3. Activity Usage	 Learning and Teaching Sending-Receiving e-mail Participating in social network Playing games, watching movies, and listening to music 	769 459 1,033 1,291	- - - -

Table 1: Summary of Physical Parameters.

technical education network, the researcher selects 3 vocational and technical institutions and selects 60 students who had used cloud technology from each Vocational and Technical Education institute by simple random sampling. receive e-mails. The details of this analysis are shown in Table 1.

6.2 The results of stepwise discriminant analysis of vocational and technical student's actual use of cloud technology

In this part, the continuous analysis was made to answer the research hypotheses and meet the objectives about the actual use of cloud



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technology on the part of vocational and technical students. The answers could be 'Less Use', 'Moderate Use', and 'Frequent Use' by applying stepwise discriminant analysis (SDA).

The dependent variable that was used in the stepwise discriminant analysis was 'actual use of cloud technology'. The results showed that 482 students (33.43%) answered 'Less Use', 460 samples (31.90%) answered 'Moderate Use', and 500 students (34.67%) answered 'Frequent Use'.

In this study, the researcher would like to present 3 sections dealing with the analysis: 1) the results of the mean value analysis, 2) the results of stepwise discriminant analysis, and 3) classification accuracy, as shown below. among the groups at a significance level of .05. Thus, the seven predictor variables were suitable for use in classifying groups. After considering the ranking of values according to Wilks' Lambda in ascending order, and the approximate F in descending order, the best independent variable that could be used to classify the group for Actual Use of cloud technology was 'Perceived Security(PSEC)'. The second best variable was 'Service Quality (SER)'. Then, in descending order the rest of the variables were System Quality (SYS), Perceived Ease of Use (PEOU), Social Cloud (SOC), Perceived Usefulness (PU), and Information Quality (INQ). This can be seen in

Variable	Less Use		Moderate Use		Often Use		Wilks'	E	461	462	2
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.	lambda		un	uiz	þ
SYS	2.480	.471	3.200	.299	3.668	.345	.372**	1214.994**	2	1439	.000
PU	2.486	.479	3.047	.350	3.535	.406	.479**	782.203**	2	1439	.000
PEOU	2.364	.544	3.096	.273	3.592	.379	.400**	1080.208**	2	1439	.000
INQ	2.398	.650	3.067	.495	3.437	.531	.627**	427.388**	2	1439	.000
SOC	2.432	.515	3.122	.304	3.584	.359	.416**	1011.493**	2	1439	.000
SER	2.363	.533	3.088	.259	3.610	.329	.365**	1249.211**	2	1439	.000
PSEC	2.351	.469	3.069	.290	3.581	.360	.358**	1287.899**	2	1439	.000
Box's M=928.318, F=16.464, df1=56, df2=5864817.654, p =.000											

Table 2: The differences of Vocational and Technical students	s' actual use of cloud technology.
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NOTE : ** p < .01

6.2.1 The result of mean value analysis

The hypotheses were checked by applying Wilks' Lambda statistic and the approximate F, the hypothesis that the dependent variable's mean value among the three groups of vocational and technical students would be equal, was rejected. This could be explained by the fact that the means of the seven independent variables were different Table 2. A bar chart and line graph reveal the differences of the means among the groups as shown in Figs. 2 and 3, respectively.

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Figure 2: The bar chart displays the comparison of the average values of variables in each group.



Figure 3: The line graph that displays the comparison of standard deviation of variables in each group.



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6.2.2 The result of Stepwise Discriminant Analysis

Seven independent variables: Perceived Usefulness, Perceived Ease of Use, System Quality, Information Quality, Service Quality, Perceived Security, and Social Cloud were incorporated in the stepwise discriminant analysis. These seven variables could be used in the equation since the value of Wilks' λ of .358 in step 1 had decreased to.234 in step 7 with a significance value at .05 (F = 216.214, P =.000). This implied that these seven independent variables could be applied to predict the classification of actual Use of Cloud Technology together as illustrated in Table 3.

Sten Variables		Wilks'	10	102	100	Exact F			
Step	v unuoros	lambda	all	df2	d13	Statistic	df1	df2	Sig.
1	PSEC	.358	1	2	1439	1287.899	2	1439	.000
2	PSEC, SYS	.284	2	2	1439	630.587	4	2876	.000
3	PSEC, SYS, SER	.258	3	2	1439	463.251	6	2874	.000
4	PSEC, SYS, SER, SOC	.244	4	2	1439	367.856	8	2872	.000
5	PSEC, SYS, SER, SOC, PEOU	.240	5	2	1439	298.812	10	2870	.000
6	PSEC, SYS, SER, SOC, PEOU, PU	.238	6	2	1439	250.867	12	2868	.000
7	PSEC, SYS, SER, SOC, PEOU, PU, INQ	.237	7	2	1439	216.214	14	2866	.000

Table 3: Variables in the Stepwise Discriminant Analysis.

The first canonical discriminant function of the discriminant analysis had an Eigenvalue at 3.184 which was higher than 1. Thus 99.7% of the total variance could be explained, whereas the second one accounted for .3% of the total variance. The value of the canonical correlation analysis between the first pair of discriminant functions was .872 at a significance level of .05 (Wilks' Lambda = .237, $\chi 2 = 2070.276$, df = 14, p = .000). For the second pair, the value of canonical correlation analysis was 102 at a significance level of .05 (Wilks' Lambda = .990, $\chi 2 = 15.107$, df = 6, p = .019). The results imply that there is a significant relationship between the discriminant function of 1, 2, and seven independent variables among the groups, as shown in Table IV.

Table 4: The Canonical Discriminant Functions.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation	Wilks, Lambda	χ2	df	р
1	3.184	99.7	99.7	.872	.237**	2070.276**	14	.000
2	.011	.3	100.0	.102	.990*	15.107*	6	.019

NOTE: * p < .05, ** p < .01

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After considering the independent variables that were used to classify the groups of discriminant function coefficients in the form of the standard score in function 1, System Quality (SYS) had the highest value of the discriminant function coefficients (.324). Therefore, System Quality (SYS) was an essential variable to separate the No.

1 group of function. For function No. 2, Perceived Usefulness (PU) was the variable with the highest value of discriminant function coefficients at .966. Hence, Perceived Usefulness (PU) was a crucial variable to separate the groups of function No. 2. In addition, Perceived Security (PSEC) was a variable that was the most important variable for canonical variables (.750) as displayed in Table 5.

Variable	Standardized	Coefficients	Structure Matrix		
v arraute	Function 1	Function 2	Function 1	Function 2	
SYS	.324	.336	.728*	.193	
PU	.061	966	.583	656*	
PEOU	.170	.116	.687*	.049	
INQ	.070	.610	.431	.432*	
SOC	.243	.117	.664*	.081	
SER	.268	141	.738*	161	
PSEC	.296	.003	.750*	127	

Table 5: The Discriminant Function Coefficients.

NOTE: * p < .05

From the value of discriminant coefficients of different variables according to the result revealed in Table 6, discriminant function can be interpreted as follows:

Discriminant function of group 1:

^ D1 = -39.785 + .8.611SYS + 4.847PU + 2.543PEOU + 1.820INQ + 5.895SOC + 3.601SER + 4.572PSEC

Discriminant function of group 2 :

D2 = -65.026 + 10.972SYS + 4.739PU + 3.645PEOU + 2.362INQ +7.489SOC + 5.267SER +6.556 PSEC

Discriminant function of group 3

 $\hat{D3} = -86.268 + 12.264SYS + 5.533PU + 4.299PEOU + 2.330INQ + 8.475SOC + 6.546SER + 7.916PSEC$

Actual Use of Cloud Technology Variable 1.00 2.00 3.00 SYS 8.611 10.972 12.264 PU 4.847 4.739 5.533 PEOU 2.543 4.299 3.645 INQ 1.820 2.362 2.330 SOC 5.895 7.489 8.475 SER 3.601 5.267 6.546 PSEC 4.572 6.556 7.916 Constant -39.785 -65.026 -86.268

Table 6: Classification Functions Coefficients.

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After considering the classification of each function, function No. 1 was revealed to be the function that separated group 1 from group 2 and group 3, while function No. 2 separated group 2

from group 1 and group 3. In the graph, the data was shown to be classified into 3 groups as illustrated in Table 7 and Figs. 4 and 5.

Table 7	: Centroid	of each	group.
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Actual Use of	Group Centroid				
Cloud Technology	Function 1	Function 2			
1	-2.305	058			
2	.245	.149			
3	1.997	081			



Figure 4: Canonical Discriminant

-8	0.6	-6.0	-4.0	-2.0		.0		2.0	4.0	6.0	8.
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6.2.3 Classification Accuracy

According to the results of the Stepwise Discriminant Analysis, the group with moderate 'Actual Use of Cloud Technology' had the highest prediction accuracy of 95.9 percent, followed by data sets had a prediction accuracy of 88.1 percent as shown in Table 8.

Actual Use of Cloud Technology			Act	CLIM		
			Less Use	Moderate Use	Moderate Use Often Use	
		Less Use	404	78	0	482
Group		Moderate Use	0	441	19	460
	Amount	Often Use	0	74	426	500
		Less Use	83.8	16.2	.0	100.0
		Moderate Use	.0	95.9	4.1	100.0
	Percent	Often Use	.0	14.8	85.2	100.0

Table 8: Classification Results.

88.1% OF ORIGINAL GROUPED CASES CORRECTLY CLASSIFIED.

7. **DISCUSSION**

The seven independent variables can be utilized to predict 3 groups of data of 'Actual Use of Cloud Technology' at 88.1 percent, which was higher than the set criteria (33.33 percent). This revealed that seven independent variables were essential for the Actual Use of Cloud Technology since these seven independent variables cover the Actual Use of Cloud Technology. 'Perceived Usefulness' and 'Perceived Ease of Use' were the main variables of the 'Technology Accept Model (TAM)'[11], 'which was a theory about the factors that lead to the adoption of new technologies. 'System Quality', 'Information Quality', and 'Service Quality' were essential variables presented in the IS Success Model [13] that positively affected the quality system. Therefore, these variables increased the user's confidence level. In addition, 'Perceived Security' was another important variable for the system, because the safety system was considered as a standard of every information technology system, and it was crucial for service providers to protect the privacy of the user [19]. Social Cloud was a service model, and involved resource sharing on the social network by using the relationship of members in the social network [9] via social network applications that let 85.2 percent and 83.8 percent. Thus, using the set

of these seven independent variables to predict 3 the user create a group to connect with each other individually, and as a group [8].

System Quality (SYS) was an important variable when it came to classifying function No. 1, because System Quality (SYS) was one of the variables of the IS Success Model [13], and this supported the importance of cloud technology being available, stable and responsive. Hence, the user chose to use such a system [15, 16].

Perceived Usefulness (PU) was an essential variable in terms of classifying function No.2, since Perceived Usefulness was the major variable for the Technology Accept Model (TAM) that directly affects technology execution [11]. Thus, when the user has 'Perceived Usefulness (PU)' in terms of cloud technology, the user will have the 'Actual Use of Cloud Technology' in his or her everyday life.

In improvements for this research, researchers may study additional variables such as attitude toward using, satisfaction, and net benefit that can discriminate among students based on the increased Actual Use of Cloud Technology.

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8. RECOMMENDATION FOR FURTHER RESEARCH

Next time, the research will use discriminant analysis into 2 groups: use and non-use. And the study other independent variables such as attitude, satisfaction, interface, and different benefits caused by the use of information systems.

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