

# Path Analysis for Distance Learning with E-Learning

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## Abstract

In today's digital age, information technology is a strategic resource for universities in the era of rapid competition. The purpose of this study is to understand the influence of information technology, learning attitude, learning satisfaction, students' learning motivation, and learning achievement by path analysis, and to provide a reference for universities to promote an overall quality of learning and teaching. A total of seventy-five questionnaires were distributed in this study, and the effective questionnaire returned rate was 100%. The results showed that : (1) there was a significant positive impact between information technology (as e-learning) and learning motivation. (2) there was a significant positive impact between learning motivation and learning achievement. (3) there was a significant positive impact between learning attitude and learning motivation. (4) there was a significant positive impact between learning satisfaction and learning motivation.

**Keywords:** Information technology, Learning motivation, Learning attitude, Learning satisfaction, Learning achievement

## 1 Introduction

Information technology is one of the most important strategic resources for universities to enhance their competitiveness. The effective application of information technology in learning and teaching has become an indispensable part of the development strategies of universities. The information technology has affected the formal learning way due to its pragmatic components which are anytime, anywhere accessibility and just-in-time delivery [1-2]. With new advancements in information technology, e-learning has transformed the way of students' learning in universities in Taiwan. Therefore, this study aims to explore the path value of information technology, students' learning motivation, learning attitude, learning satisfaction, and learning achievement. The contribution of the research is that it's better understanding for the causal connections between

variables by a path analysis.

## 2 Research Background and Purpose

Due to the rapid changes in the technology environment in recent years, people learn new thinking and new ideas through the Internet and computer. The development of computer and Internet are combined with a large number of information technology application, production of various types of digital content or video materials, even offering on-demand video, and other kinds of more flexible distance education mode, which enable students to learn the tools, to surf the web and to make students themselves have a variety selection of diverse ways of learning. So, this study is going to investigate the interaction and correlation between information technology, learning motivation, learning attitude, learning satisfaction, and learning achievement.

### 2.1 The Survey Design and Sample Size

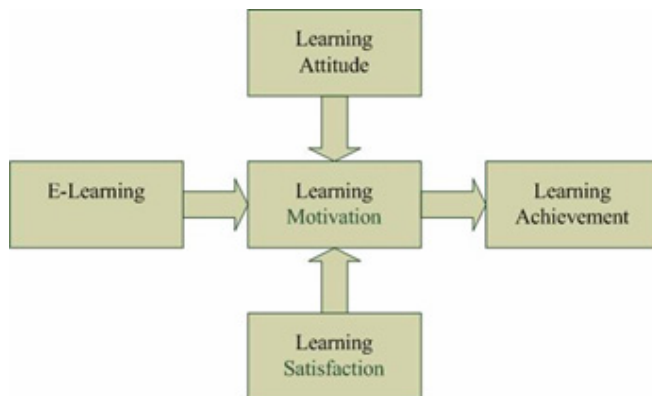
The present study wanted to explore if information technology, students' attitude, and learning satisfaction affect students' learning motivation and if students' learning motivation affects students' learning achievement. A survey with self-administered questionnaires did implement. The sample size of this study consisted of seventy-five undergraduate learners enrolled in regular-session online courses from the College of Engineering at Far East University. It took the researcher about four weeks to acquire seventy-five returned questionnaires for data collections under student's and instructor's permission to participate in the study.

### 2.2 The Survey Design and Sample Size

According to the above discussion, the main objectives of this study were to explore whether information technology (e-learning) will influence learning motivation, whether learning attitude and learning satisfaction will affect learning motivation, whether learning motivation will affect learning achievement from the perspective of students.

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Therefore, this study will analyze the relationship between information technology (e-learning), learning motivation, learning attitude, learning satisfaction, and learning achievement. As a result of this study to summarize the research objectives and the research structure as Figure 1.



**Figure 1.** Research structure

- (1) To verify if information technology (E-Learning) affects learning motivation.
- (2) To verify if learning attitude affects learning motivation.
- (3) To verify if learning satisfaction affects learning motivation.
- (4) To verify if learning motivation affects learning achievement.

### 3 Literature Review

Due to the establishment of research objectives and purpose, this chapter was divided into five sections. The first section was the definition of information technology; the second section was the description of learning motivation; the third section was the definition of learning attitude; the fourth section was the description of learning satisfaction; the last section was the meaning of learning achievement.

#### 3.1 Information Technology (e-learning)

The information technology is involving with computer systems, hardware, software, networks, electronics, internet, telecommunications, e-commerce, computer services for processing, storing, retrieving, analyzing and sending information [3-4]. The term e-learning is explained by “any learning that involves using internet or intranet” and “anything delivered, enabled, or mediated by electronic technology for specific purpose of learning”. It is the best way to improve the spreading and sharing knowledge and education programs through the Internet and e-learning. E-learning can be defined as a powerful learning way which can assist learners to evolve, enhance in everywhere, at every time and to everyone. E-learning not only provides a new chance for learners without barriers of location and time limitation but also extends

choices for teaching and learning by using information technology, and then the effect and advantage of e-learning depends on the self-motivation of individuals to study efficiently [5-7].

#### 3.2 Learning Motivation

Learning motivation is often defined as being intrinsic intention, where learners are interested in the course content, or extrinsic, where learners are interested in earning a course grade or credit [8]. Motivation coming from the individual’s learning behavior is called intrinsic motivation which is triggered internally for his/her benefit, interest, challenges, or curiosity; on the other hand, the individual affected by the encouragement from the outside such as award, compliment, punishment or social pressures is called extrinsic motivation [9]. Therefore, motivation is that learners are willing to participate and engage in the learning process and to move towards the established the goal-directed activity. Learners should be according to their own learning experience to moderate a learning attitude for improving learning motivation, to improve learning outcomes, achieve learning goals, and learning achievement [10-11].

#### 3.3 Learning Attitude

Students’ learning attitude towards e-learning is influenced by their thoughts and actions and good/bad comments and feelings as well. Learning attitude is the way of learners engaging in the motivation through the activity and the course towards a certain direction, purpose, habitually consistent, persistent response to form a positive or negative attitude which is under learners in learning environment, education situation, the response between the teachers and peers [12]. Besides, the quality of the e-learning curriculum, the flexibility of e-learning course, and user-friendly at convenience are critical factors to affect learners’ attitudes and satisfactions [13].

#### 3.4 Learning Satisfaction

Learning satisfaction is about the degree of learners’ satisfaction with the overall learning processes and outcomes, which means the implications of personal inner feelings or attitude to participate in learning activities. Meanwhile, learning satisfaction is one of the primary measures of learning outcomes even though many factors can influence the learners’ satisfaction such as teachers’ curriculum design, knowledge delivery, study skills, personal growth, service quality, interaction, social development and learning environment [14]. Providing the highest quality by using the e-learning technology provided raises students’ satisfaction which in the result leads to value and benefit for the long term to students themselves [15-17].

### 3.5 Learning Achievement

Learning achievement refers to the consequence of the implementation of various evaluation reviews after learners get involved with the learning activities. According to the evaluation reviews, it can be understood that the performance of learners on the indicators of learning content or changes in certain behaviors [18-22]. Learning achievement is the capability of a person caused by the stimulus coming from the external environment and the internal cognitive processes performed by the students. The purpose of measuring learning achievement is to make students understand their learning status and serves as a basis for teachers to improve their teaching ways or materials and students to improve their learning motivations and attitudes [18]. Lindner and Dooley [23] stated distance learning programs should be routinely evaluated and instructors of online courses should implement evaluation approaches to ensure if students are able to absorb the knowledge and to have a positive attitude and motivation and high satisfaction in collaborative learning environments [24-25].

## 4 Research Method

### 4.1 Research Hypothesis

The main objective of this study was to understand how much influence of the e-learning, learning attitude and satisfaction toward to the motivation, and learning motivation towards impact the learning achievement for undergraduate students according to the research model in Figure 2. In this study, four research hypotheses were examined to determine which hypothesis should be accepted and which should be rejected. H1: There will be a positive relationship between e-learning and learning motivation. H2: There will be a positive relationship between learning attitude and learning motivation. H3: There will be a positive relationship between learning satisfaction and learning motivation. H4: There will be a positive influence on learning achievement through learning motivation. All questionnaire items were responded to on a 7-point Likert scale, ranging from 7 (strongly agree), through 4 (neutral), to 1 (strongly disagree).

### 4.2 Data Analyses

SPSS 10.0 and AMOS for Windows were used to analyze the collected data which included demographic characteristics, descriptive statistics, KMO value [26] and Bartlett's test [27], factor analysis, Pearson's correlation, construct reliability, multiple regression and path analysis.

#### 4.2.1 Demographic Characteristics

In the present study, the demographic variables

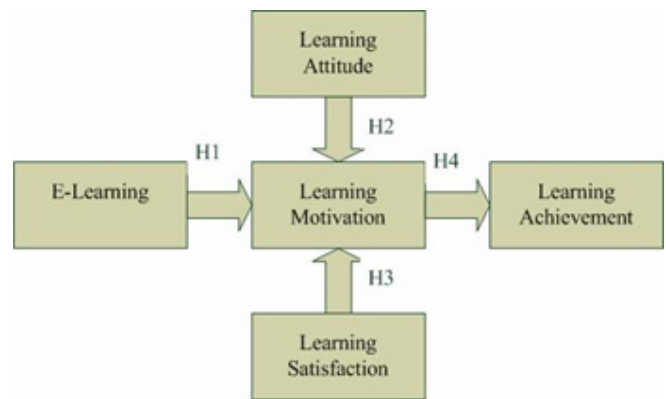


Figure 2. The research model for the present study

Table 1. Gender and age in the research

Gender	Percentage %	Quantity of 20 years old	Quantity of 21 years old
Male	68% (N=51)	42	9
Female	32% (N=24)	20	4

included gender and age were in Table 1, there were the 75 valid responses, 68 percent (N=51) were male students and 32 percent (N=24) were female students; the quantity of male were 42 and female were 20 in age of 20 years old; the quantity of male were 9 and female were 4 in 21 years old.

### 4.2.2 Descriptive Statistics

In Table 2, the strongest variable was student felt comfortable with the e-learning environment in information technology component (M=6.42), then e-learning was more interested in learning and student was willing to learn the course by it in learning motivation component (M=6.50), e-learning environment improved student's thinking skills and problem-solving skill in learning attitude component (M=6.48), the last was that student was satisfied with the "perceived interactions" in the e-learning environment in learning satisfaction component (M=6.43), the most weakness variable was that student can accomplish the assignments by e-learning in learning achievement (M=5.88). M is median and SD is standard deviation in Table 2.

### 4.2.3 KMO Value and Bartlett's Test

Bartlett's test is often used to assess if at least some of the correlations are significant. Kaiser [28] proposed KMO value and Bartlett's test to confirm whether the sample data are suitable for factor analysis. The larger the sampling suitability value of KMO value, the better the correlation degree. In Table 3, KMO value of each component was greater than 0.9 in which was very suitable for factor analysis, more than 0.8 suitable for factor analysis, well above 0.7 was acceptable for factor analysis.

**Table 2.** Descriptive statistics from component one to five

Item	Topic	M	SD
<b>Component 1 Information Technology (e-learning)</b>			
IT1	I have no problem at all to access information technology (e-learning).	6.38	.816
IT2	I am comfortable with the e-learning environment.	6.42	.627
IT3	I get used to staying in the e-learning environment.	6.36	.654
IT4	It is so efficient to finish homework and assignment by e-learning.	6.07	.669
<b>Component 2 Learning Motivation.</b>			
LM1	I think the teacher’s application of e-learning is useful that helps me improve my skills.	6.24	.736
LM2	Using e-learning for this course is more interesting than the traditional method.	6.37	.641
LM3	E-learning makes me more interested in learning and I am willing to learn the course by it.	6.50	.655
LM4	I think my grades get improved by using e-learning.	6.12	.684
LM5	Using e-learning encourages me to continue learning on the Internet by myself.	6.29	.756
LM6	The opportunity of interaction with the teacher is enhanced by using e-learning.	6.38	.612
LM7	The opportunity of interaction with my classmates is enhanced by using e-learning.	6.00	.665
<b>Component 3 Learning Attitude</b>			
LA1	Use of online learning methods makes learning easier to me.	6.02	.685
LA2	There is effective communication between the instructor and the students with e-learning.	6.29	.811
LA3	I can find information actively in the e-learning environment.	6.35	.658
LA4	The e-learning environment improves my thinking skills and problem-solving skill.	6.48	.667
LA5	There are more opportunities to create my own knowledge in the e-learning environment.	6.34	.642
LA6	The hyper-text online instruction can enhance my learning motivation.	6.29	.779
<b>Component 4 Learning Satisfaction</b>			
LS1	I am satisfied with the “Content and Organization” in the course.	6.25	.687
LS2	I am satisfied with the “Learning Resources” in the course	6.35	.798
LS3	I am satisfied with the “Perceived Interactions” in the e-learning environment.	6.43	.598
LS4	I am satisfied with “Knowledge/Skills Delivery” in the course.	6.32	.772
LS5	I am satisfied with “Learning Process” in the course.	6.37	.674
<b>Component 5 Learning Achievement</b>			
LACH1	I have understood the content in the course by e-learning.	6.02	.582
LACH2	I can get grades improvement a lot by e-learning behavior.	5.96	.564
LACH3	I believe using e-learning environment is great helpful for learning.	6.00	.786
LACH4	It is helpful for me to absorb knowledge by e-learning.	6.28	.749
LACH5	I can accomplish the assignments by e-learning.	5.88	.634

**Table 3.** KMO and Bartlett’s test

Component	KMO	Bartlett’s Test		
		Chi-square	df	Sig.
Information Technology (IT)	0.912	2738.344	147	0.000***
Learning Motivation (LM)	0.898	3645.911	105	0.000***
Learning Attitude (LA)	0.864	31068.955	230	0.000***
Learning Satisfaction (LS)	0.916	4978.525	231	0.000***
Learning Achievement (LACH)	0.866	2435.461	56	0.000***

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

#### 4.2.4 The Factor Analysis of Eigenvalues

Eigenvalues are direct indices of how much of the total item variance is accounted for by a particular component [29]. The larger the eigenvalue, the more variable in the item is explained by that component. The eigenvalues-greater-than-one rule proposed by Kaiser [28]. The reasoning is that an eigenvalue less than one implies that the scores on the component would have negative reliability.

The loadings of the factors were sorted into five dimensions: information technology, learning motivation, learning attitude, learning satisfaction and learning achievement. Table 4 presented the loadings

for each component. Component One consisted of four of the twenty-seven variables: IT 1 (Accessing), IT 2 (Comfortable), IT 3 (Environment), IT 4 (Efficiency). Component Two consisted of seven of the twenty-seven variables: LM 1 (skill improvement), LM 2 (interesting), LM 3 (willing), LM 4 (grades), LM 5 (encouragement), LM 6 (interaction with teacher), LM 7 (interaction with students). Component Three consisted of six of the twenty-seven variables: LA 1 (methods), LA 2 (communication), LA 3 (activeness), LA 4 (problem-solving), LA 5 (to create knowledge), LA 6 (motivation enhancement). Component Four consisted of five of the twenty-seven variables: LS 1 (content and organization), LS 2 (resources), LS 3 (perceived interaction), LS 4 (knowledge and skill

delivery), LS 5 (learning process). Component Five consisted of five of the twenty-seven variables: LACH 1 (content understanding), LACH 2 (behavior improvement), LACH 3 (helpful environment), LACH 4 (absorbing), LACH 5 (accomplishment). These

variables have positive loadings and address each component. The result of Table 4 in this study yielded five factors with an eigenvalue of 30.09, which accounted for 76.576% of the total variance which meant the factors were positive reliability.

**Table 4.** The factor analysis of eigenvalues

Component	Eigenvalue	% of variance	Cumulative eigenvalue	Cumulative of % total
1	11.896	32.868	11.896	32.868
2	6.392	15.276	18.288	48.144
3	5.144	14.164	23.432	62.308
4	3.970	8.142	27.402	70.450
5	2.688	6.126	30.09	76.576

**4.2.5 Pearson R Correlation Analysis**

Pearson r correlation analysis is the most widely used correlation statistics to measure the degree of the relationship between linearly variables and is useful way to study the strength of a relationship between the continuous variables and to establish if there are possible connections between variables. Pearson Correlation Analysis is the measurement of correlation and ranges between +1 and -1. +1 indicates the strongest positive correlation possible, -1 indicates the strongest negative correlation possible, and 0 indicates no correlation [28]. The following formula is used to calculate the Pearson r correlation:

$$\gamma_{xy} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - (\sum x_i)^2} \sqrt{n\sum y_i^2 - (\sum y_i)^2}}$$

$\gamma_{xy}$  = Pearson r correlation coefficient between x and y  
 n = number of observations  
 $x_i$  =value of x (for ith observation)  
 $y_i$  = value of y (for ith observation)

In this study, each of the five components was positive correlated and connected. Five correlations were statistically significant in Table 5 ( $p < .001$ ). The strongest correlations were between learning motivation and learning attitude ( $r = .774$ ), and then learning motivation and information technology ( $r = .753$ ).

**Table 5.** Pearson R correlation analysis

		IT	LM	LA	LS	LACH
IT	Pearson Sig.	1				
LM	Pearson Sig.(pairs)	.753** .000	1			
LA	Pearson Sig.(pairs)	.587** .000	.774** .000	1		
LS	Pearson Sig.(pairs)	.822** .000	.758** .000	.678** .000	1	
LACH	Pearson Sig.(pairs)	.319** .000	.396** .000	.421** .000	.565** .000	.1

\*\* $p < .01$ .

**4.2.6 Multiple Regression Analysis**

Multiple Regression analysis is a form of predictive modelling technique which investigates the relationship between a dependent and independent variable(s). Multiple linear regression has more than one independent variable. This technique is used for finding the causal effect relationship between variables. There are multiple benefits of using regression analysis such as indicating the significant relationships between dependent variable and independent variable, and the strength of impact of multiple independent variables on

a dependent variable [30-31].

Beaver [32] indicated multiple regression analysis may be utilized to ascertain the model’s goodness of fit, the strength of the relationship between y and other predictor variables, and the quality of the estimates and predictions. The mathematical representation of multiple linear regression is:

$$Y = a + bX_1 + cX_2 + dX_3 + \epsilon$$

where the Y is a dependent variable,  $X_1, X_2, X_3$  are independent (explanatory) variables, a is an intercept, b, c, d are slopes and  $\epsilon$  is a residual (error).

According to Table 6, the statistic results demonstrated that the strongest strength of the relationship was between learning motivation and learning attitude (adjusted  $R^2 = .886$ ), which was the best model fits, then learning motivation and learning

satisfaction (adjusted  $R^2 = .815$ ), learning motivation and e-Learning (I.T.) (adjusted  $R^2 = .726$ ), and learning motivation and learning achievement (adjusted  $R^2 = .489$ )

**Table 6.** Summary of multiple regression analysis

Dependent Variable: Learning Motivation			
Independent Variable: e-Learning (IT)	B	T	P
	0.805	17.998	.000***
<i>Adjusted R<sup>2</sup> = .726</i>			
Dependent Variable: Learning Motivation			
Independent Variable: Learning Attitude	B	T	P
	0.869	14.226	.000***
<i>Adjusted R<sup>2</sup> = .886</i>			
Dependent Variable: Learning Motivation			
Independent Variable: Learning Satisfaction	B	T	P
	0.836	24.863	.000***
<i>Adjusted R<sup>2</sup> = .815</i>			
Dependent Variable: Learning Achievement			
Independent Variable: Learning Motivation	B	T	P
	0.774	9.258	.000***
<i>Adjusted R<sup>2</sup> = .489</i>			

\*\*\* $p < .001$ .

**4.2.7 Construct Reliability**

Construct reliability indicates the internal consistency and reliability for items, just alike Cronbach’s alpha [33]. It can be considered as being equal to the total amount of true score variance relative to the total scale score variance [34]. Alternatively, it’s an “indicator of the shared variance among the observed variables used as an indicator of a latent construct [35]. The higher CR value is, the higher the proportion of true variation in the total variation is, and the higher the internal consistency is, Fornell [35] was first proposed this concept, suggested that the CR value of potential variables could reach above 0.60. Formula of CR [32] is as below:

$$\frac{(\sum_{i=1}^p \lambda_i)^2}{(\sum_{i=1}^p \lambda_i)^2 + \sum_i V(\delta)}$$

or

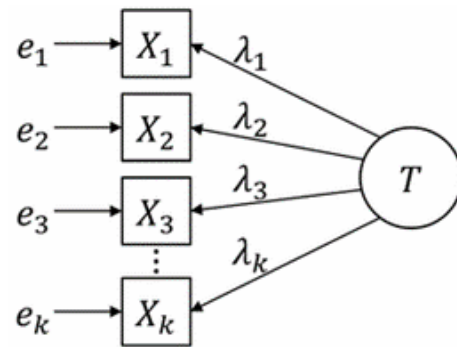
$$CR = \frac{(\lambda_{x11} + \lambda_{x21} + \lambda_{x31})^2}{(\lambda_{x11} + \lambda_{x21} + \lambda_{x31})^2 + (\delta_1 + \delta_2 + \delta_3)}$$

where  $\lambda_i$  is a completely standardized loading for the  $i$ th indicator,  $V(\delta_i)$  is a variance of the error term for the  $i$ th indicator and  $p$  is a number of indicators.

**4.2.8 Average Variance Extracted**

Average Variance Extracted (AVE) is a measure of

the amount of variance that is captured by a construct in relation to the amount of variance due to measurement error as Figure 3. AVE is calculated based on a congeneric measurement model as below:



**Figure 3.** Average variance extracted

Therefore, AVE can be calculated as follows:

$$AVE = \frac{\sum_{i=1}^k \lambda_i^2}{\sum_{i=1}^k \lambda_i^2 + \sum_{i=1}^k Var(e_i)}$$

Here,  $\kappa$  is the number of items,  $\lambda_i$  is the factor loading of item  $i$  and  $Var(e_i)$  is the variance of the error of item [36]. From the result of the statistics analysis, both construct reliability ( $CR \geq 0.6$ ) and average variance extract ( $AVE \geq 0.5$ ) from Table 7 to Table 11 were greater than 0.7, which meant that the inner quality and the internal consistency reliability were considered acceptable [35, 37].

**Table 7.** CR and AVE of information technology

Comp.	Vari.	SK	KU	SFL	SE	SMC	CR	AVE
IT							0.858	0.760
	1	-.465	-1.04	.960*	.688	.269		
	2	-1.68	2.246	.874*	.770	.250		
	3	-1.01	.684	.744*	.275	.616		
	4	-.270	.748	.876*	.584	.622		

**Table 8.** CR and AVE of learning motivation

Comp.	Vari.	SK	KU	SFL	SE	SMC	CR	AVE
LM							0.869	0.806
	1	.154	-.779	.870*	.248	.784		
	2	.164	-.746	.866*	.219	.799		
	3	.179	-.848	.879*	.198	.870		
	4	.256	-.658	.901*	.210	.830		
	5	.178	-.781	.914	.138	.874		
	6	.198	-.790	.938*	.143	.861		
	7	.228	-.829	.847*	.286	.736		

**Table 9.** CR and AVE of learning attitude

Comp.	Vari.	SK	KU	SFL	SE	SMC	CR	AVE
LA							0.865	0.784
	1	.143	-.855	.699*	.294	.623		
	2	.083	.635	.784*	.249	.649		
	3	.092	-.146	.872*	.368	.778		
	4	.148	.267	.867*	.248	.752		
	5	.163	.284	.798*	.425	.569		
	6	.199	.448	.768*	.253	.536		

**Table 10.** CR and AVE of learning satisfaction

Comp.	Vari.	SK	KU	SFL	SE	SMC	CR	AVE
LS							0.842	0.756
	1	-.591	-.381	.778*	.316	.668		
	2	-.455	1.531	.627*	.162	.658		
	3	-.441	-.273	.797*	.424	.586		
	4	-.486	.876	.779*	.392	.578		
	5	-.913	.721	.892*	.342	.456		

**Table 11.** CR and AVE of learning achievement

Comp.	Vari.	SK	KU	SFL	SE	SMC	CR	AVE
LACH							0.836	0.748
	1	-.196	-.212	.678*	.026	.639		
	2	.264	-.532	.739*	-.018	.673		
	3	-.145	-.439	.752*	.086	.762		
	4	-.186	-.382	.734*	.145	.759		
	5	-.172	-.610	.534*	.774	.596		

#### 4.2.9 Path Analysis

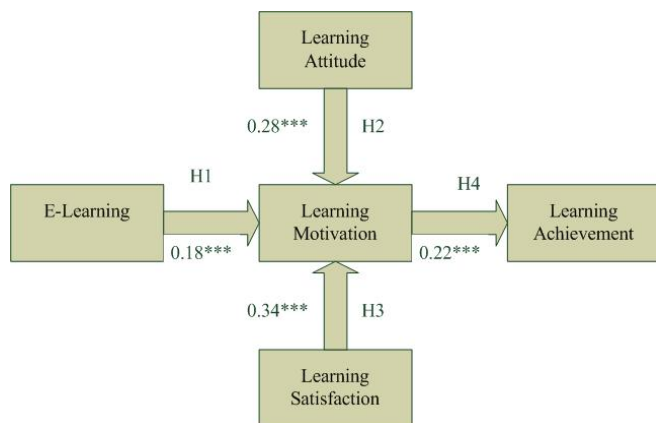
Path analysis is a kind of multiple regression statistical analysis for analyzing causal models by examining the relationships between a dependent variable and an independent variable. In fact, we can realize both the magnitude and significance of causal connections between variables, and can better understand the causal relationships between different variables by a path analysis. Drawing a diagram as Figure 4 that demonstrated a visual representation of

the relationship between variables through AMOS [38]. From an overall path diagram as Figure 4, the research results showed that learning attitude strongly affected learning motivation (0.34); learning satisfaction affected learning motivation (0.28); e-learning (information technology) affected learning motivation (0.22) and learning motivation affected learning achievement (0.18). Therefore, H1, H2, H3, and H4 were supported due to a positive and significant influence ( $p < .001$ ). Table 12 was a summary of the results of hypothesis testing in the present study.

**Table 12.** A summary of hypothesis

Hypothesis	Path	Causal Relationships	Path Coefficient	Support
1	I.T. → L.M.	Positive	0.22	Yes
2	L.A. → L.M.	Positive	0.34	Yes
3	L.S. → L.M.	Positive	0.28	Yes
4	L.M. → L.ACH.	Positive	0.18	Yes

\*\*\* $p < .001$ .



**Figure 4.** An overall path diagram

## 5 Conclusion

According to research model, we had found that information technology, learning attitude and learning satisfaction affected learning motivation strongly, directly and positively by investigating the influence of each component.

The strongest correlation was between learning motivation and learning attitude ( $r=.774$ ), and the 2nd strongest correlation was learning motivation and information technology ( $r=.753$ ), which meant the variables relationship was very correlated and connected. Besides, the strongest strength of the relationship was the learning attitude towards learning motivation (adjusted  $R^2=.886$ ), learning attitude strongly affected learning motivation (0.34) from path analysis as well. The above statistic outcomes explained that learning attitude influenced learning motivation the most than information technology and learning satisfaction; therefore, learning attitude and learning motivation was the best model fits.

The present study identified several of components of information technology, learning motivation, learning attitude, learning satisfaction and learning achievement that may guide information technology (e-learning) to have being feasible in universities and to improve the media quality of learning and teaching, and may further enhance the competitiveness in high education as well.

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