

Identifying Factors that Promote the Effectiveness of Online Learning using Structural Equation Modeling

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Abstract- This research utilized structural equation modeling (SEM) to investigate factors that promoted effectiveness of online learning for an information and communication technology (ICT) class. The dependent measures included the learners' understanding of the lessons and their abilities to apply such knowledge in their daily lives (Y1) as well as their ability to do it ethically and legally (Y2). The cross validation technique showed that the mean magnitude of relative error (MMRE) of the final SEM model of Y1 was 20.23% and Y2 was 16.37%. The results of SEM showed that the three most important factors that promoted effectiveness of online learning Y1 and Y2 were teaching and content (6.05), communication (4.86), and evaluation (4.18).

Keyword: Effectiveness, Factor Analysis, Structural Equation Modeling, Online learning.

I. INTRODUCTION

For the last two years, most activities and organisations are affected by COVID-19 pandemic. For example, flights are cancelled. Most restaurants and hotels are closed down, temporarily or permanently. Schools, colleges, universities are forced to migrate to online learning. It is obvious that technology and Internet network has gained a crucial role during this trying time.

Teaching in schools, colleges, and universities has changed because of COVID-19 pandemic. Online learning is employed by a large numbers of teachers. Likewise, at Rajamangala University of Technology Suvarnabhumi, Nonthaburi Campus, 286 first-year students were taught through online platforms. In this research, the first-year students enrolling in Integrated Information Technology were taught online and took part under this research. This research aimed at investigating factors affecting online learning effectively using structural equation modeling (SEM). The research instrument was a questionnaire. The duration was from 5th July, 2021-22nd October, 2021.

II. LITERATURE REVIEWS

A. Structural Equation Modeling

Structural Equation Modeling (SEM) is considered as one of the most powerful techniques in order to combine the delicate path models and latent variables. According to the researchers, confirmatory analysis models, regression models, and complex path models are indicated.

The basic element of a structural equation model was illustrated by introducing the estimation technique, Maximum Likelihood (ML), and a discussion about the problems of assessment and improvement of the model fit and model extensions to multi-group problems, and factor mean. SEM is one of the most widely used for behaviour sciences. It is a combination of factor analysis and regression or path analysis. Latent factor is generally used to display SEM. The relationship of theoretical constructs is illustrated by regression or path coefficients between the factor [2].

B. Factor Analysis

Factor analysis is a type of technique for reducing the number of variables. It is a part of general linear model (GLM). Which is divided into four main types: a) principle component analysis, b) common factor analysis, c) image factoring, and d) maximum likelihood method. Factor loading is normally at 0.7 or over that shows variant. Confirmatory factor analysis (CFA) is used to determine factors and load factors for measurable variables. This is to confirm the theory as well [3].

C. Effectiveness of Online Learning

In 2020, Hussain et al studied the effectiveness of online learning system during COVID-19 in Sargodha. It showed that online learning system was effective and efficient. It could be one of the good alternatives for remote learning [4].

Mahyoob studied about the effectiveness of online learning during COVID-19 pandemic in Saudi Universities. Activities resulting in success of online learning were satisfactions towards online learning, effectiveness of students' participation, success, and assignments. A questionnaire was used to collect data from 333 students who studied bachelor degrees in various majors in the universities in Saudi Arabia. The main part of the questionnaire consisted of various questions about online learning activities. The p coefficient is highly correlated with r by Pearson and Spearman. The Alpha of Cronbach is 0.93. This indicated that it was reliable. The average score was

0.20. Standard deviation was 0.095. This study also emphasised the influence of online learning which affected students' achievement, except assignments which seemed to be problematic. In accordance with Mahyoob et al, the findings showed some activities that enabled a successful online learning. They were satisfactions in online learning, effectiveness of participation, success, and assignments. A questionnaire was used to collect data from 333 students in the regular programs in the bachelor degree [5].

Wangdi et al studied about investigated online learning amid COVID-19 pandemic via Bhutanese students' perspective. It showed that COVID-19 pandemic had greatly influenced all over the world. One of them was education. This study was a mixed method of quantitative and qualitative approaches by a questionnaire and an interview. 200 students were selected by purposive sampling. Descriptive statistical analysis was employed for data analysis. The results revealed that the Internet fee in Bhutan was too high for students. In addition, teachers may not have sufficient and necessary knowledge and skills for online classrooms. Around 70% of students lacked gadgets or electrical devices such as smart phones or laptops for online learning. As a result, Ministry of Education should improve teachers' digital literacy. In addition, Internet fee should be reduced for students [6].

According to Wang et al, they studied the effectiveness of students' e-learning in COVID-19 circumstance. It showed that e-learning strategies could have positive influences on e-learning effectiveness. Students could apply these strategies when studying online. Before class, students needed to know what topics or lessons they were going to study. While they were studying, they could manage their plans and time. After that, students should be able to summarise what they learned and shared the idea with their classmates [7].

Al-Karaki et al evaluated the effectiveness of distance learning in higher education during COVID-19 of the global crisis. It showed that most students said that online learning might be one of the best solutions for them during COVID-19. However, teaching formats may be different in terms of students' participation. Furthermore, students agreed that the lack of infrastructure at home would be the great obstacle,

especially a subject that requires students to practice [8].

III. METHODOLOGY

A. Research hypothesis

The research conceptual model was shown in Figure 1. This research conceptual model was constructed/created on the basis of related research. This study consisted of four hypotheses, H1-H4. They were as follows:

H1: learning evaluation has a direct effect on academic results.

H2: communication has a direct effect on academic results.

H3: environment and convenience has a direct effect on academic results.

H4: teaching and content has a direct effect on academic results.

The four independent factors were learning evaluation, communication, environment and convenience, and teaching and content, and the dependent factor was academic results.

B. Conceptual model

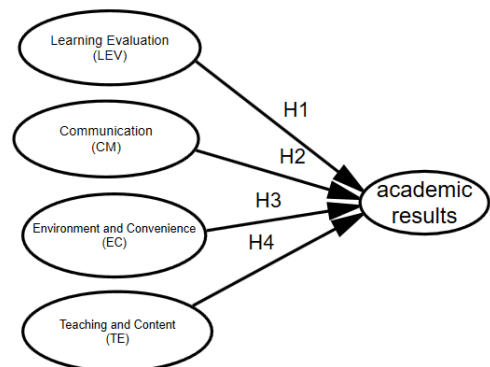


Figure 1. Research Conceptual Model

C. Research Work Flow

The research was conducted in sequence shown in Figure 2.

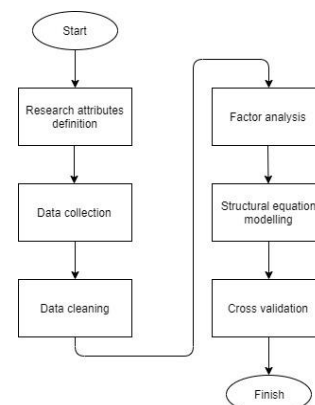


Figure 2. Sequence of research activities

In terms of data collection, the questionnaire was constructed. All independent and dependent attributes were considerably chosen from related research and online learning theory. After that, this questionnaire was validated by five experts by IOC (Index of Item Objective Congruence). Later, this questionnaire was administered to 286 students who enrolled in the Integrated Information Technology class.

In the aspect of data cleaning, collected observation was rechecked for skewness, outlier, and missing data in order to clean the incorrect or incomplete appearance. Then, factor analysis was performed in order to create the new variables from the interest groups of some aspect attributes. Some attributes were removed due to insufficient relevancy. Factor analysis could overcome the multi-collinearity problem between the related attributes. Structural equation modeling (SEM) was then used to test four research hypotheses if there were significant relationship. Nevertheless, the coefficient could present the level of importance of each independent factor to dependent factor. The SEM model was then measured for its accuracy of prediction using cross-validation. Mean magnitude of relative error (MMRE) was used to measure the percentage of error in prediction.

D. Research Attributes

According to related research, four factors were chosen to be studied. There were 28 attributes which were grouped into four factors based on the following aspects: attribute name, label, type, range, and meaning in Table I.

TABLE I. RESEARCH ATTRIBUTES DESCRIPTION

Factor	Attribute	Data type	Data range	Meaning
Learning Evaluation - LEV	Clear assignments (Individual/Group work) – LE1	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Clear rules, timing and communication – LE 2	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Clearly specify the delivery channel – LE3	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred

TABLE I. Cont.

Factor	Attribute	Data type	Data range	Meaning
Learning Evaluation - LEV	Determine the work that must be submitted, including notifying the scoring criteria to be consistent – LE4	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Measurement meets learning objectives – LE5	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Measurement meets learning objectives – LE6	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Measurement is transparent and fair – LE7	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Atmosphere in online teaching friendly – LE8	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Instructors have knowledge and expertise in using programs, equipment, and online teaching – LE9	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
Communication - CM	You use internet at home/residence – CM1	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Teaching is a two-way format such as Google Meet, Zoom Meeting, Microsoft Teams, etc. – CM2	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
Environment and Convenience – EC	Studying online saves time and expenses such as travel, accommodation, food, etc. –EC1	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	The content is suitable for the learner level- EC2	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	The place where you study is well lit and ventilated – EC3	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred

TABLE I. Cont.

Factor	Attribute	Data type	Data range	Meaning
Environment and Convenience – EC	The place where you study is suitable without outside noise – EC4	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	You are ready in various devices used in teaching such as computers, notebooks, smartphones, etc. – EC5	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Online learning increases the opportunity to access learning content from a variety of devices via the Internet. – EC6	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Content is interesting complete – EC7	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Online learning is a convenient way to communicate with teachers. – EC8	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
Teaching and Content - TE	Teachers can solve problems with programs, equipment, and online teaching - TE1	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Teachers use language in teaching that is suitable and easy to understand - TE2	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Teachers can answer questions clearly – TE3	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Instructors inform learners of the teaching management plan– TE4	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	The content is direct and comprehensive for the purpose – TE5	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Teachers are ready to follow up, answer questions, and solve problems - TE6	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred

TABLE I. Cont.

Factor	Attribute	Data type	Data range	Meaning
Teaching and Content - TE	The content uses the correct language – TE7	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	The language or symbols of the menu or the links of the communication system are easy to understand – TE8	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	There is a use of multimedia media in teaching, such as AR, VR, etc. – TE9	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
Academic results	Use of information and communication technology systems – Y1	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred
	Application of information technology systems – Y2	Order	1-5	5 = Strongly Preferred 4= Moderately to strongly preferred 3= Moderately Preferred 2= Equally to moderately preferred 1= Equally Preferred

E. Independent Attribute

The proposed independent factor and its member were presented in Figure 3-6

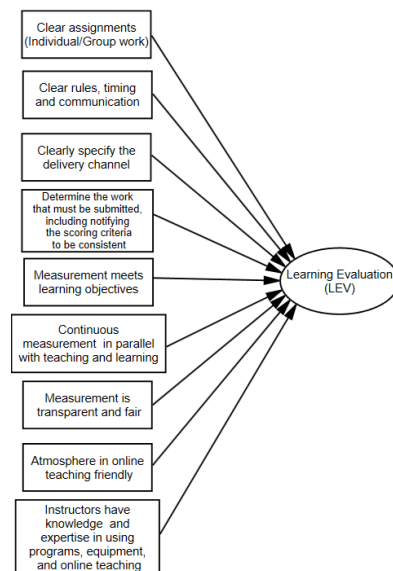


Figure 3. Factor: learning evaluation

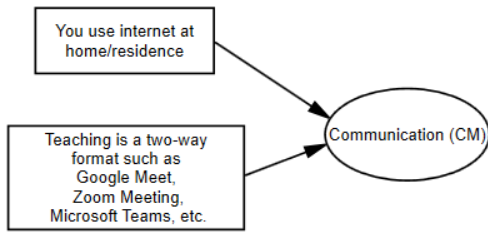


Figure 4. Factor: communication

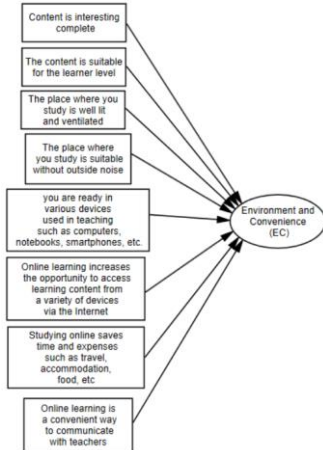


Figure 5. Factor: environment and convenience

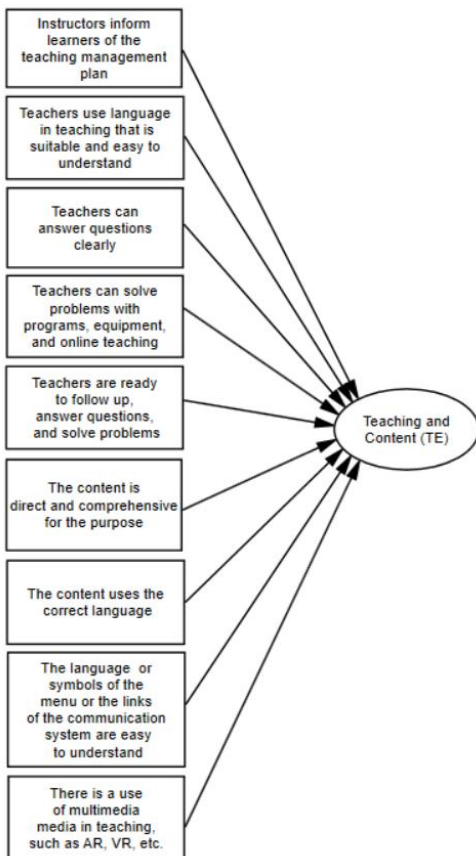


Figure 6. Factor: teaching and content

F. Dependent Variable

The proposed dependent factor (academic results) and its member were shown in Figure 7.

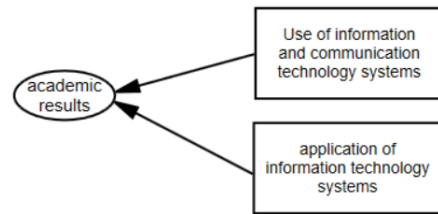


Figure 7. Factor: academic results

G. Index of Item-Objective Congruence: IOC

All attributes were examined by five experts in the aspect of IOC. The result of expert's opinions showed that all attributes were closely related to the dependent variable in Table II.

Table II. Result of IOC Test

Attribute	Expert opinion					total	IOC	result
	expert #1	expert #2	expert #3	Expert #4	Expert #5			
Clear assignments (Individual/Group work)	'+1	'+1	0	'+1	'+1	4	0.8	Pass
Clear rules, timing and communication	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Clearly specify the delivery channel	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Determine the work that must be submitted, including notifying the scoring criteria to be consistent	'+1	'+1	0	'+1	'+1	4	0.8	Pass
Measurement meets learning objectives	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Measurement is transparent and fair	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Atmosphere in online teaching friendly	'+1	'+1	0	'+1	'+1	4	0.8	pass
Instructors have knowledge and expertise in using programs, equipment, and online teaching	'+1	'+1	'+1	'+1	'+1	5	1	pass
Clear assignments (Individual/Group work)	'+1	'+1	'+1	'+1	0	4	0.8	pass
You use internet at home/residence	'+1	'+1	'+1	'+1	'+1	5	1	pass
Teaching is a two-way format such as Google Meet, Zoom Meeting, Microsoft Teams, etc.	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Content is interesting complete	'+1	'+1	0	'+1	'+1	4	0.8	Pass

Table II. Cont.

Attribute	Expert opinion					total	IOC	result
	expert #1	expert #2	expert #3	expert# 4	expert# 5			
The content is suitable for the learner level	'+1	'+1	'+1	'+1	'+1	5	1	Pass
The place where you study is well lit and ventilated	'+1	'+1	'+1	'+1	'+1	5	1	Pass
The place where you study is suitable without outside noise	'+1	'+1	0	'+1	'+1	4	0.8	Pass
You are ready in various devices used in teaching such as computers, notebooks, smartphones, etc.	'+1	'+1	'+1	'+1	'+1	5	1	pass
Online learning increases the opportunity to access learning content from a variety of devices via the Internet.	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Studying online saves time and expenses such as travel, accommodation, food, etc.	'+1	'+1	0	'+1	'+1	4	0.8	Pass
Online learning is a convenient way to communicate with teachers.	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Instructors inform learners of the teaching management plan	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Teachers use language in teaching that is suitable and easy to understand	'+1	'+1	0	'+1	'+1	4	0.8	Pass
Teachers can answer questions clearly	'+1	'+1	0	'+1	'+1	4	0.8	Pass
Teachers can solve problems with programs, equipment, and online teaching	'+1	'+1	'+1	'+1	'+1	5	1	Pass
Teachers are ready to follow up, answer questions, and solve problems	'+1	'+1	'+1	'+1	'+1	5	1	Pass
The content is direct and comprehensive for the purpose	'+1	'+1	0	'+1	'+1	4	0.8	Pass
The content uses the correct language	'+1	'+1	0	'+1	'+1	4	0.8	Pass
The language or symbols of the menu or the links of the communication system are easy to understand	'+1	'+1	'+1	'+1	'+1	5	1	Pass
There is a use of multimedia media in teaching, such as AR, VR, etc.	'+1	'+1	'+1	'+1	'+1	5	1	Pass

H. Data Gathering

286 first-year students at Rajamangala University of Technology Suvarnabhumi, Nonthaburi participated this study. They enrolled Integrated Information Technology. This study was conducted from 5th July, 2021 to 22nd October, 2021.

I. Data Cleaning

After the data were collected, skewness, outlier, and missing data were detected and dealt with appropriately.

J. Factor Analysis

Factor analysis was performed in order to explore whether its members were significantly related. This activity was proceeded with four independent factors and one dependent factor.

K. Structural Equation Modeling

Structural Equation Modeling was used to confirm whether the research conceptual model hypothesis or proposed model was accepted or rejected.

L. Model Accuracy

The SEM model had to be checked for its prediction accuracy. MMRE was calculated for the fitted SEM model to measure the error of prediction.

$$MMRE = \frac{1}{n} \sum_{i=1}^n \frac{|actual_i - estimated_i|}{actual_i} \quad (1)$$

$$PercentageCorrect = 100(1-MMRE) \quad (2)$$

IV. Research result

A. Data Cleaning

Gathered observations were calculated for descriptive statistics, as shown in Table 3. The result of data cleaning showed that there were no outlier observed. All attributes followed a normal distribution. There were no attribute with significant skewness.

B. Factor Analysis

Factor EC (ec1, ec2, ec3, ec4, ec5, ec6, ec7, ec8, ec9) all proposed attributes were dimensionality reduced by factor analysis. The result of factor analysis was shown in Table 3. All attributes had significant relationship to form up factor EC. In the same way, LEV, CM, TE, and academic results presented the result in the same direction.

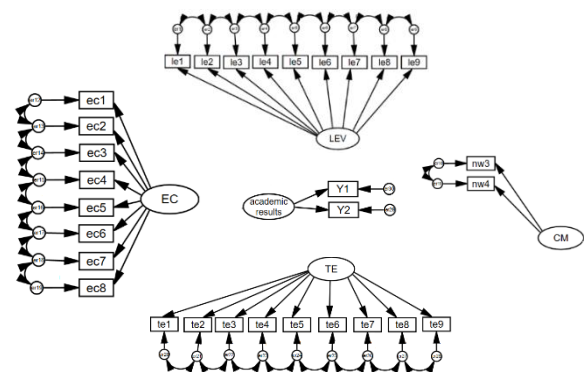


Figure 8. Proposed factors and their attributes

Table III. Summary of Factor Analysis

KMO	Bartlett	Cumulative variance %
0.816	0.00	69.91

From Table 3, factor analysis KMO in this study was 0.816. The Bartlett’ experiment is significantly important (p=0.00). It can be interpreted as “appropriate”, including sufficient amount of samples for analysing factors. This can be described that variables are well related, and it can be able to analyse

C. Structural Equation Modeling

The proposed SEM model was presented in Figure 9. This proposed SEM was a confirmatory check for the best fitting. The result of the best-fitting SEM Model was shown in Figure 9.

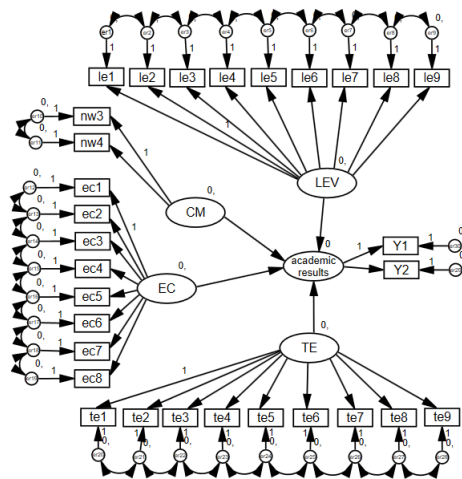


Figure 9. Proposed SEM Model

The fitting statistics were presented in table 4.

Table IV. Best fitted SEM Model criteria statistics

Measure	Cut-off	result	pass/fail
Model Chi-square	p>0.05	0.098	pass
Goodness of fit: GFI	GFI>0.95	0.96	pass
Root Mean Square Error of Approximation: RMSEA	RMSEA< 0.08	0.073	pass

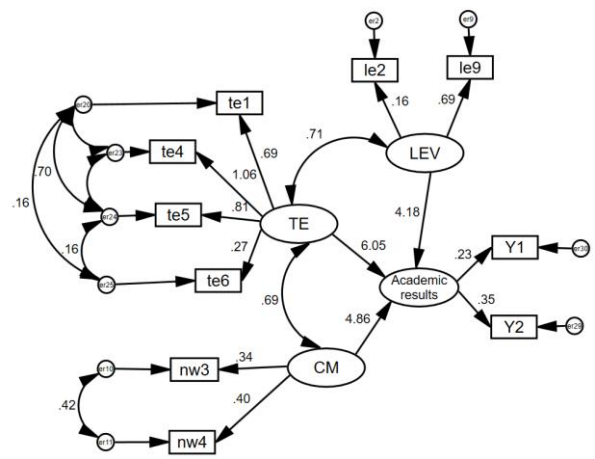


Figure 10. Fitted SEM Model

D. Model Cross Validation

From the structural equations, it showed that only three factors were selected: CM (Communication), LEV (Learning Evaluation) , TE (Teaching and Content) . Factor Academic results had two dependent variables: Y1 and Y2.

Y1 equation was presented in details shown in (3). In the same word, Y2 equation was presented by (4).

$$Y1 = 0.23Academic\ results + er30 \quad (3)$$

$$Y2 = 0.35Academic\ results + er29 \quad (4)$$

$$Academic\ results = 4.86CM + 6.05TE + 4.18LEV$$

Where CM, TE and LEV are exogenous factor score, er30=0.68, and er29 = 1.

20% of the observed data were randomly sampled for SEM Model validation. The average and standard deviation were shown in Table 5.

Table V. MMRE-CROSS VALIDATION RESULT

ITEM	AVERAGE MMRE	CORRECT PREDICTION PERCENTAGE
Y1	20.23	79.77
Y2	16.37	83.63

V. Conclusion

From this study, the structural equation modeling (SEM) showed that three factors promoting online learning effectively: teaching and content (6.05), communication (4.86), and learning evaluation (4.18). These three factors directly affected learners’ academic results: Y1 and Y2. Y1 represented learners’ understanding and their abilities to use their knowledge in daily life (0.23). Y2 represented the learners’ abilities to apply said knowledge ethically and legally (0.35). The findings from this study could be used as a guideline to promote online learning during COVID-19 pandemic.

From Model 10, it showed that factors enhancing online learning effectively in Integrated the Information Technology class were teaching and content: Te4 (Teachers can solve problems with programs, equipment, and online teaching) at 1.06, followed by

Te5 (Teachers are ready to follow up, answer questions, and solve problems) at 0.81, Te1 (Instructors inform learners of the teaching management plan) at 0.69 and Te6 (The content is direct and comprehensive for the purpose). These findings were in line with [7] that online learning was directly related to teaching management. Before each class, learners should know and understand what they were going to study, and teachers created lesson plans. After that, learners summarised the lesson and exchanged their idea or knowledge with their classmates.

Next, “communication”, it showed that the indicator was Nw4 (two ways of learning such as Google Meet, Zoom Meeting, and Microsoft Teams) at 0.40. This finding was in accordance with [4] that online learning could respond learners’ need, especially those who need to attend remotely. In addition, this was in agreement with [8] that online learning during COVID-19 pandemic was more suitable for them than traditional classrooms. Another indicator was Nw3 (Home Internet). As reported by Norbu that Internet fee greatly resulted in the strong Internet signal. As stated in [8] that the insufficient infrastructure might be a great obstacle for online learning, especially the subjects that requires to practice.

The last factor “Learning Evaluation”, two factors indicated were Le9 (Instructors have knowledge and expertise in using programs, equipment, and online teaching) at 0.69 and Le2 (Clear rules, timing and communication) at 0.16. This findings were in line with [5] that clear rules, timing, and communication might result in students’ assignments which were quite problematic in online.

REFERENCE

- [1] Favale, T., Soro, F., Trevisan, M., Drago, I., and Mellia, M. (2020). Campus traffic and e-Learning during COVID-19 pandemic. *Comput. Netw.* 176:107290. doi: 10.1016/j.comnet.2020.107290
- [2] Hox, J. J., & Bechger, T. M. (1998). An introduction to structural equation modeling. *Family science review*, 11, 354-373.
- [3] Shapiro, S. E., Lasarev, M. R., & McCauley, L. (2002). Factor analysis of Gulf War illness: What does it add to our understanding of possible health effects of deployment, *American Journal of Epidemiology*, 156, 578-585.
- [4] Hussain, I. H. I., Saeed, R. M. B., & Syed, A. F. (2020). A Study on Effectiveness of Online Learning System during COVID-19 in Sargodha. *International Journal of Language and Literary Studies*, 2(4), 122-137.
- [5] Mahyoob, M. (2021). Online Learning Effectiveness During the COVID-19 Pandemic: A Case Study of Saudi Universities. *International Journal of Information and Communication Technology Education (IJICTE)*, 17(4), 1-14.
- [6] Wangdi, N., Dema, Y., & Chogyel, N. (2021). Online learning amid COVID-19 pandemic: Perspectives of Bhutanese students. *International Journal of Didactical Studies*, 2(1), 101456.
- [7] Wang, C. Y., Zhang, Y. Y., & Chen, S. C. (2021). The empirical study of college students' E-learning effectiveness and its Antecedents towards COVID-19 epidemic environment. *Frontiers in Psychology*, 3212.
- [8] Al-Karaki, J. N., Ababneh, N., Hamid, Y., & Gawanmeh, A. (2021). Evaluating the Effectiveness of Distance Learning in Higher Education during COVID-19 Global Crisis: UAE Educators’ Perspectives. *Contemporary Educational Technology*, 13(3), ep311. *Business Management* November, Finland. 2017.