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INTERACTIVE PERSUASIVE LEARNING ELEMENTS AMONG ELDERLY: A MEASUREMENT MODEL

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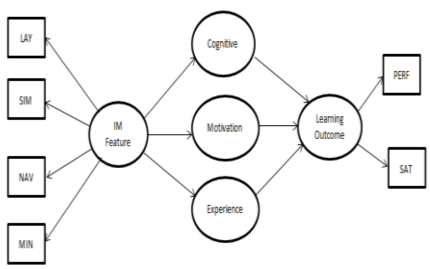
Graphical abstract



Abstract

The increasing usage of computer technology in myriad fields involves almost all level of the society to interact with the technology. Although the receptions are going well, however, for certain level of ages in the society, the need seems to be difficult to them. Of the level, elderly is a must to be considered for designing and developing computer technology systems that suit them better. Hence, our study proposes a conceptual model of an interactive persuasive learning system to encourage the elderly to use a computer application for learning. This paper is part of our study that evaluates a measurement model of interactive elements of persuasive learning among elderly. This study used empirical study as a method for data collection. Data was collected from 300 elderly respondents and each respondent was supplied with a laptop to enable him/her to use the interactive courseware. The data was analyzed using the Structural Equation Modeling (SEM) with Analysis of Moment Structures (AMOS). The results have shown that the measurement model fits the data. Therefore, the model is suitable for interactive media among elderly. Further, this study intends to identify the relationship between the interactive media features and persuasive learning elements among elderly.

Keywords: Elderly, persuasive, interactive, structural equation model.

1.0 INTRODUCTION

There is a marked increase in interest in the last few years on how computers and information technology influence, encourage and persuade people to change their behavior and attitude. This technology is known as persuasive technology promotes interactivity that can change a person's attitude or behavior [1]. It has already been utilized in public health and management [2-3], sales [4], religion [5], military training and others. Furthermore, presently, the persuasive experiences can come to us in a plethora of technologies such as web-based applications, portable hand-held devices [2], robots [6], computerized toys, game applications [7] as well as standalone applications [8]. In designing up-to-date human-computer interaction requires the skill in motivating and persuading people through the products or applications that have been developed [9].

In fact, persuasion is the focus of persuasive technology. Fogg [1] defined persuasion as "an attempt to change behaviours, attitudes or both (without using coercion or deception)". He coined the word 'captology' that emphasizes a specific study of computers as persuasive technology and it focuses on human-computer interaction. In order to increase the effect of persuasiveness, captology sets its focus on the computer programs that have been planned to have persuasiveness elements, not as a side effect [8]. A computer system or product that has changed the way people think, feel and act, whereby the changes are not planned before to persuade people as such is a side effect. In other words, captology refers to computer systems that have been planned by the designers in their designs to persuade people intentionally through any focused behavioural or attitude changes, not unintentionally [10].

In computer technology, there are three elements that can be used as persuaders, namely; the computer as a tool, a medium and a social actor; and all the three are referred to as the functional triad [1]. As a tool, a computer is designed to change people's behaviours and attitudes by increasing their abilities or by making a task easier [9]. The power of simulations generated by computer programs is the second element in the functional triad which provides the user experiences that can influence their behaviours and attitudes [11]. The third element is computers as persuasive social actors. Related to this element, a previous study has utilised persuasiveness in interactive media application [12]. It is clear that a well-designed interactive media application that has been intentionally implemented to persuade people to change their behaviours and attitudes can be an effective persuader.

The utilization of interactive media in learning stresses on the combined use of text, graphics, video, animation and audio to construct knowledge and provide an active learning environment to the learners [13]. Hence, interactive media is defined as the combinations of various digital media elements which include text, images, sound, animation and video that can persuade users to use the technology for learning and conveying information in an interactive way.

Learning for the elderly is referred to as andragogy or "adult learning" [14] and one of the principles proposed by Knowles [15] is that adults are internally motivated for learning something. Elderly are attracted to a learning process if the learning benefits them. There are myriad ways of creating meaningful experience in learning and one of the approaches is to convey the learning in an interactive way. Besides using the conventional method in conveying information, the use of both auditory and visual channels can significantly increase the learners' ability to retrieve information and enhance their understanding.

Several previous studies have discussed on the use of technology among elderly which include elderly-based system design [16] and multimodal interfaces for the elderly. Previous studies have proposed various interactive systems and tools to capitalise the impact of persuasion on the elderly. However, very few studies have focused on learning for the elderly. As such, in order to develop a persuasive computer application for the elderly, the best suite of interactive media features should be identified and highlighted.

Thus, this study proposes a conceptual model of interactive persuasive learning for the elderly. It would provide a mechanism to overcome elderly preference towards computer based learning based on their suitability while interacting with computers [17]. The target population is elderly aged above 50 years old. A survey is conducted to construct a conceptual model of interactive persuasive learning among elderly. There is indication that elderly choose the use of computer applications as their last resort to learning.

2.0 RESEARCH MODEL

Technology Mediated Learning (TML) framework by Alavi and Leidner [18] has been adapted as the underpinning framework in the study. Alavi and Leidner [18] clearly discuss how to enhance the learning outcome in the technology-mediated learning or computer-based learning environment. The focus in the information technology part is related to the interactive media features; and then the psychological learning process is related to interactive persuasive psychological factor which can accelerate the learning outcome for elderly. According to Hiltz [19], the physiological characteristics have been shown to be positively correlated with the learning outcome in the asynchronously distance learning environment. Thus, in this study, by identifying essential psychological characteristics for elderly learning, a learning process might has positive outcome. Additionally, the interactive media features that are important for elderly learning could also be identified. It is an attempt to increase the learning outcome in elderly learning by using computer-based learning environment.

The research model for this study has been developed as shown in Figure-1. The model showed that learning outcome is the main variable, whereby 2 indicators were classified; PERF (performance) and SAT (satisfaction). The determinants (antecedents) include cognitive, motivation and experience, which is followed by IM (interactive media) features. The IM feature indicators include LAY (layout and consistency), SIM (simulation), NAV (navigation) and MIN (minimal input devices).

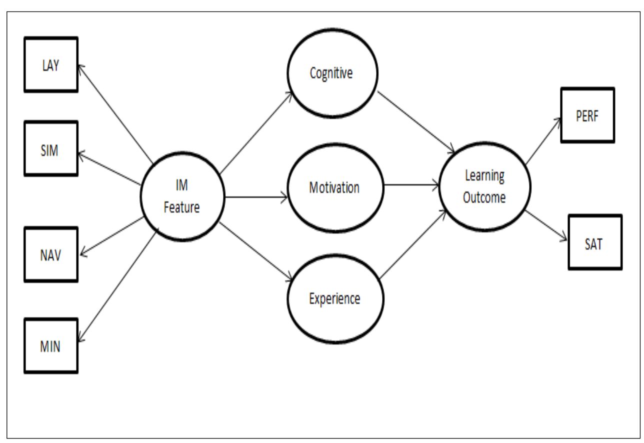


Figure 1 Research model

3.0 METHODOLOGY

3.1 Subjects and Procedures

The target population of this study is elderly group which is in 50 years old and above as suggested by [20] in the area of computer technology and learning. Although the elderly age level is used differently in myriad studies such as 60 years and above [21], 65 years old and above [22] 70 years and above [23], 68 years and above [24] and 45 years old and above [6]; this study tend to use the age of 50 years old and above (approximately to 64 years old) as the respondent in the age level is more likely to be interested, need and want to learn new things and technology and give their effort to learn new activities [25] The number of the respondents for this study is approximately 300 elderly. This number satisfies the proposed minimum of 200 subjects for SEM [26]. The 300 elderly respondents are from the Kubang Pasu district in Kedah, Malaysia. The respondents were randomly selected based on their age's level. Each respondent was supplied by a laptop during the process was conducted.

3.2 Measurement

There are three sections of questionnaires that respondents needed to answer. These include a section containing respondent's demographic details, nine factors and features of the Interactive Persuasive Learning (InPeL) conceptual model (layout and consistency, simulation, navigation, minimal input devices, motivation, experience, cognitive and satisfaction of the learning outcome) questionnaires, and the last section is related to another learning outcome factor, performance. The questionnaires for investigating the performance factor were isolated as the questionnaires contain the selected courseware content, V-Hajj.

In this study, four experts were involved to validate the model and the instrument. The experts were selected based on their expertise in the computer learning and interactive multimedia field for over 5 years of experience. Several amendments for model and questionnaires were corrected based on the comments by the experts in computer learning and interactive multimedia. The refinement of the model has been made after several inputs from the experts. The pilot study was carried out to validate the instrument. In the study, the Cronbach Alpha value was greater than 0.7 which is reliable because it is greater than the threshold value 0.6 [27]. Table 1 depicts the Cronbach Alpha values for the instrument. For all items participants rated themselves on a five-point Likert scale ranging from (1) Strongly Disagree to (5) Strongly Agree.

In this study, the evaluation was held at the participants' places. A natural setting was selected instead of a laboratory setting for conducting the evaluation since the former was more realistic [28]. Furthermore, the setting is particularly affecting the learning outcome and far illuminating when they are undertaken in their own context [29]. The evaluation was conducted with each individual respondent. A laptop or computer equipped with speakers or headphones was required to run the V-Hajj courseware. The respondents were briefed on the objectives of the evaluation and the way it would be conducted. Then the respondents were given ample time to explore and learn the contents of the V-Hajj courseware prototype on their own without any interference from the researcher. Once they were done, they were asked to answer the questionnaires containing three sections. Approximately, they complete their session in one to one and half hours.

Table 1 Interactive persuasive learning (InPeL) measurement instrument.

Construct	Element	Items	Cronbach's Alpha
Interactive Media Features	Layout & Consistency	9	0.886
	Simulation	7	0.831
	Navigation	4	0.833
	Minimal Input Device	4	0.701*
Interactive persuasive Learning elements	Motivation (Attention, Relevance, Confidence, Satisfaction (ARCS))	18	0.931
	Experience	4	0.744
	Cognitive	4	0.827
Learning Outcome	Satisfaction	7	0.894

3.3 Software- The Virtual Hajj (V-Hajj Courseware)

A desktop based courseware for hajj learning procedures, V-Hajj was used to evaluate the conceptual model. V-Hajj is a courseware under the copyright of Universiti Utara Malaysia (UUM) as one of the university's research product in computer and multimedia field. It emphasizes the use of myriad multimedia elements as well as virtual environment to facilitate learners in learning Hajj procedures. Hajj procedures are complex as it contains a lot of information, rules, tasks, practical steps, doa and zikir to be learnt before performing Hajj in Mecca. Even though comprehensive courses are provided by the authorized organization for the pilgrims, supplementary learning materials are still required [30]. For this reason, it supports the relevancy of the V-Hajj courseware development and use.

4.0 DATA ANALYSIS AND RESULTS

Statistical Package for Social Sciences (SPSS) was used to analyses the data for internal consistency reliability and descriptive statistics such as frequency and proportion. Analysis of Moment Structures (AMOS) was used for SEM to determine the fit of the measurement model. SEM is an analysis technique that considers measurement error i.e. handling factors that influence the indicator [31], technology forecasting [32] and identifiability of sparse for directed network. Some indexes are used including chi-square, i.e. a Root Mean Square Error of Approximation (RMSEA) [33] Comparative Fit Index (CFI) [34], Tucker Lewis Fit Index (TLI) [35], Normed Fit Index (NFI) [36] and Chi Square/Degree of Freedom [37]. The criteria for model fit assessment for both the CFA and SEM are presented in Table 2.

Table 2 Criteria for model fit assessment

Name of category	Name of index	Index full name	Level of acceptance	Literature	Comments
Absolute fit	Chisq	Chi-square	P > 0.05	Wheaton *et al.* (1977)	Sensitive to sample size > 200
	RMSEA	Root Mean Square Error of Approximation	RMSEA<0.08	Browne and Cudeck (1993)	Range 0.05 to 1.00 acceptable.
	GFI	Goodness of Fit Index	GFI > 0.90	Joreskog and Sorbom (1996)	GFI = 0.95 is a good fit
Incremental fit	CFI	Comparative Fit Index	CFI > 0.90	Bentler (1989)	CFI = 0.95 is a good fit
	TLI	Tucker-Lewis Index	TLI > 0.90	Bentler and Bonett (1980)	TLI = 0.95 is a good fit
	NFI	Normed Fit Index	NFI > 0.80	Reinard (2006)	NFI = 0.95 is a good fit
Parsimonious	Chisq/df	Chi Square/Degree of Freedom	Chi square/df < 5.0	Marsh and Hocevar (1985)	The value should be below 5.0

SEM is used to measure the direct effects of structural model to predict the significant relationship among the factors of interactive persuasive learning among elderly. A two-step model building approach was used to analyses the two conceptually distinct models: the measurement model followed by the structural model. The fit and construct validity of the proposed measurement model was first tested and once a satisfactory measurement was obtained, the structural paths of the SEM were estimated. The evaluation of the measurement models and structural models was done using maximum likelihood estimation.

4.1 Demographic Statistics

Among the respondents, 40.7% (122) were male and 59.3% (178) were female. The range age of the participants was 50-71 years old. Descriptive statistics of the respondents is depicted in Table 3.

Table 3 Demographic data of the respondent

Demographic data	Frequency	Percentage
Gender		
Male	122	40.7
Female	178	59.3
Age		
50-71 years old	300	100
Educational level		
Primary School	47	15.7
Secondary School	163	54.3
College/University	90	30
Computer use		
Yes	155	51.7
No	145	48.3
Computer-Based learning material use		
Yes	107	35.7
No	193	64.3

4.2 Measurement for Model Specification

The measurement models were assessed based on the significance of each estimated coefficient or loading, the convergent validity and discriminant validity. All items loaded significantly on their latent construct ($p < 0.05$). Convergent validity was assessed using composite reliability and average variance extracted. A commonly used threshold value for composite reliability is 0.6 [37] whereas for average variance extracted is 0.5 [38]. The composite reliability and average variance extracted are in the acceptable range. The scales were therefore considered satisfactory for SEM. Discriminant validity appeared to be satisfactory for all operationalization as the estimated correlations were less than 0.85. Discriminant is achieved if indicator correlates more highly with the construct that it is intended to measure than with other constructs [40]. Table 4 shows the acceptable model fit that was obtained since all the chosen fit statistics was verified to the requirements. While all the factors have acceptable reliability value, each factor can also be measured individually depending on the nature of the research.

Table 4 Summary of measurement scales

Construct	**Cronbach Alpha** (above 0.6)	**CR** (above 0.6)	**AVE** (Above 0.6)
IM Feature	0.9540	0.9547	0.7016
Cognitive	0.9020	0.8561	0.6040
Motivation	0.9200	0.8561	0.5653
Experience	0.8920	0.9206	0.5889
Learning outcome	0.9350	0.6545	0.9296

4.3 The CFA Procedures IM Feature

The CFA procedures for IM Feature illustrated in Figure 2. 15 items that have factor loading less than 0.5 have been removed and new values for goodness-of-fit indices are summarized in Table 5. The new loadings for IM Feature ranged from 0.6 to 0.8.

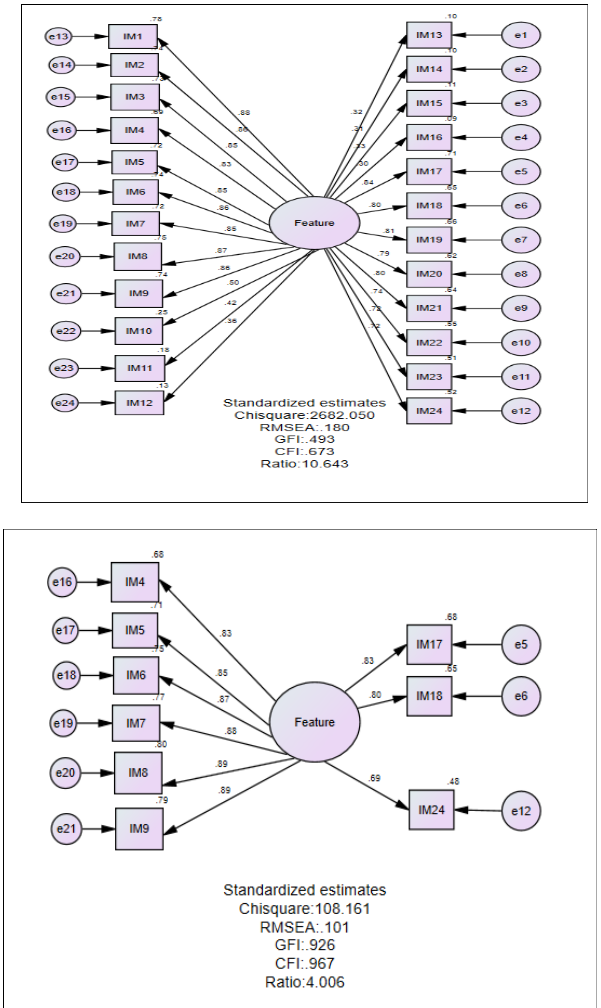


Figure 2 The IM feature CFA.

Table 5 The assessment of fitness for IM Feature measurement model

Fit Indices	**Fit Statistics**	**Recommended Fit Criteria**	**Conclusion**
Absolute fit indices			
Chisq	108.161	P > 0.05	Satisfactory
RMSEA	0.101	RMSEA < 0.08	Satisfactory
GFI	0.926	GFI > 0.90	Satisfactory
Incremental fit indicates			
CFI	0.967	Over 0.90	Satisfactory
Persimony fit Index			
Chiq/df (ratio)	4.006	Below 5	Satisfactory

4.4 The CFA Procedures For Cognitive

Figure 3 shows the CFA procedures for Cognitive. As indicators, factor loading for each item is stated. Additionally, the goodness-of-fit indices for Cognitive measurement are also stated. According to Hair, Black, Babin, and Tatham [39] an acceptable factor loading is greater 0.30. Having tested the new model, new values for goodness-of-fit indexes are depicted in Table 6. The new loading for Cognitive range from 0.6 to 0.9.

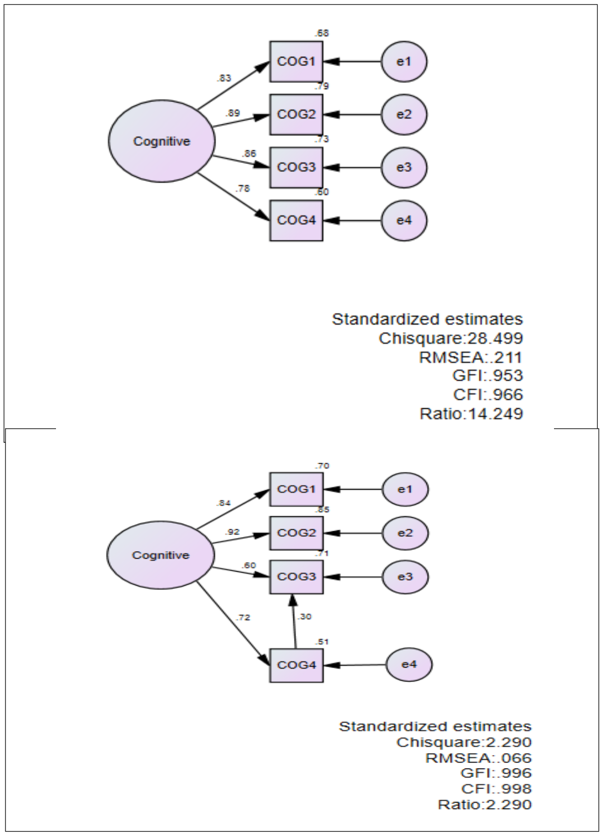


Figure 3 The cognitive CFA.

Table 6 The assessment of fitness for Cognitive measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute fit indices			
Chisq	0.255	P > 0.05	Satisfactory
RMSEA	0.000	RMSEA < 0.08	Satisfactory
GFI	0.998	GFI > 0.90	Satisfactory
Incremental fit indicates			
CFI	1.000	Over 0.90	Satisfactory
Persimony fit Index			
Chiq/df (ratio)	0.128	Below 5	Satisfactory

4.5 The CFA Procedures For Motivation

Figure 4 illustrates the CFA procedures for Motivation, which is described by Table 7. Figure 7 illustrates the factor loading for each item and goodness-of-fit indices for Motivation measurement model. Hence, all (9) items that have factor loading less than 0.5 have been removed and new values for goodness-of-fit indices are summarized in Table 7. The new loadings for Motivation ranged from 0.5 to 0.8.

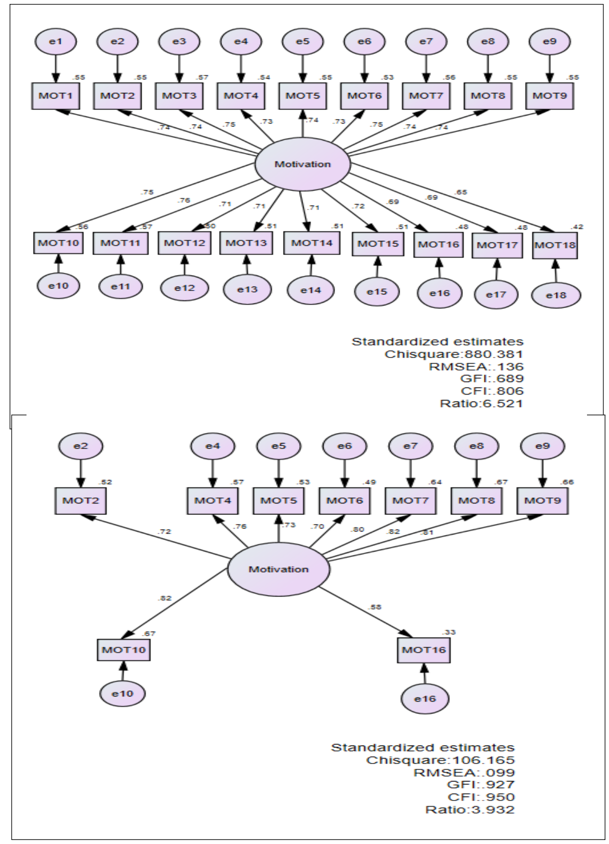


Figure 4: The motivation – CFA.

Table 7 The assessment of fitness for Motivation measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute fit indices			
Chisq	106.165	P > 0.05	Satisfactory
RMSEA	0.099	Range 0.05 to 1.00 acceptable	Satisfactory
GFI	0.927	GFI > 0.90	Satisfactory
Incremental fit indicates			
CFI	0.950	Over 0.90	Satisfactory
Persimony fit Index			
Chiq/df (ratio)	3.832	Below 5	Satisfactory

4.6 The CFA Procedures For Experience

The CFA procedures and measurement model for Experience is illustrated in Figure 5 with the new values for goodness-of-fit indices, described by Table8. Then, the loadings for Experience ranged from 0.5 to 0.9.

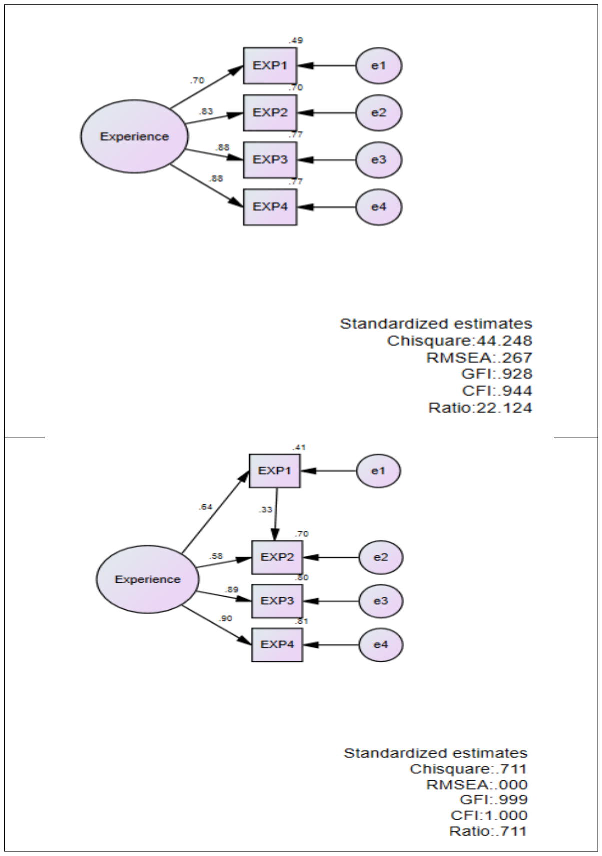


Figure 5 Experience CFA.

Table 8 The assessment of fitness for experience measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute fit indices			
Chisq	0.711	P > 0.05	Satisfactory
RMSEA	0.000	Range 0.05to 1.00 acceptable	Satisfactory
GFI	0.999	GFI > 0.90	Satisfactory
Incremental fit indicates			
CFI	1.000	Over 0.90	Satisfactory
Persimony fit Index			
Chiq/df (ratio)	0.711	Below 5	Satisfactory

4.7 The CFA Procedures For Learning Outcome

Furthermore, the CFA procedures for Learning Outcome is showed in Figure 6 and described by Table 9. Figure 6 also states measurement model and the factor loading for each item and good-of-fit indexes for learning outcome. Hence, there is one item has to be removed because factor loading less than 0.5. Having tested the new model, the new values for goodness- of-fit indices are summarized in Table 9. The new loadings for learning outcome ranged from 0.7 to 0.8.

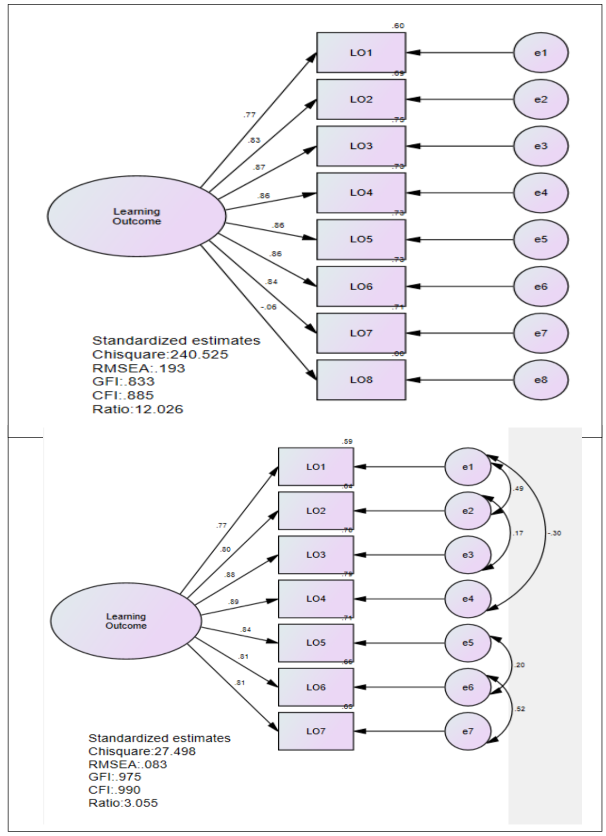


Figure 6 The learning outcome CFA.

Table 9 The assessment of fitness for learning outcome measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute fit indices			
Chisq	27.498	P > 0.05	Satisfactory
RMSEA	0.083	Range 0.05 to 1.00 acceptable	Satisfactory
GFI	0.975	GFI > 0.90	Satisfactory
Incremental fit indicates			
CFI	0.990	Over 0.90	Satisfactory
Persimony fit Index			
Chiq/df (ratio)	3.055	Below 5	Satisfactory

5.0 CONCLUSION AND FUTURE RESEARCH

This paper presented a study which was conducted to propose and evaluate a measurement model of interactive persuasive media potentials in supporting and enhancing learning among elderly. The study used an empirical study for data collection and the measurement model was tested using SEM with AMOS. The study concludes that the model is suitable for interactive media learning environment among elderly. Therefore, the future work will concentrated on identifying the relationship of the interactive persuasive learning elements for elderly.

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