



# Construct validity of Thai lifelong learning inventory: Evidence from high-school students in Phrae, Kalasin, Prachin Buri, and Pangnga provinces



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## ABSTRACT

This study aimed to assess the construct validity of Thai lifelong learning inventory: evidence from high-school students in Phrae, Kalasin, Prachinburi, and Pang-nga provinces. The participants in this study were 1,939 high-school students and were selected through multi-stage sampling. The tools were two sets of an inventory to determine the students of lifelong learning, each of which contained 70 items. The first set was a 5-scale Likert inventory and the second was a situational inventory with 4 choices for each item. The data were validated using second order confirmatory factor analysis followed by the LISREL 8.72. The results indicated that the models fitted to the empirical data found in the former inventory,  $\chi^2 = 125.79$ ,  $df = 106$ ,  $p = .09$ , GFI = 1.00, AGFI = 0.98 and RMSEA = 0.01, and those found in the latter,  $\chi^2 = 149.96$ ,  $df = 127$ ,  $p = .08$ , GFI = 0.99, AGFI = 0.98, RMSEA = 0.01.

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## Introduction

Lifelong learning is important for the 21st century living; as a result, every country has to cultivate the attitude of lifelong learning because a key purpose of lifelong learning the active citizenship which is important in terms of connecting individuals to the structures of social and economic activity in both local and global contexts. Lifelong learning can be divided into two phases: initial education referring to formal education and later learning referring to education or training following formal education (Gorard, 2001; as cited in Sumretphol, 2004) The two phases are related in that an individual will transfer what he has learned in the formal education

to later learning. Those who are successful in the first phase have a higher motivation to pursue their learning through life (Hasan, 1996; Medel–Añonuevo, Ohsako & Mauch, 2001; Sumretphol, 2004). Therefore, lifelong learning attributes should be cultivated during the first phase and should be monitored continuously on the individual and national levels.

The assessment of lifelong learning attributes is generally carried out by using a lifelong learning attributes inventory developed according to professions such as the Oddi Continuing Learning Inventory (OCLI), (Oddi, 1986), Characteristic of Lifelong Learners in the Professions (CLLP), (Livneh, 1988), Employee Lifelong Learning Scale (ELLS), (Gardiner, 1998), Effective Lifelong Learning Inventory (ELLI), (Deakin, Patricia, & Guy, 2004), Revised Oddi Continuing Learning Inventory, (Harvey, Rothman & Frecker, 2006), Characteristics of Lifelong Learning of the Senior (Choomsai Na Ayuthaya, 2008) and Characteristics of Lifelong Learning of High-School Students (Rittilun, 2012).

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The assessment of these attributes is a psychological assessment and the validity of the results depends on the quality of the inventory. The construct validity is an important feature of the assessment (Kanjanaawasee, 2005) because it can confirm that the assessment has adopted a certain theory or can actually determine certain factors. According to Rittilun (2012), his first phase of exploratory factor analysis revealed that a model for determining the Thai lifelong learning inventory comprised three factors – ability to learn, effective learning management, and motivation and learning exchange. To confirm that high-school students have these factors are theoretical – based, this study was conducted based on construct validity.

## Literature Review

This study based on second order confirmatory factor analysis follows the model developed by Rittilun (2012) revealing that there are 3 main factors validated by exploratory factor analysis and 26 sub-factors as follows:

1. The ability to learn comprising 7 sub-factors: 1) information seeking skill, 2) ability to analyze, synthesize and evaluate, 3) creativity, 4) ability to communicate effectively, 5) ability to summarize, 6) ability to integrate what has been learned, and 7) various learning strategies.
2. Effective learning management comprising 8 sub-factors: 1) inquisitive mind, 2) avid reader, 3) curiosity and problem solving, 4) effective recording, 5) future orientation, 6) academic challenge, 7) being able to work alone, and 8) effective time management.
3. Motivation and learning exchange comprising 11 sub-factors: 1) self-directed learning, 2) active involvement in improving oneself and society, 3) learning enjoyment, 4) moral judgment, 5) self-awareness of potential, 6) recognizing others' competence, 7) being open-minded, 8) supporting others to learn, 9) willingness to change, 10) information literacy, and 11) viewing everything as a learning process.

## Research Objective

This paper aimed to assess the construct validity of Thai lifelong learning inventory from the evidence from high-school students in Phrae Kalasin Prachinburi and Pangnga province.

## Methods

This research method was descriptive research to assess the construct validity of Thai lifelong learning inventory models of high-school students. The research tools included 1) a 70-item-5-scale Likert inventory whose discriminating power was between 0.21 and 0.64 and whose reliability was .96 and 2) a 70-item situational inventory with 4 choices for each item whose discriminating power was between 0.21 and 0.53 and whose reliability was .93.

## Participants

The population in this study was 923,227 high-school students under Office of Basic Education Commission in 2011 academic year.

The sample in this study was 1,939 high-school students under the Office of Basic Education Commission in 2011 academic year. Four hundred eighty nine students from Phrae province in the Northern region, 481 students from Kalasin province in the Northeastern region, 483 students from Prachinburi province in the Central Plains and 486 students from Pangnga province in the Southern region. They were randomly selected through multi-stage sampling.

## Data Collection

In this study, the data were collected from 15 schools in four regions: 3 schools (Rongkwanganusorn, muangkhaipittayakhom, Wiengtep Wittaya) from Phrae province, 4 schools (Somdetpitayakhom, Khammuang, Noncomwitaya, Morsaunkhingpiitayasan) from Kalasin province, 4 schools (Prantaratbamrung, Chitjaichuen, Kabinburi, Thairath-witthaya) from Prachinburi province in the Central plains and 4 schools (Deebukphangngawittayayon, Satreep-hangnga, Takuatungngantaweewittayakom, Takuapasana-nukul) from Pangnga province.

## Data Analysis

Second order confirmatory factor analysis and LISREL 8.72 were used to analyze the data.

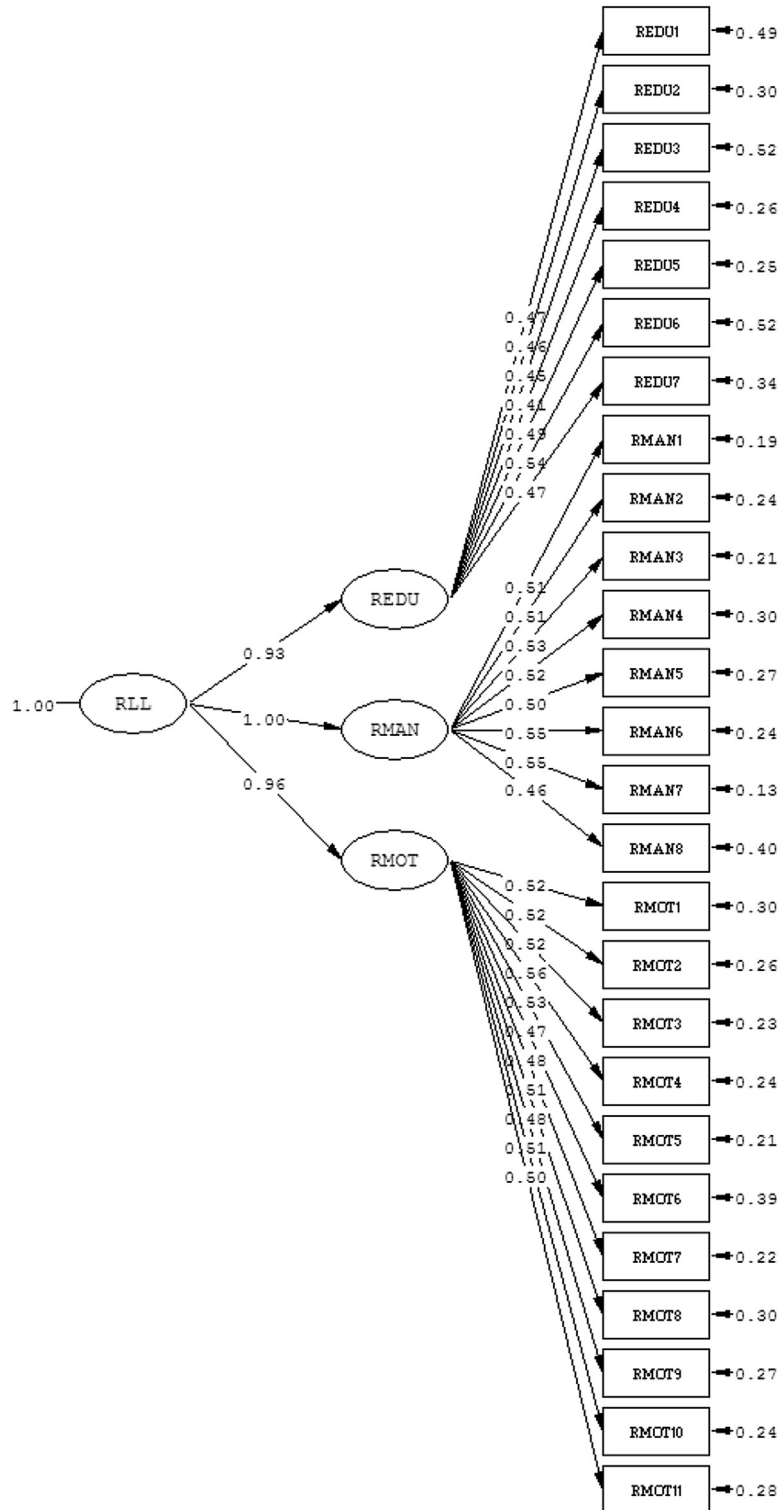
## Results

The findings can be divided into two parts.

1. According to the Likert-scale inventory, the Chi-square ( $\chi^2$ ) value was 125.79 df of 106 and  $p$  was .09. The  $\chi^2$  value was statistically insignificant to zero. This means that the model fitted to the empirical data, in that the Goodness of Fit Index (GFI) of the model was 1.00 and its Adjusted Goodness of Fit Index (AGFI) was 0.98. The value of Root Mean Square Error of Approximation (RMSEA) was 0.01, meaning that the model fitted to the empirical data. The linear relationship of the sub-factors is shown in Figure 1 and the results in Table 1.

Based on Figure 1 and Table 1, the factor loadings of the twenty-six sub-factors were positive. Their sizes ranged from 0.53 to 0.84 and their statistically significant level at .01. The highest factor loading sub-factor was being able to work alone, RMAN7 (0.84), followed by inquisitive mind, RMAN1 (0.76) and self-awareness of potential, RMOT5 (0.76) while the lowest factor loading sub-factor was creativity, REDU3 (0.53).

According to the second order confirmatory factor analysis, the factor loading of the three factors were positive and their sizes ranged from 0.93 to 1.00 with their statistically significant level at .01. The coefficient of



chi-square=125.76, df=106, p-value=0.9211, RMSEA=0.10

Figure 1 The Likert Scale Inventory of the Thai lifelong learning inventory model of high-school students

**Table 1**

The results obtained from second order confirmatory factor analysis of the lifelong learning inventory model of high-school students according to the Likert-scale inventory

Sub-factor	Factor loadings (b)	SE	SC	t	R <sup>2</sup>	Coefficient of factor value (FS)
<b>First Order Factor Analysis</b>						
<b>Ability to Learn (REDU)</b>						
REDU1	0.47**	–	0.56	–	0.31	0.10
REDU2	0.46**	0.02	0.64	21.79	0.41	0.13
REDU3	0.45**	0.02	0.53	18.83	0.28	0.08
REDU4	0.41**	0.02	0.63	20.05	0.39	0.14
REDU5	0.49**	0.02	0.70	21.73	0.49	0.22
REDU6	0.54**	0.02	0.60	19.63	0.35	0.15
REDU7	0.47**	0.02	0.63	19.04	0.39	0.08
<b>Effective Learning Management (RMAN)</b>						
RMAN1	0.51**	–	0.76	–	0.58	0.13
RMAN2	0.51**	0.02	0.72	33.66	0.52	0.11
RMAN3	0.53**	0.02	0.75	33.53	0.56	0.14
RMAN4	0.52**	0.02	0.69	31.65	0.47	0.07
RMAN5	0.50**	0.02	0.70	30.87	0.49	0.09
RMAN6	0.55**	0.02	0.75	32.68	0.56	0.16
RMAN7	0.55**	0.02	0.84	38.16	0.70	0.25
RMAN8	0.46**	0.02	0.59	23.89	0.34	–0.01
<b>Motivation and Learning Exchange (RMOT)</b>						
RMOT1	0.52**	–	0.69	–	0.47	0.15
RMOT2	0.52**	0.02	0.72	27.32	0.52	0.16
RMOT3	0.52**	0.02	0.74	27.09	0.55	0.15
RMOT4	0.56**	0.02	0.75	28.94	0.57	0.15
RMOT5	0.53**	0.02	0.76	28.91	0.58	0.16
RMOT6	0.47**	0.02	0.60	23.42	0.36	0.01
RMOT7	0.51**	0.02	0.71	26.76	0.51	0.15
RMOT8	0.51**	0.02	0.68	26.76	0.46	0.08
RMOT9	0.48**	0.02	0.67	26.30	0.45	0.05
RMOT10	0.51**	0.02	0.72	27.02	0.52	0.11
RMOT11	0.50**	0.02	0.68	25.78	0.47	0.08
<b>Second Order Factor Analysis</b>						
REDU	0.93**	0.04	0.93	23.80	0.86	–
RMAN	1.00**	0.03	1.00	37.98	1.00	–
RMOT	0.96**	0.03	0.96	31.47	0.93	–

$\chi^2 = 125.79$ ,  $df = 106$ ,  $p = .09$ ,  $GFI = 1.00$ ,  $AGFI = 0.98$ ,  $RMSEA = 0.01$

\*\*Significant level at .01

prediction ranged from 0.86 to 1.00. The ranking of factor loading from high to low was as follows: the second factor: effective learning management (RMAN) at 1.00 ( $R^2 = 1.00$ ), the third factor: motivation and learning exchange (RMOT) at 0.96 ( $R^2 = 0.93$ ) and the first factor: ability to learn (REDU) at 0.93 ( $R^2 = 0.86$ ).

The covariation of the first factor and the attributes accounted for about 93 percent. According to its sub-factors, the covariation of ability to summarize (REDU5) and the ability to learn was highest (49%) while that of creativity (REDU3) and the ability to learn was lowest (28%). The covariation of the second factor (RMAN) and the attributes accounted for 100 percent. According to its sub-factors, the covariation of being able to work alone (RMAN7) and effective learning management was highest (70%) while effective time management (RMAN8) and effective time management were lowest (30%). The covariation of the third factor (RMOT) and the attributes accounted for 96 percent. According to its sub-factors, the covariation of self-awareness of potential (RMOT5) and motivation and learning exchange was highest (58%) while that of recognizing others' potential (RMOT6) was lowest (36%).

Based on second order confirmatory factor analysis, the Likert scales of the Lifelong Learning Inventory Model can be translated into the following equations:

$$\begin{aligned} RLL = & 0.10(REDU1) + 0.13(REDU2) + 0.08(REDU3) \\ & + 0.14(REDU4) + 0.22(REDU5) + 0.15(REDU6) \\ & + 0.08(REDU7) + 0.13(RMAN1) + 0.11(RMAN2) \\ & + 0.14(RMAN3) + 0.07(RMAN4) + 0.09(RMAN5) \\ & + 0.16(RMAN6) + 0.25(RMAN7) - 0.01(RMAN8) \\ & + 0.15(RMOT1) + 0.16(RMOT2) + 0.15(RMOT3) \\ & + 0.15(RMOT4) + 0.16(RMOT5) + 0.01(RMOT6) \\ & + 0.15(RMOT7) + 0.08(RMOT8) + 0.05(RMOT9) \\ & + 0.11(RMOT10) + 0.08(RMOT11) \end{aligned}$$

2. Regarding the results based on second order confirmatory factor analysis of the situational inventory, the Chi-Square ( $\chi^2$ ) value was 149.96  $df$  of 127 and  $p$  was .08. The  $\chi^2$  value was statistically insignificant to zero, meaning that the model fitted to the empirical data in that the GFI

of the model was 0.99 and its AGFI was 0.98. The RMSEA was 0.01, meaning that the model fitted to the empirical data. The linear relationship of the sub-factors is shown in Figure 2 and the results in Table 2.

Based on Figure 2 and Table 2 the factor loadings of the twenty-six sub-factors were positive. Their sizes ranged from 0.12 to 0.72, and their statistically significant level at .01. The highest factor loading sub-factor was being able to work alone, SMAN7 (0.72), followed by inquisitive mind, RMAN1 (0.71) while the lowest factor loading sub-factor was creativity, SEDU3 (0.12).

According to the second order confirmatory factor analysis, the factor loadings of the three factors were positive. Their sizes ranged from 0.79 to 1.00 and their statistically significant level was at .01. The coefficient of prediction ranged from 0.62 to 1.00. The ranking of the factor loadings from high to low was as follows: the first factor: ability to learn (SEDU) and the second factor: effective learning management (SMAN) were 1.00 ( $R^2 = 1.00$ ) and the third factor: motivation and learning exchange (SMOT) were 0.79 ( $R^2 = 0.62$ ).

The covariation of the first factor and the attributes accounted for 100 percent. According to its sub-factors, the covariation of various learning strategies (SEDU7) and the ability to learn was highest (37%) while that of creativity (SEDU3) and the ability to learn was lowest (1%). The covariation of the second factor (SMAN) and the attributes accounted for 100 percent. According to its sub-factors, the covariation of being able to work alone (SMAN7) and the effective learning management was highest (52%) while that of avid reader (SMAN2) and effective learning management was lowest (15%). The covariation of the third factor and the attributes accounted for 62 percent. According to its sub-factors, the covariation of learning enjoyment (SMOT3) and the motivation and learning exchange was highest (51%) while that of moral judgment (SMOT4) and motivation and learning exchange was lowest (32%).

Based on the second order confirmation factor analysis, the situational inventory of the Lifelong Learning Inventory Model can be translated into the following equations:

$$\begin{aligned} SLL = & 0.07(SEDU1) + 0.06(SEDU2) - 0.01(SEDU3) \\ & + 0.08(SEDU4) + 0.00(SEDU5) - 0.02(SEDU6) \\ & + 0.37(SEDU7) + 0.33(SMAN1) - 0.09(SMAN2) \\ & + 0.38(SMAN3) + 0.06(SMAN4) + 0.18(SMAN5) \\ & + 0.24(SMAN6) + 0.46(SMAN7) - 0.08(SMAN8) \\ & + 0.23(SMOT1) + 0.21(SMOT2) + 0.47(SMOT3) \\ & + 0.16(SMOT4) + 0.31(SMOT5) + 0.08(SMOT6) \\ & + 0.08(SMOT7) + 0.04(SMOT8) + 0.11(SMOT9) \\ & + 0.09(SMOT10) + 0.37(SMOT11) \end{aligned}$$

According to the results obtained from the second order confirmatory factor analysis of the two inventories, the value of GFI, that of AGFI and that of RMSEA were about the same. Based on the  $\chi^2/df$ , the value of the Likert-scale model was 1.187 while that of the situational inventory

model was 1.190. The values of both models were less than 2, revealing that both models matched the empirical data. The Likert-scale model, however, fitted to the empirical data better than the other model and it provided more reliable data since its value of  $\chi^2/df$  was closer to 0.

The difference between the  $\chi^2$  of the Likert-scale model and that of the situational model was 24.17 df of 21. The critical value of  $\chi^2$  at .01 or 38.93 meant that the difference between the two  $\chi^2$  values was statistically insignificant, in other words, the two models did not differ in terms of statistical significance but the Likert-scale model was more reliable than the situational model as shown in Table 3.

According to the standard scores of the two models, these were statistically significant level at .01. The scores of the Likert-scale inventory varied from 0.93 to 1.00 and the values of the coefficient of prediction varied from 0.86 to 1.00, while the scores of the situational inventory varied from 0.79 to 1.00 with its values of coefficient of prediction varying from 0.62 to 1.00. This means that both have construct validity, but the former has more construct validity and more covariation with the Thai lifelong learning inventory than the latter.

## Discussion

Some results in this study that should be addressed are as follows:

1. Both models fitted to the empirical data and this means that both models had construct validity of the theoretical framework. Moreover, the differences of the  $\chi^2$  values of both models were statistically insignificant. It can be concluded that both can be used to determine the Thai lifelong learning Inventory of high-school students because they were developed from the same factors systematically in that the theories regarding lifelong learning had been thoroughly researched and those with such attributes had been interviewed. All of the data were used to determine the framework, the terms and the questions related to the attributes before the construct validity of the models was assessed by experts. The methods to determine the discriminating power, the reliability, the exploratory factor analysis and the assessment of the different performance of the questions due to different gender were similar; as a result, the questions did not differ.
2. Since the  $\chi^2/df$  value of the Likert-scale model was less than that of the situational model, it can be concluded that the Likert-scale model provides more complete data and fit to the empirical data more than the situational model. The reasons for this could be because the students were more familiar with the former than the latter and the questions were shorter, more precise and easy to interpret (Lawthong, 2005; Mehrens & Lehmann, 1978); therefore, the students answer the questions in this model more attentively than the other. The situational model contained longer descriptions and the students had to decide which alternative would best match their attribute in such a situation; consequently, the students had to spend more time on each question, so they felt

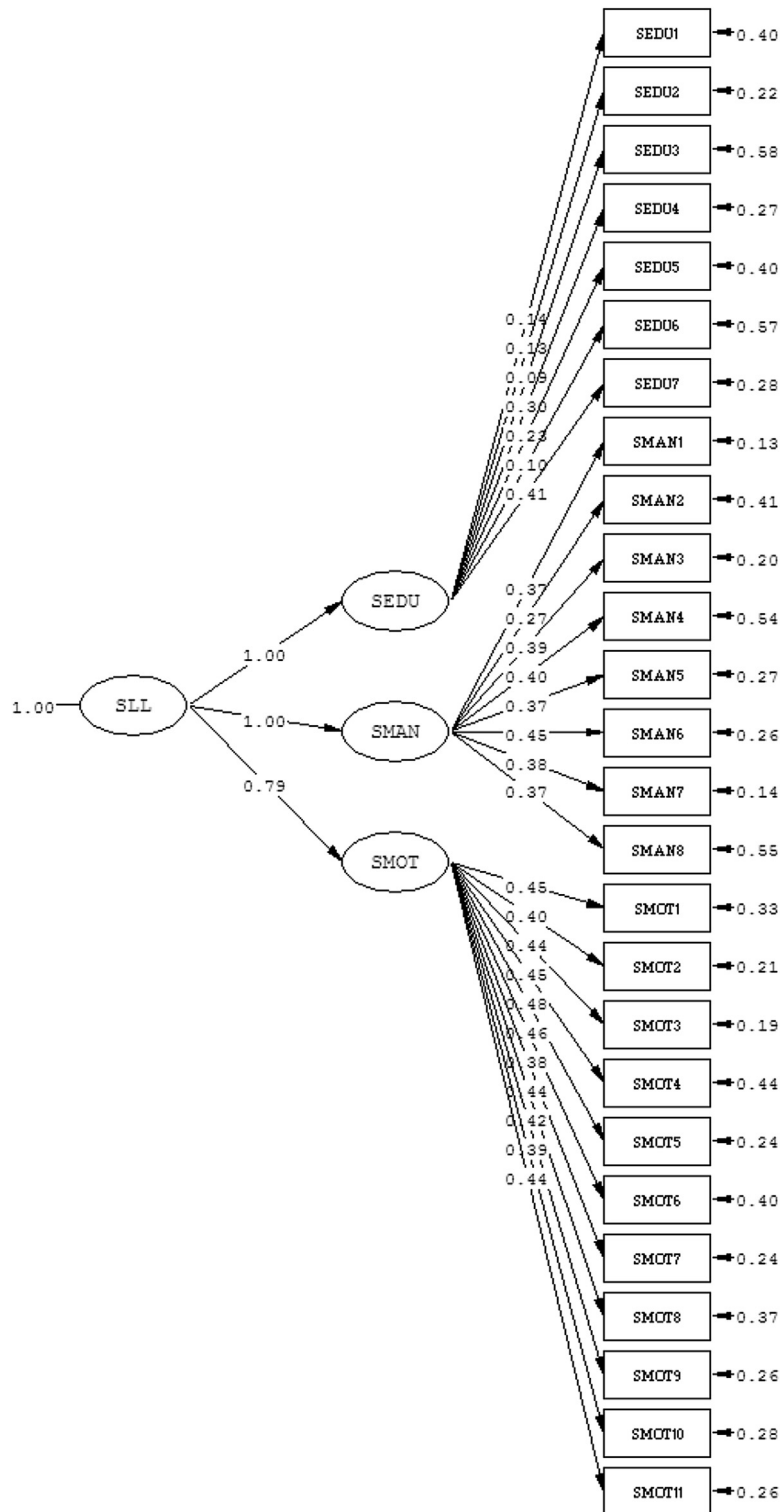


Figure 2 The situational inventory of the lifelong learning inventory model of high-school students

**Table 2**

The results obtained from second order confirmatory factor analysis of the lifelong learning inventory model of high-school students according to the situational inventory

Sub-factor	Factor loadings (b)	SE	SC	t	R <sup>2</sup>	Coefficient of factor value (FS)
<b>First Order Factor Analysis</b>						
<b>Ability to Learn (SEDU)</b>						
SEDU1	0.14**	–	0.22	–	0.05	0.07
SEDU2	0.13**	0.02	0.26	7.28	0.07	0.06
SEDU3	0.09**	0.02	0.12	4.41	0.01	–0.01
SEDU4	0.30**	0.04	0.50	8.15	0.25	0.08
SEDU5	0.23**	0.03	0.34	7.33	0.11	0.00
SEDU6	0.10**	0.02	0.14	4.67	0.02	–0.02
SEDU7	0.41**	0.05	0.61	7.92	0.37	0.37
<b>Effective Learning Management (SMAN)</b>						
SMAN1	0.37**	–	0.71	–	0.51	0.33
SMAN2	0.27**	0.02	0.39	3.9–1	0.15	–0.09
SMAN3	0.39**	0.02	0.66	22.38	0.43	0.38
SMAN4	0.40**	0.02	0.46	19.65	0.23	0.06
SMAN5	0.37**	0.02	0.57	21.44	0.33	0.18
SMAN6	0.45**	0.02	0.66	23.48	0.44	0.24
SMAN7	0.38**	0.02	0.72	24.83	0.52	0.46
SMAN8	0.37**	0.02	0.45	16.01	0.20	0.08
<b>Motivation and Learning Exchange (SMOT)</b>						
SMOT1	0.45**	–	0.61	–	0.37	0.23
SMOT2	0.40**	0.02	0.66	19.96	0.44	0.21
SMOT3	0.44**	0.02	0.71	18.29	0.51	0.47
SMOT4	0.45**	0.02	0.57	18.34	0.32	0.16
SMOT5	0.48**	0.02	0.70	21.66	0.49	0.31
SMOT6	0.46**	0.03	0.59	18.20	0.35	0.08
SMOT7	0.38**	0.02	0.61	19.50	0.37	0.08
SMOT8	0.44**	0.02	0.58	19.45	0.34	0.04
SMOT9	0.42**	0.02	0.64	20.20	0.41	0.11
SMOT10	0.39**	0.02	0.60	18.77	0.36	0.09
SMOT11	0.44**	0.02	0.65	18.50	0.42	0.37
<b>Second Order Factor Analysis</b>						
SEDU	1.00**	0.11	1.00	8.75	1.00	–
SMAN	1.00**	0.03	1.00	31.55	1.00	–
SMOT	0.79**	0.04	0.79	22.34	0.62	–

$\chi^2 = 149.96$ ,  $df = 127$ ,  $p = .08$ ,  $GFI = 0.99$ ,  $AGFI = 0.98$ ,  $RMSEA = 0.01$

\*\*Significant level at .01

tired and bored (Ritjaroon, 2002), resulting in earning lower statistical values than the Likert-scale model.

- According to the factor loadings of the two models, the highest factor loading value was being able to work alone, followed by inquisitive mind. It can be concluded that being able to work alone and inquisitive mind are essential attributes of a lifelong learner. As a results, they are further discussed as follows:

**Being able to work alone** earned the highest factor loading value and this concurs with studies conducted by Candy, Crebert, and O' Leary (2009); Deakin et al. (2004); Sumretphol (2004) and Choomsai Na Ayuthaya (2008). Their results indicated that a lifelong learner has to be able

to work by himself and be equipped with the effective skills to cope with personal activity. This might be because a lifelong learner has to be, first of all, independent; in particular, high-school students have to do assignments by themselves. They take pride in achieving their goals by themselves and they believe that this will help them succeed in their future lives. Steinberg (1996) and Kaewkangwan (2006)-stated that high-school students were those who had the drive to seek information or solutions by themselves.

**Inquisitive mind**, another important attribute of a lifelong learner, was also found to be positively related in the studies conducted by Oddi (1986); Gardiner (1998); Charoenwongsak (2001); Deakin et al. (2004); Harvey, Rothman, and Frecker (2006); Hojat, Veloski, Nasca, and

**Table 3**

Comparison of Goodness fit index and statistical values of lifelong learning inventory models of high-school students according to the Likert-scale inventory and the situational inventory

Model	$\chi^2$	df	p	$\chi^2/df$	GFI	AGFI	RMSEA
Likert-scale Inventory	125.79	106	.09	1.187	1.00	0.98	0.01
Situational Inventory	149.96	126	.08	1.190	0.99	0.98	0.01
Comparison of the Likert-scale Inventory and the Situational Inventory	$\Delta\chi^2$	$\Delta df$					
	24.17	21					

Gonnella (2006); Sumretphol (2004) and The Office of the Basic Education Commission of Thailand (2004). They confirmed that the drive and desire to learn was a key attribute of a lifelong learner and the reason for this is that the inquisitive mind provides the inner motivation for the learner to have an insatiable thirst for knowledge. Steinberg (1996) and Kaewkangwan (2006) stated that high-school students were curious and always in search of new experiences.

## Conclusion and Recommendations

1. The results revealed that
  - 1.1 The Chi-Square;  $\chi^2$  value of the Likert-scale model was 125.79 df of 106 and p-value was .09. The  $\chi^2$  value was different from zero without statistical significance. This means that this model fitted to the empirical data, with the GFI equal to 1.00 and the AGFI equal to 0.98. The RMSEA was 0.01, meaning that the model fitted to the empirical data.
  - 1.2 The Chi-Square;  $\chi^2$  value of the situational model was 149.96 df of 127 and p-value was .08. The  $\chi^2$  value was different from zero without statistical insignificance. This means that the model fitted to the empirical data, with the GFI equal to 0.99 and the AGFI equal to 0.98. The RMSEA was 0.01, meaning that the model fitted to the empirical data.
2. Recommendations for application
  - 2.1 In terms of quality, the two models could be used to determine the Thai lifelong learning Inventory, but the Likert-scale model provided more reliable data and fitted to the empirical data more than the situational model. The use of which model depends on the time-frame and the context. However, they should not be used at the same time because they will tire the participants.
  - 2.2 According to the results, the most important factor was effective learning management comprising inquisitive mind, avid reader, curiosity and problem solving, effective recording, future orientation, academic challenge, being able to work alone, and effective time management. Teachers, therefore, should cultivate these attributes in students and be role models. Teachers should create an enjoyable autonomous learning atmosphere (Bryce & Wither, 2003) while schools should provide students with a suitable environment for lifelong learning and adequate modern search engines or resources.
3. Recommendations for further studies
  - 3.1 The second order confirmatory factor analysis in the situation inventory revealed that some of factor loading in the first-order indicators lower than 0.40 (Nunnally & Bernstein, 1994). Accordingly, if their want to development of the models and research repeatedly: should be omitted for the perfect Thai lifelong learning inventory model.
  - 3.2 Other methods to analyze the validity should be used to assess and confirm that the factors are theoretically-based. Such methods include multi trait-multi method analysis and cross validation.

## Conflict of Interest

There is no conflict of interest.

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