Structural Equation Modeling of Teaching Behavior in Internet Use of Teachers in Thailand

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Abstract – At present, instruction via the internet is a challenge for teachers. Many teachers have changed their teaching behavior (TB) from a conventional style into a style of teaching via the internet. For this reason, this research had the objective to develop a structural equation model (SEM) of TB in internet use of lower secondary (LS) school teachers, classified according to school size. The developed SEM model of TB in internet use of LS school teachers had validity that was congruent to the empirical data of every model with good criteria of all goodness of fit indices. The model was composed of 8 latent variables from 24 observed variables. All causal variables in the model had a positive direct effect on TB in internet use, and these were able to explain the variation in TB in a large sized school, a very large sized school, and an extra-large sized school, with 99, 100, and 92, respectively.

Keywords – Teaching Behavior, Internet Use, Secondary School, Teacher, Structural Equation Model.

1. Introduction

The advancement of information technology has played an increasingly significant role in the way of life of people in society in all aspects of studying, working, and daily living.

Therefore, educational institutes at different levels have adjusted their pattern, of teaching, learning, and management in order to extensively utilize the advantages of information technology. Teachers need to adjust their pattern of teaching-learning by using increased information technology, [1],[2],[3] suggested that, for social media to be used as effective learning tools, and to adjust students' prior affordances with these tools, complicated efforts in designing, scaffolding, and interacting with students during the process are necessary. Besides those who directly teach in the field of information technology/computers, those who teach other subjects need to adapt themselves to use the information technology/computers as well, particularly in using internet as media for teaching-learning management [4],[5],[6].

However, the teacher must be able to introduce internet use properly; this needs to have various supportive factors, in terms of internal factors, external factors, the background of the teacher, internal factors of the teacher, including different traits, and external factors of the teacher, covering numerous situations [7]. Particularly, school support and the background of teacher factor composing education and experiences would assist in teaching behavior (TB) in internet use; therefore this would provide complete benefits for learners [8], [9]. The internet would provide a more valuable advantage.

Teachers of lower secondary (LS) schools are groups of teachers who play an important role in introducing the internet to benefit LS school students. These students have paid attention to, and have had a lot of contact with the internet, but they are still unable to effectively use it; schools and teachers still have the burden of and play a role to develop them to have appropriate behavior for internet usage. Moreover, the teacher is an essential person in helping them in this important task in order for them to accomplish targets.

Currently, there is no clear evidence of which variables have an effect on TB in internet use, and whether it is a trait, a situation, or a background. Therefore, it is interesting to develop a SEM model

of TB in internet use of LS school teachers of secondary schools under the Office of the Basic Education Commission (OBEC) of Thailand. The selected type of casual relationship model used was a SEM model, because this is a delicate causal relationship model for both research design and data analysis.

2. Literature Reviews

2.1. TB in Internet Use

TB in internet use of LS school teacher is a result variable. This was used as a conceptual framework that the research team named the ADPIE model [10], composing of 5 aspects, as per the following:

1. Analysis of primary essence;
2. Designing of instruction;
3. Preparation of internet media;
4. Implementation of internet media for learning management, and
5. Evaluation of internet utility for learning management.

The model was adapted from the conceptual framework of behavior on the use of information technology media of teachers at the secondary education level, that was composed of 7 factors [11], which were analysis of a student, analysis of a curriculum, selection of a teaching method and a teaching model, selection of a type/model of IT media, preparation of IT media, implementation of IT media, and evaluation of IT media usage.

Factor behavior in each aspect was composed of 2 variables; therefore, there were 5 factors (latent variables) from 10 observed variables, as per the following details:

1. Analysis of primary essence:
    1.1 Analysis of a student, and
    1.2 Analysis of a curriculum.
2. Designing of instruction:
    2.1 Selection of a teaching method and a teaching model, and
    2.2 Selection of a type/model of internet media.
3. Preparation of internet media:
    3.1 Production/Providing internet media, and
    3.2 Preparedness for internet media usage.
4. Implementation of internet media for learning management:
    4.1 Internet usage of online social network, and
    4.2 Internet usage of no online social network.
5. Evaluation of internet utility for learning management:
    5.1 Evaluation of internet utility for student learning, and
    5.2 Evaluation of internet utility for teacher teaching.

2.2. Causal Variables of TB in Internet Use

Causal variables of TB in internet use of teachers was used as the conceptual framework of causal variables of behavior on the use of information technology media, composed of 3 aspects- trait, situation, and background. Each aspect was composed of latent variables and observed variables that were adapted from the variables that were correlated with behavior on the use of information technology media of secondary school teachers, discovered by Leekitchwatana [11] and other research findings, as per the following:

1. Traits of a teacher were the first aspect of causal variable, composed of 3 latent variables, including ability, self-learning, and affection:

1.1. Latent variables of ability were composed of 4 traits- basic knowledge of computers and the internet, basic skills in computers and the internet, knowledge of internet usage, and skills in internet use.
1.2. Latent variables of self-learning were composed of 3 traits- planning of learning, action of learning, and evaluation of learning.
1.3. Latent variables of affection were composed of 2 traits- attitude toward internet media and achievement motive.

2. Situation of a teacher was the second aspect of causal variable, composed of 3 latent variables, including home, school, and friends:

2.1. Latent variables of home situation were composed of 2 variables- home readiness and home convenience.
2.2. Latent variables of school situation were composed of 3 variables- school policy, school readiness, and school teacher development.
2.3. Latent variables of friends were composed of 2 variables- friend character and friend interaction.

3. Background of teacher was the third aspect of causal variable, composed of 3 variables- learning experience of information technology/internet/e-learning subject in higher education with amount of credits, teaching experience with internet use with amount of years, and training experience of information technology/internet/e-learning with amount of days.

3. Research Methods

3.1. Population and Sample

The population were teachers at LS schools in all learning substance groups (excepting information technology/computer teachers) of secondary schools under OBEC, across Thailand, in the academic year 2011. The size of the sample was according to the

concept of Hair et al. [12], which mentioned that, when the number of factors is larger than six, some of which have fewer than three measured items as indicators, and multiple low communalities are present, the sample size requirements may exceed 500. In this study, the author defined the size of the sample as being equal to 1,200 teachers, and sampling by multistage random sampling was classified according to 3 school sizes, including large sized school (500-1,499 students), very large sized school (1,500-2,499 students), and extra-large sized school (>2,500 students). The sample size of 400 teachers for each subgroup was congruent to the proper sample size for analysis of the Structural Equation Model (SEM) that followed the opinion of Schumacker & Lomax [13].

3.2. Research Tool

A questionnaire was used as the research tool provided to teachers of LS schools, composed of 3 sections as per the following:

Section 1, General information of the LS school teacher.

Section 2, TB in internet use of the LS school teacher

Section 3, Variables related to TB in internet use of LS teacher, covering 3 aspects, including trait, situation, and background.

The questionnaire used a summated rating scale with 5 levels, presented in Table 1.

Table 1. Criteria for score rating of teacher opinions

Opinion level	Criteria for score rating	
	Positive	Negative
Most / Strongly agree	5	1
More / Agree	4	2
Moderate / Neutral	3	3
Less / Disagree	2	4
Least / Strongly disagree	1	5

The set of questions used to measure the latent variables had content validity, as ascertained by the research team, and construct validities were good, as ascertained by confirmatory factor analysis with the LISREL program version 9.10. Data were collected from the opinions of 1,200 teachers. It was found that all latent variable models were congruent to the empirical data at good criteria, with all goodness of fit indices shown in Table 4.

Reliabilities of the sets of questions to measure the observed variables of 21 variables by tryout with 70 LS school teachers and the α-coefficients of Cronbach were calculated with SPSS for Windows. Reliabilities ranged between 0.75–0.96, and reliabilities of latent variables were between 0.86-0.98 (Table 2.).

Table 2. CFA of latent and observed variables

Latent and Observed variables	Items	α	Loading	AVE	CR
Behaviors	**46**	**0.96**		**0.53**	**0.85**
1. Analysis of primary essence	8	0.89	0.59		
2. Designing of instruction	8	0.91	0.65		
3. Preparation of internet media	12	0.91	0.99		
4. Implementation of internet media for learning management	12	0.96	0.64		
5. Evaluation of internet utility for learning management	6	0.96	0.71		
Ability	**28**	**0.97**		**0.79**	**0.84**
6. Basic knowledge of computers and internet	7	0.91	0.94		
7. Basic skills in computers and internet,	7	0.92	0.94		
8. Knowledge of internet usage	7	0.89	0.85		
9. Skills in internet usage	7	0.93	0.81		
Self-learning	**10**	**0.94**		**0.78**	**0.91**
10. Planning of learning	3	0.88	0.84		
11. Action of learning	3	0.93	0.96		
12. Evaluation of learning	4	0.88	0.84		
Affection	**20**	**0.86**		**0.65**	**0.78**
13. Achievement motive	10	0.79	0.93		
14. Attitude toward internet media	10	0.82	0.66		
Home situation	**8**	**0.88**		**0.80**	**0.89**
15. Home readiness	4	0.86	0.85		
16. Home convenience	4	0.75	0.94		
School situation	**26**	**0.97**		**0.66**	**0.85**
17. School policy	8	0.94	0.85		
18. School readiness	10	0.95	0.82		
19. School teacher development	8	0.96	0.76		
Friends	**10**	**0.96**		**0.82**	**0.90**
20. Friend character	5	0.92	0.90		
21. Friend interaction	5	0.94	0.91		
Background of teacher	**3**	**-**		**0.19**	**0.40**
22. Learning experience of IT	1	-	0.37		
23. Teaching experience with internet use	1	-	0.55		
24. Training experience of IT	1	-	0.36		

3.3. Data Collection

Data were collected by the researcher's assistant and the researcher network at each school from the questionnaire distributed to the LS school teachers who were the collected sample group of teachers of all learning substance groups (with the exception of information technology/computer teachers) from secondary schools under OBEC, across Thailand, in the academic year of 2011, with 400 teachers from each of the 3 school sizes of education, 1,200 teachers in total. This number was classified by learning substance group and school size (Table 3.). All questionnaires were returned.

Table 3. Number of teachers and school size of education classified by learning substance group

Learning substance group	School size			Total
	Large	Very large	Extra-large	
Thai	60	54	55	169
Math	53	48	67	168
Science	43	47	62	152
Social	52	60	49	161
Hygiene	38	42	33	113
Arts	37	51	26	114
Foreign language	66	53	47	166
Occupation	51	45	61	157
Total	400	400	400	1,200

3.4. Data analysis

Data analysis was conducted to examine the validity of the developed SEM model of TB in internet use of LS school teachers, and to determine the effect values between latent variables in the model with path analysis by using the LISREL program version 9.10 for 3 subgroup models classified by school size of large sized school, very large sized school and extra-large sized school. Then, the analysis was interpreted for the validity of causal relationship model of teaching behavior with internet use by Goodness of Fit Statistics, shown in Table 4.

Table 4. Criteria and theory of values of Goodness of Fit appraisal.

Criteria Index	Criteria	Values	Results	Supporting theory
Chi-square: χ^2	$p \geq 0.05$	0.14	passed	Rasch [14]
Relative Chi-square: χ^2/df	≤ 2.00	1.32	passed	Byrne et al. [15]
RMSEA	≤ 0.05	0.03	passed	Hu & Bentler [16]
GFI	≥ 0.90	0.99	passed	Jöreskog et al. [17]
AGFI	≥ 0.90	0.95	passed	Hooper et al. [18]
RMR	≤ 0.05	0.02	passed	Hu & Bentler [16]
SRMR	≤ 0.05	0.02	passed	Hu & Bentler [16]
NFI	≥ 0.90	0.99	passed	Schumacker & Lomax [13]
CFI	≥ 0.90	1.00	passed	Schumacker & Lomax [13]

4. Research Results

4.1. SEM Model in Large Size School Group

Results of data analysis are presented in Figure 1.

$$\chi^2 = 163.32, df = 139, p = 0.08, RMSEA = 0.02, R^2 = 0.99, *p < 0.05, **p < 0.01$$
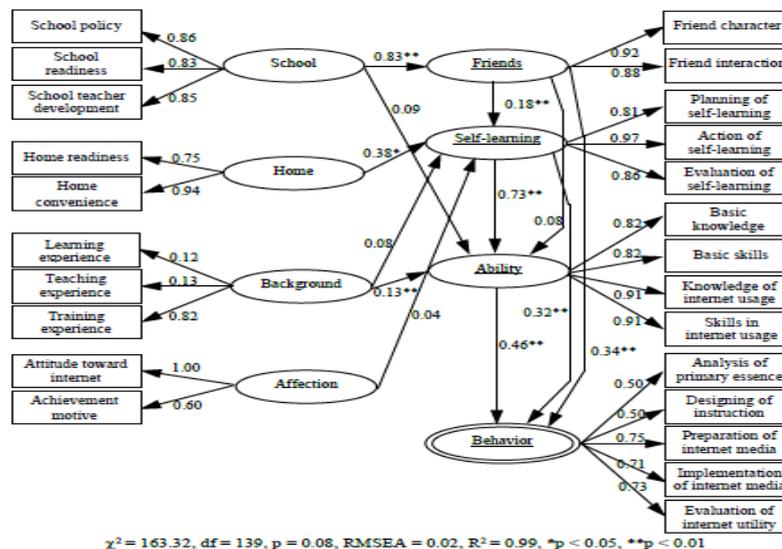
Figure 1. SEM model of TB in internet use of LS school teachers of large sized school group

It was found that the developed SEM model of TB in internet use of LS school teachers in the large sized school group had good validity, because the model was congruent to the empirical data of teachers in the large sized school group when it was considered on the goodness of fit indices with good criteria for all values, and χ^2 had no statistically significant level of 0.05 (p=0.08), RMSEA=0.02, GFI=0.97, AGFI=0.93, and SRMR=0.04.

This model was composed of 8 latent variables from 24 observed variables. The latent variables were classified into 1 result variable and 7 causal variables. The result variable was TB in internet use of LS school teachers in large sized school group, constructed from 5 observed variables. Causal variable was the variable that affected result variables, including 7 latent variables. These were constructed from 19 observed variables.

All causal variables in the model had positive effects on TB in internet use of LS school teachers, and these were able to explain the variation in TB in the model of the large sized school group at 99 percent.

Considering the important sequence of the causal variable from the total effect value, it was found that the self-learning latent variable had the most effect on TB in internet use of teachers in the large sized school group, at 0.66, followed by friends, ability, school, home, background, and affection, with 0.50, 0.46, 0.45, 0.25, 0.12, and 0.02, respectively, with a statistically significant level of 0.01 for the first six variables, but with the last having no statistically significant level of 0.05.

Furthermore, causal variables were classified according to the direction of effect into 3 types, which were variables with both direct and indirect effects and variables with only a direct or indirect effect. It was found that each type had 1-4 variables, as per the following:

1. There were 2 variables with both direct and indirect effects, ordered according to the total effect- self-learning and friends, with 0.66 and 0.50, respectively.
2. The variable with only direct effects was ability, with 0.46.
3. There were 4 variables with only indirect effects, ordered according to the effect- school, home, background, and affection, with 0.45, 0.25, 0.12, and 0.02, respectively.

4.2. SEM Model in Very Large Sized School Group
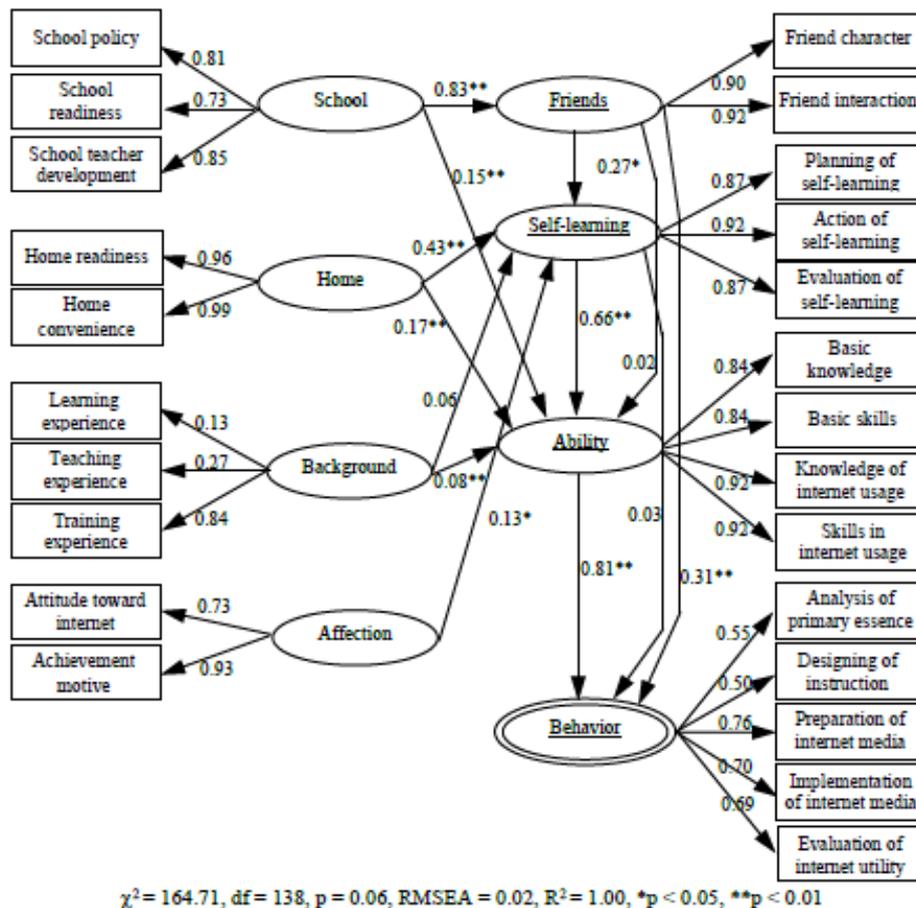
Results of data analysis are presented in Figure 2.

$\chi^2 = 164.71$, df = 138, p = 0.06, RMSEA = 0.02, $R^2 = 1.00$, *p < 0.05, **p < 0.01

Figure 2. SEM model of TB in internet use of LS school teachers of very large sized school group

The developed SEM model of TB in internet use of LS school teachers in the very large sized school group had good validity, because the model was congruent to the empirical data of teachers in the large sized school group when it was considered on the goodness of fit indices with good criteria for all values, and χ^2 had no statistically significant level of 0.05 (p=0.06), RMSEA=0.02, GFI=0.97, AGFI=0.93, and SRMR=0.03.

This model was composed of 8 latent variables from 24 observed variables. The latent variables were classified into 1 result variable and 7 causal variables. The result variable was TB in internet use of LS school teachers in the very large sized school group, constructed from 5 observed variables. The causal variable was the variable that affected the result variables, including 7 latent variables. These were constructed from 19 observed variables.

All causal variables in the model had positive effects on TB in internet use of LS school teachers, and these were able to explain the variation in TB in the model of the large sized school group at 100 percent.

Considering the important sequence of the causal variable from the total effect value, it was found that the ability latent variable had the most effect on TB in internet use of teachers in the very large sized school group, at 0.81, followed by self-learning, school, friends, home, background, and affection, with 0.57, 0.52, 0.47, 0.38, 0.10, and 0.07, respectively, with a statistically significant level of 0.01 for the first five variables, and the two last having a statistically significant level of 0.05.

Additionally, causal variables were classified according to the direction of effect into 3 types, which were variables with both direct and indirect effects and variables with only a direct or indirect effect. It was found that each type had 1-4 variables, as per the following:

1. There were 2 variables with both direct and indirect effects, ordered according to the total effect- self-learning and friends, with 0.57 and 0.47, respectively.
2. The variable with only direct effects was ability, with 0.81.
3. There were 4 variables with only indirect effects, ordered according to the effect- school, home, background, and affection, with 0.52, 0.38, 0.10, and 0.07, respectively.

4.3. SEM Model in Extra-large Sized School Group
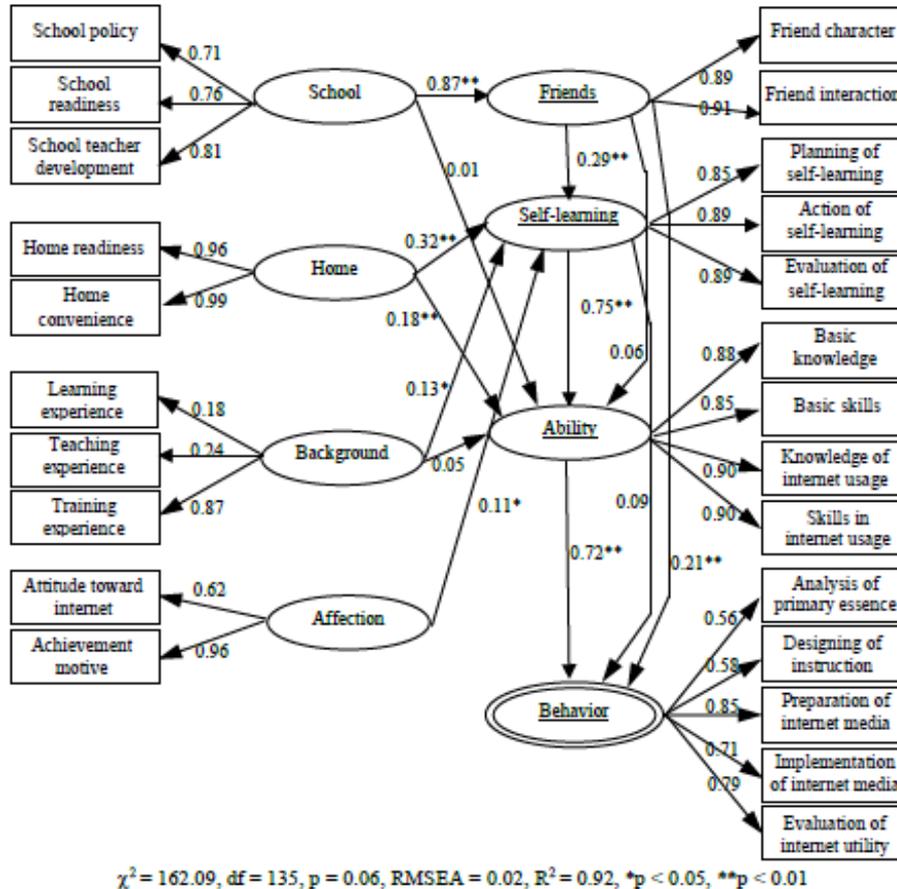
Results of data analysis are presented in Figure 3.

$\chi^2 = 162.09$, df = 135, p = 0.06, RMSEA = 0.02, $R^2 = 0.92$, *p < 0.05, **p < 0.01

Figure 3. SEM model of TB in internet use of LS school teachers in extra-large sized school group

It was found that the developed SEM model in TB with internet use of LS school teachers in the extra-large sized school group had good validity, because the model was congruent to the empirical data of teachers in the large sized school group when it was considered on the goodness of fit indices with good criteria for all values, and χ^2 had no statistically significant level of 0.05 (p=0.056), RMSEA=0.02, GFI=0.97, AGFI=0.93, and SRMR=0.04.

This model was composed of 8 latent variables from 24 observed variables. The latent variables were classified into 1 result variable and 7 causal variables. The result variable was TB in internet use of LS school teachers in the extra-large sized school group and was constructed from 5 observed variables. Causal variable was the variable that effected the result variables, including 7 latent variables. These were constructed from 19 observed variables.

All causal variables in the model had positive effects on TB in internet use of LS school teachers, and these were able to explain the variation in TB of the model of the extra-large sized school group at 92 percent.

Considering the important sequence of the causal variable from the effect value, it was found that the ability latent variable had the most effect on TB of teachers in the extra-large sized school group, at 0.72, followed by self-learning, friends, school, home, background, and affection, with 0.63, 0.43, 0.38, 0.12, and 0.07, respectively, with a statistically significant level of 0.01 for the first six variables, and the last having a statistically significant level of 0.05.

Moreover, causal variables were classified according to the direction of effect into 3 types, which were variables with both direct and indirect effects and variables with only a direct or indirect effect. It was found that each type had 1-4 variables, as per the following.

1. There were 2 variables with both direct and indirect effects, ordered according to the total effect- self-learning and friends, with 0.63 and 0.43, respectively.
2. The variable with only direct effects was ability, with 0.72.
3. There were 4 variables with only an indirect effect, ordered according to the total effect- school, home, background, and affection, with 0.38, 0.33, 0.12, and 0.07, respectively.

5. Conclusion

The developed SEM model of TB in internet use of LS school teachers had validity that was congruent to the empirical data of every model with good criteria of all goodness of fit indices. The model was composed of 8 latent variables from 24 observed variables. All causal variables in the model had a positive direct effect on TB in internet use, and these were able to explain the variation in TB in a large sized school, a very large sized school, and an extra-large sized school, with 99, 100, and 92, respectively.

Table 5. Total effect values in SEM model of TB in internet use of LS school teacher

Casual variable			School size		
			Large size	Very large size	Extra-large size
Trait	Ability	TE	0.46**	0.81**	0.72**
		Order	3	1	1
	Affection	TE	0.02	0.07*	0.07*
		Order	7	7	7
	Self-learning	TE	0.66**	0.57**	0.63*
		Order	1	2	2
Situation	School situation	TE	0.45**	0.52**	0.38**
		Order	4	3	4
	Home situation	TE	0.25**	0.38**	0.33**
		Order	5	5	5
	Friends	TE	0.50**	0.47**	0.43**
		Order	2	4	3
Background of teacher		TE	0.12**	0.10*	0.12**
		Order	6	6	6

**p < .01, *p < .05

6. Discussion

The developed SEM model of TB in internet use of LS school teachers had validity that was congruent to the empirical data of teachers in the subgroup models classified according to school size. All causal variables in the model had effect on TB in the 3 subgroup models of large sized school, very large sized school, and extra-large sized school, with 99, 100, and 92, respectively. Every model was highly fitted to the empirical data, and all casual variables were able to explain very high variation in TB, because the studied conceptual framework of the model was based on theory and related research and casual variables had been carefully selected from many research findings. Considering the subgroup models, the ability latent variable had the most effect in the very large school size and extra-large school size, with total effects of 0.81 and 0.72, respectively. Another subgroup model was large school size, where self-learning had the most effect, with 0.66.

The research results are congruent to the discovered variables in the previous study of Leekitchwatana [19] on "Development of Hierarchical Linear Model of Information Technology Use Behavior of Secondary School Teacher in Thailand", which was conducted in schools under the Office of the Basic Education Commission (OBEC). It was found that the information technology's behavior use of secondary

school teachers in secondary schools had correlation with teacher ability, teacher affection, friends in school, experience of computer use, computer training received, and computer subject learning. This was similar to the research results of Dusick & Yıldırım [20], who stated that teachers should have the necessary knowledge and skills in order to answer the requirements of the information age. Pelgrum [21] pointed to the importance of technology competency by saying that technology will not be used unless teachers are provided with the skills and knowledge necessary to integrate it into the curriculum, and that teachers with more ICT competency are more likely to use technologies in many different ways [22]. Furthermore, Baylor & Ritche [23] emphasized that teachers must reach and maintain a certain degree of ICT competency in order to integrate technologies into educational settings. Having technology competency helps teachers to become more efficient. Compeau & Higgins [24] and Compeau et al. [5] found that self-efficacy regarding computers refers to a person's perceptions of, and capabilities to apply their skills to, computers. Ropp [25] used the term 'computer self-efficacy' to claim that, while many teachers have positive attitudes to the use of educational technologies, computer self-efficacy is positively correlated with an individual's willingness to choose and participate in computer-related activities, expectations of success in such activities, and persistence or effective coping behaviors when faced with computer-related difficulties [4].

In addition, computer use directly affects teachers' technology integration. This finding was supported by Hermans et al. [26], who stated that computer experience has significant effects on teachers' class use of computers. Similarly, Drent & Meelissen [27] found that computer experience directly influenced teachers' innovative use of ICT. Robinson [28] said that their results indicated that teachers' computer usage for enhancement activities and their computer proficiency levels directly affected teachers' actual total computer usage. Gülbahar & Güven [29] found that teacher computer competency is a significant predictor of social studies teachers' attitudes towards the use of computers. Beck et al. [30] explained that teachers who have more computer experience would have better practices of teaching, and would be more comfortable and more confident about using computers, and so those teachers with more years of experience in using computers are more likely to use technologies in a variety of ways in their lessons. Van Braak et al. [31] proposed a path model which indicated that prior computer experience had positive indirect effects on attitude towards computers in education. Therefore, with more years of experience, teachers are likely to develop more technology competencies, and so are likely to develop more favorable attitudes towards using technologies [32].

Acknowledgements

References

[1] Mao, J. (2014). Social media for learning: A mixed methods study on high school students' technology affordances and perspectives. *Computers in Human Behavior, 33*, 213–223. DOI: 10.1016/j.chb.2014.01.002

[2] Sukic, C. (2009) Improving eLearning by Personalization. *Technics Technologies Education Management, 4*(1), 15-20.

[3] Hsu, S. (2010). The relationship between teacher's technology integration ability and usage. *Journal of Educational Computing Research, 43*(3), 309-325. DOI: 10.2190/EC.43.3.c

[4] Sang, G., Valcke, M., Van Braak, J., & Tondeur, J. (2009). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviorswith educational technology. *Computers & Education, 54*(1), 103-112. DOI: 10.1016/j.compedu. 2009.07.010

[5] Compeau, D.R., Higgins, C.A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly, 23*(2), 145-158.　　DOI: 10.2307/249749

[6] Touran, A., & Vafa, G. (2013). The Effect of Teacher-directed Internet-based Extensive Reading Materials on Intermediate Students' Reading Self-efficacy. *Pertanika Journal of Social Sciences & Humanities*, *21*(3), 1213-1229.

[7] Miranda, H. & Russell, M. (2011). Predictors of Teacher-Directed Student Use of Technology in Elementary Classrooms. *Journal of Research on Technology in Education, 43*(4), 301-323. DOI: 10.1080/15391523.2011.10782574

[8] Mumtaz, S. (2000) Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342. DOI: 10.1080/14759390000200096

[9] Lawrence, J.E., & Tar, U.A. (2018) Factors that influence teachers' adoption and integration of ICT in teaching/learning process. *Educational Media International, 55*(1), 79-105. DOI: 10.1080/09523987 .2018.1439712

[10] Peterson, C. (2003). Bringing ADDIE to Life: Instructional Design at Its Best. *Journal of Educational Multimedia and Hypermedia, 12*(3), 227-241.

[11] Leekitchwatana, P. (2012). Development of hierarchical linear model information technology use behavior of secondary school teacher in Thailand. *European Journal of Social Sciences, 32*(4), 554-566.

[12] Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2014). Multivariate data analysis. (7th ed.). London: Pearson Education.

[13] Schumacker, R.E., & Lomax, R.G. (2010). *A beginner's guide to structural equation modeling.* 3rd ed.. New York: Routledge/Taylor & Francis.

[14] Rasch, G. (1980). Probabilistic models for some intelligence and attainment tests. Chicago, IL: University of Chicago Press.

[15] Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin, 105*(3), 456-466. DOI: 10.1037//0033-2909.105.3.456.

[16] Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1-55. DOI: 10.1080/10705519909540118

[17] Jöreskog, K. G., Olsson, U. H., & Fan, Y. W. (2016). *Multivariate analysis with LISREL.* Berlin: Germany.

[18] Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic journal of business research methods*, *6*(1), 53-60.

[19] Leekitchwatana, P. (2010). Development of hierarchical linear model of information technology using the behavior of secondary school teachers. Research Report, Bangkok, Thailand: Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang. [in Thai].

[20] Dusick, D. M., & Yıldırım, S. (2000) Faculty computer use and training: Identifying distinct needs for different populations. *Community College Review, 27*(4), 33-47. DOI: 10.1177/009155210002700403

[21] Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers & Education, 37*(2), 163-178. DOI: 10.1016/S0360-1315(01)00045-8

[22] Dexter, S., Seashore, D. R., & Anderson, R. E. (2003, April). Leading the Learning: Expertise and Technology Integration Support Staff. 84th Annual Meeting of the American Educational Research Association, Chicago, IL.

[23] Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms?. *Computers & Education, 39*(4), 395-414. DOI: 10.1016/S0360-1315(02)00075-1

[24] Compeau, D.R., & Higgins, C.A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly, 19*(2), 198-211. DOI: 10.2307 /249688

[25] Ropp, M.M. (1999). Exploring individual characteristics associated with learning to use computers in preservice teacher preparation. *Journal of Research on Computing in Education, 31*(4), 402-424. DOI: 10.1080/08886504.1999.10782262

[26] Hermans, R., Tondeur, J., Van Braak, J., & Valcke, M. (2008) The impact of primary school teachers" educational beliefs on the classroom use of computers. *Computers & Education, 51*(4), 1499-1599. DOI: 10.1016/j.compedu.2008.02.001

[27] Drent, M., & Meelissan, M. (2007) Which factors obstruct or stimulate teacher educators to use ICT innovatively?. *Computers & Education, 51*(1), 187-199. DOI: 10.1016/j.compedu.2007.05.001

[28] Robinson, W. I. (2003) External and Internal Factors which predict teacher's computer usage in K-12 classrooms. Wayne State University, Detroit, MI.

[29] Gulbahar, Y., & Guven, I. (2008) A survey on ICT usage and the perceptions of social studies teachers in Turkey. *Journal of Educational Technology & Society*, *11*(3), 37-51.

[30] Beck, J., Czerniak, C.H., & Lumpe, A. (2000). An exploratory study of teachers' beliefs regarding the implementation of constructivism in their classrooms. *Journal of Science Teacher Education, 11*(4), 323-343. DOI: 10.1023/A:1009481115135

[31] Van Braak, J., Tondeur, J., & Valcke, M. (2004). Explaining different types of computer use among primary school teachers. *European Journal of Psychology of Education, 19*(4), 407-422.

[32] Karaca, F. (2011). Factors Associated with Technology Integration to Elementary School Settings: A Path Model. Thesis of Doctor of Philosophy in Computer Education and Instructional Technology Department, Middle East Technical University.