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PLS PATH MODELING OF USEFULNESS, SATISFACTION AND BEHAVIORAL INTENTION OF PROFESSIONAL DEVELOPMENT PROGRAMS FOR SCHOOL PRINCIPALS

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ABSTRACT. *The main purpose of this research is to explore the structural correlation among usefulness (UF), satisfaction (SAT), and behavioral intention (BI) of NAER (National Institute for Educational Research) leadership development programs for school principals in Taiwan. Questionnaire investigation and PLS（partial least squares）analysis are employed in this research and totally 131subjects of school principals are included. Briefly, the main findings are as follows: (1) Participants have high levels of UF, SAT and BI of the programs. (2) Male and female participants show significant different levels of UF, SAT and BI. (3) UF and SAT have great influences on BI and UF has a great influence on SAT. (4) UF is much more influential than SAT in determining behavioral intention (5) SAT is a weak mediator variable between UF and BI. (6) PLS path modeling of UF, SAT, BI in this research has a good model data-fit. (7) PLS path modeling of UF, SAT and BI has measurement invariance across groups. (8) UTL is proved to have significant negative interacting effect with UF upon BI, and also have significant negative interacting effect with SAT upon BI.*

Keywords: PLS; Usefulness; Satisfaction; Behavioral Intention; Leadership Development Programs; School Principal.

1. Introduction. School principals are key figures when their schools are in pursuit of progress or when their nations are devoted to educational reform, and it's been proved that their leadership is inextricably linked to school effectiveness (Chin, 2007). However, related researches during the past two decades commonly point out that educational environment becomes more and more complex as a result of irresistible school changes and constantly rapid educational reforms, and school leaders need more and strong reliance on continuing professional development (Johnson, 1994; Imants, Putten **&**Leijh, 1994; Brady, 1996; Dror, 1998; Thody, 1998; Bush & Chew, 1999; Payne & Wolfson, 2000; Flanary, 2000; Frampton, Vaughn & Didelot, 2003; Gamage&Ueyama, 2004; Mulford, 2004; O'Brien & Torrance, 2005; Sandy, Miller, Johnston&Rutledge, 2006; Pang, 2007; Salazar, 2007; Wu & Ehrich, 2009; Keith, 2011). As information technology continues leaping forward, and knowledge half-life is much shorter than ever, pre-employment training of school principals seems insufficient to the rapid-changing educational environment. Practically, Taiwan has been facing the challenge that numerous experienced school principals retired early because of overloads, high pressure, loneliness, and even helplessness. Therefore

continuing professional development is necessary to these school leaders.

For school leaders in Taiwan, there are several formal and informal ways of continuing professional development. The formal ways includes: (1) Master and PhD programs of universities and colleges. (2) Workshops, conferences and specific training programs from Ministry of Education (MOE), Local Educational Authorities (LEA), National Institute for Education Research (NAER), and other academic institutions. The informal ways includes: (1) School principal's reading groups or clubs. (2) Informal chatting and experience sharing between school principals. Briefly, the ways of continuing professional development are quite diverse and a lot, but the research concerns about the effects of these different ways mentioned above, especially about the programs from NAER.

NAER has been entrusted by MOE with the training programs for in-service school principals for three years. In 2012, nine programs were held respectivelduring April 9-13, May 1-4, May 7-10, June 4-7, November 7-9, November 14-16, November 21-23, November 28-30, and December 12-14. They are three-day or four-day programs, including 8-10 courses. All participants are asked to stay in dorms of NAER, and senior coach principals were invited as the classroom counselors.

Despite slight differences between nine periods, all of them focus on the seven issues in common as follows: (1) National educational policies. (2) Interaction with the media. (3) School law. (4) Bully and sexual harassment at school. (5) Thinking models of school major issues. (6) Innovative management at school. (7) Round tables for sharing experience among principals. According to Lin (2007), we concluded with 8 indicators of usefulness which corresponds to the 7 issues mentioned above.

Briefly, the purpose of this study is to explore the relationship among usefulness (UF), satisfaction (SAT), and behavior intention (BI) of NAER professional development programs for school principals. Specifically, there are five relevant research questions below:

1. Do participants have high levels of UF, SAT and BI about programs?
2. Do participants with different personal backgrounds (gender, age and so on) show different levels of UF, SAT and BI?
3. Do UF and SAT have great influences on BI? Which affects BI more strongly?
4. Does UF have a great influence on SAT? Is SAT a mediator variable between UF and BI?
5. Does Structure Equation Modeling (SEM) of the three latent variables (UF, SAT, BI) have a good model data-fit?
6. Does SEM of UF, SAT and BI have measurement invariance across groups?
7. Does unidirectional teaching and learning (UTL) moderate the influence among UF, SAT and BI?

2. Research model and hypotheses. Technology Acceptance Model (TAM)

(Davis, 1989; Davis, Bagozzi & Warshaw, 1989) derived from the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) offers a powerful explanation for user acceptance and behavioral intention of information technology. TAM theorizes that an individual's behavioral intention to adopt a system is determined by two beliefs, usefulness and ease of use (SEE figure 1). Usefulness is defined as "the degree to which an individual believes that using a particular system would enhance his or her

productivity" while ease of use is defined as " the degree an individual believes that using a particular system would be free of effort" (Davis, 1989). Between these two, ease of use has a direct effect on both usefulness and behavioral intention, and usefulness is much more influential than ease of use in determining behavioral intention (Adams et al., 1992; Davis, 1993).

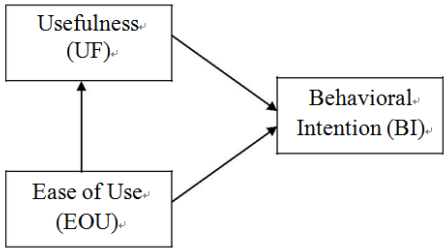

FIGURE 1. Technology acceptance model.

The research model (USB model) partly derived from the theory of TAM suggests a possible explanation for participants' perceived usefulness, perceived satisfaction and behavioral intention of professional development programs for leaders. Usefulness is defined as "the degree to which a participant believes that the professional development program would enhance his or her leadership" while satisfaction is defined as "the degree to which a participant feels pleasant and comfortable about the professional development program"

Briefly, the research intends to know which (UF or SAT) is more influential on participant's BI. Besides, we believe UTL might have interacting effects with UF and SAT. The research model was created as figure 2.

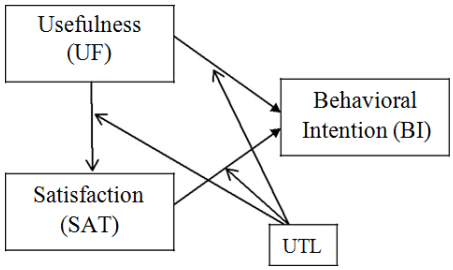

FIGURE 2. The research model.

According to the research model, totally 27 hypotheses which need to be tested as follows:

H_1: Participants show averagely high level of UF (Mean≥7, SD≤1). H_2: Participants show averagely high level of SAT (Mean≥7, SD≤1). H_3: Participants show averagely high level of BI (Mean≥7, SD≤1).

H_4: Participants of different gender have no significant different levels of UF. H_5: Participants of different ages have no significant different levels of UF.

H_6: Participants of different years of experience have no significant different levels of UF. H_7: Participants in different sizes of schools have no significant different levels of UF. H_8: Participants of different gender have no significant different levels of SAT.

H_9: Participants of different ages have no significant different levels of SAT.

H_{10}: Participants of different years of experience have no significant different levels

of SAT. H_{11}: Participants in different sizes of schools have no significant different levels of SAT. H_{12}: Participants of different gender have no significant different levels of BI.

H_{13}: Participants of different ages have no significant different levels of BI.

H_{14}: Participants of different years of experience have no significant different levels of BI. H_{15}: Participants in different sizes of schools have no significant different levels of BI. H_{16}: UF has a significant influence on BI.

H_{17}: SAT has a significant influence on BI. H_{18}: UF has a significant influence on SAT.

H_{19}: SAT is a mediator variable between UF and BI.

H_{20}: PLS model of UF, SAT, BI has a good model data-fit.

H_{21}: PLS model of UF, SAT and BI has measurement invariance between gender groups. H_{22}: PLS model of UF, SAT and BI has measurement invariance between age groups.

H_{23}: PLS model of UF, SAT and BI has measurement invariance between experience groups. H_{24}: PLS model of UF, SAT and BI has measurement invariance between school-size groups. H_{25}: UTL significantly moderates the influence of UF on BI.

H_{26}: UTL significantly moderates the influence of SAT on BI

H_{27}: UTL significantly moderates the influence of UF on SAT.

3. Methodology.

3.1. Investigation method. Investigation method refers to standard operating procedure (SOP) of collecting data through reliable and valid samples for statistically estimating or testing the hypothesis (Chu, 2007). Practically, this study used questionnaires to investigate in-service principals who attended NAER programs for collecting data. The questionnaire was first examined by three experts for its validity during April 1-7. After a slight modification, pretest questionnaires were issued on April 13. The valid 24 copies were from 35 principals who attended programs during April 9-13 and May 1-4. The alpha coefficient of 13 items in this questionnaire is 0.936, suggesting that the items have high internal consistency.

Formal questionnaires were issued respectively on April 13, May 4, May 10, June 7, November 9, November 16, November 23, November 30, and December 14, and totally 131 copies of valid questionnaires were collected. Table 1 presents the demographic profile of 131 respondents in this survey. Besides, by using ANOVA (analysis of variance) test, there is no significant difference on UF (F-value=0.954), SAT (F-value=0.801) and BI (F-value=1.302) in comparing 9 periods of respondents.

TABLE 1. Summary of demographic profile of respondents in this survey (N=131)

Background	Items	N	Percent
1.gender	(1)male	78	59.5%
	(2)female	53	40.5%
2.age	(1)45 years old and younger	38	29.0%
	(2)46-50 years old	50	38.2%
	(3)51 years old and older	43	32.8%

3.2. Data processing and statistical computing. First, the research used SPSS 19.0 for descriptive statistics (e.g. M, SD), ANOVA test, t-test in order to test H1 to H15. Secondly, the research used SmartPLS for structural equation modeling analysis (bootstrapping sampling repeatedly 1,000 samples) in order to test H16 to H27.

The choice of variance-based PLS method over covariance-based structure analysis methods (e.g. AMOS, LISREL) was due to following reasons: (1) PLS does not require any distributional assumptions (e.g. normal distributional assumption); (2) PLS is a prediction-oriented method which gives optimal prediction accuracy (Fornell & Cha, 1994); (3) PLS can be applied to relative small-sample-size studies (Chin, 1988); (4) PLS is appropriate for testing theories in the early stages of development (Fornell & Bookstein, 1994).

4. Results.

4.1. Descriptive statistics and difference analysis. Respondents were asked to rate their opinion using a 9-point Likert scale ranging from 1=Strongly disagree, 3=Disagree, 5=Moderate, 7=Agree and 9=Strongly agree, for perceived usefulness (8 items), perceived satisfaction (3items) and behavioral intention (2 items). Table 2 presents the result of respondents' level of UF, SAT and BI about programs. The research finds that participants have averagely high level of UF (M=7.72; SD=0.99), SAT (M=8.19; SD=0.93) and BI (M=7.66; SD=0.98). The hypotheses H1, H2, H3 are supported.

Table 2. Summary of respondents' level of UF, SAT and BI (N=131)

	Minimum	Maximum	Mean	SD
UF	4.00	9.00	7.72	0.99
SAT	2.00	9.00	8.19	0.93
BI	3.00	9.00	7.66	0.98

*p<.05; **p<.01

Table 3 shows the t-test value and ANOVA F-test values about comparing different groups of participants' levels of UF, SAT and BI. The independent samples *t*-test is used for comparing two groups (gender groups) while one-way ANOVA test is recommended for comparing more than three groups. The result shows participants of different ages, of different years of experience, and in different sizes of schools show no significant difference of UF, SAT and BI. However, participants of different gender have significantly different levels of UF, SAT and BI, and male participants' levels of UF, SAT and BI are significantly higher than female. Briefly, the hypotheses H5, H6, H7, H9, H10, H11, H13, H14, H15 are supported, while H4, H8, H12 are not supported.

TABLE 3. Summary of t-test & ANOVA test for respondents' level of UF, SAT and BI (N=131)

Variable	Gender (T)	Age (F)	Year-of-Experience(F)	School Size(F)
UF	2.768** (M > F)	0.981	0.833	0.653
SAT	2.393* (M > F)	0.221	0.817	0.763
BI	2.126* (M > F)	0.313	0.578	1.616

4.2. The measurement model. The results of composite reliability, cronbach's alpha and AVE are given in Table 4. First, the values of composite reliability range from 0.932 to 0.967, which highly exceed the recommended threshold value of 0.6. Secondly, the values of cronbach's alpha range from 0.932 to 0.967, which also highly exceed the recommended threshold value of 0.7. Finally, the values of AVE range from 0.781 to 0.935, which also highly exceed the recommended threshold value of 0.5.

TABLE 4. Summary of assessment of measurement model

Variable	Composite Reliability	Cronbach's Alpha	AVE
UF	0.966	0.959	0.781
SAT	0.932	0.892	0.822
BI	0.967	0.931	0.935

Table 5 reports the results of testing the discriminant validity of the measure scales. The elements in the matrix diagonals, which represent the square roots of the values of AVE, are greater in all cases than the off-diagonal elements in their corresponding row and column. According to Fornell-Larcker criterion, the results are proved to ensure the discriminant validity.

TABLE 5. Summary of discriminant validity (intercorrelations) of variable constructs

Variable	UF	SAT	BI
UF	**0.884**		
SAT	0.489	**0.907**	
BI	0.484	0.245	**0.967**

The study tested the convergent validity using Smart PLS by extracting the factor loadings and cross loadings of all indicator items to their respective latent constructs. The results (SEE Table 6) indicate that all factor loadings of items from 0.848 to 0.967 are much greater than their cross loadings from 0.253 to 0.501. Besides, each item's factor loadings are highly significant at $p<0.001$. Both mentioned above confirm the convergent validity of the indicators.

TABLE 6. Summary of factor loadings (bolded) and cross loadings

	BI	SAT	UF
BI_1	**0.967**	0.439	0.462
BI_2	**0.967**	0.452	0.462
SAT_1	0.439	**0.903**	0.307
SAT_2	0.389	**0.902**	0.344
SAT_3	0.405	**0.916**	0.253
UF_1	0.427	0.457	**0.896**
UF_2	0.412	0.487	**0.904**
UF_3	0.386	0.417	**0.848**
UF_4	0.501	0.421	**0.886**
UF_5	0.473	0.441	**0.866**
UF_6	0.482	0.497	**0.882**
UF_7	0.408	0.355	**0.892**
UF_8	0.348	0.478	**0.893**

4.3. The PLS structural model. Figure 3 shows the structural model results of path diagram and relationship of UF, SAT and BI. Each beta path coefficient is positive in the expected direction and statistically significant respectively at $p<0.05$ and $p<0.001$. That means UF and SAT have positive influences on BI, and UF also has a great influence on SAT. It is surprising to find that UF (0.540) is much more influential than SAT (0.245) in determining behavioral intention. Besides, according to Chin (1988), R^2 values of 0.67, 0.33, and 0.19 in PLS path models are described as substantial, moderate and weak respectively. In this study, R^2 value of SAT is 0.347, which fits the moderate level; R^2 value of BI is 0.508, which is much higher than the moderate level but still not reaches the substantial level. Because this structural model explains a endogenous latent variable only by one or two exogenous latent variables, moderate R^2 values are considered acceptable. Finally, in line with the effect sizes for R^2 (small: 0.02; medium: 0.13; large: 0.26) proposed by Cohen (1988), we derive the following *GOF* criteria for small, medium, and large effect sizes of R^2 by substituting the minimum average AVE of 0.50 and the effect sizes for R^2 in the equation defining *GOF* (*GOF=the square roots of AVE *R*2) ; *GoFsmall*=0.1, *GoFmedium*=0.25, and *GoFlarge*=0.36. These may serve as baseline values for validating the PLS model globally. We obtained a *GOF* value of 0.655, which exceeds the cut-off value of 0.36 for large effect sizes of *R2* and allows us to conclude that our model performs well compared to the baseline values defined above.

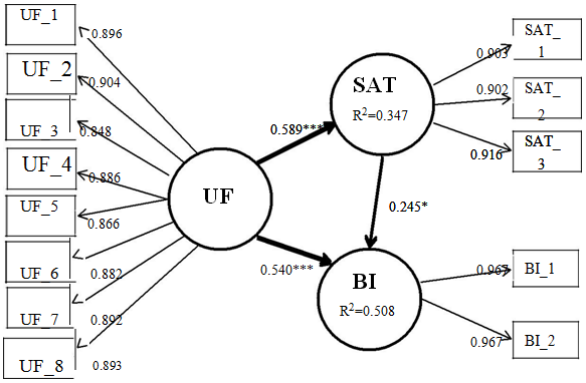

FIGURE 3. The structural model results.

Note: *P<0.05; ***P<0.001

To test the significance of a mediation effect, the study used the Sobel test, a specialized t-test that provides a method to determine whether the reduction in the effect of the independent variable, after including the mediator in the model, is a significant reduction and therefore whether the mediation effect is statistically significant (Sobel, 1982). After calculation, the indirect effect is 0.144, and the Sobel test value (2.077) is statistically significant at p<0.05. However, the direct effect, coefficient of route(c) is 0.540, of which T-value (10.224) is also proved to reach the significant level at p<0.001. Therefore the study concludes that a weak mediation effect exists in the path of UF-SAT-BI, and SAT is proved a weak mediator variable.

TABLE 7. Summary of indirect and direct effects

Route	Sample Mean(M)	Standard Error(STERR)	UF→BI	
			Indirect Effect	Direct Effect
(a)UF→SAT	0.595	0.072	2.077*	
(b)SAT→BI	0.234	0.109		
(c)UF→BI	0.688	0.064		10.224***

Note: *p<0.05; ***p<0.001

To compare results across multi-group analysis might very well contribute to the invariance of PLS path modeling. Table 8 presents 4 different kinds of groups to be compared.

TABLE 8. Summary of comparing groups profile for PLS (N=131)

Items	Groups	N	Percent
1.gender	(a) male group	78	59.50%
	(b) female group	53	40.50%
2.age	(a) younger group	38	29.00%
	(b) older group	43	32.80%
3.years of experience	(a) rookie group	43	32.80%
	(b) veteran group	40	30.50%
4.school size	(a) smaller-size group	37	28.20%
	(b) larger-size group	51	38.90%

Multi-group analysis can be applied in PLS path modeling using a t-test to compare parameter estimates across samples (Duxbury & Higgins, 1991). However, the use of asymptotic (i.e., large sample) tests is not quite adequate for PLS path modeling (Chin & Dibbern, 2009). Therefore, Z test is used in this research for multi-sample analysis in PLS path modeling. Table 9 shows the results respectively between gender groups, age groups, experience groups, and school-size groups. All the Z-test values between (a) and (b) groups did not reach the significant level ($p<0.05$)

TABLE 9. Summary of multi-group analysis with Z-test across samples

	(a) Male (N=78)		(b) Female (N=53)		Z value	Significant or not
	M	STERR	M	STERR	(a)-(b)	(Z> ±1.96)
(a)UF→SAT	0.584	0.074	0.586	0.122	-0.014	not
(b)SAT→BI	0.052	0.123	0.361	0.191	-1.36	not
(c)UF→BI	0.668	0.061	0.693	0.124	-0.181	not
	(a)Younger (N=38)		(b) Older (N=43)			
(a)UF→SAT	0.662	0.073	0.669	0.113	-0.052	not
(b)SAT→BI	0.077	0.229	0.073	0.158	0.014	not
(c)UF→BI	0.637	0.105	0.746	0.061	-0.898	not
	(a) Rookie (N=43)		(b) Veteran (N=40)			
(a)UF→SAT	0.612	0.098	0.731	0.094	-0.876	not
(b)SAT→BI	0.179	0.179	0.106	0.216	0.26	not
(c)UF→BI	0.763	0.079	0.663	0.073	0.929	not
	(a)Smaller (N=37)		(b)Larger (N=51)			
(a)UF→SAT	0.764	0.081	0.603	0.133	1.033	not
(b)SAT→BI	0.026	0.181	0.339	0.261	-0.985	not
(c)UF→BI	0.761	0.069	0.546	0.132	1.443	not

To model the interaction effects, the study followed the process to construct and compare models without and with the moderator variable UTL. First, Respondents were asked to rate their opinion using a 5-point Likert scale ranging from 1=Too Low, 2=Low, 3=Moderate, 4=High and 5=Too high, for perceived the proportion of UTL in the programs. Figure 4 shows the results of the model with the moderator variable UTL. First, UF and SAT still have positive influences on BI, and UF also has a great influence on SAT. Secondly, UTL doesn't have significant negative interacting effect with UF upon SAT (beta=-0.021). Thirdly, UTL is proved to have significant negative interacting effect with UF upon BI (beta=-0.132, $p<0.01$). Fourthly, UTL is proved to have significant negative interacting effect with SAT upon BI (beta=-0.099, $p<0.05$). Finally, by including the effects of UTL, a smaller proportion of variances in SAT (R^2=0.335) and BI (R^2=0.466) are accounted for.

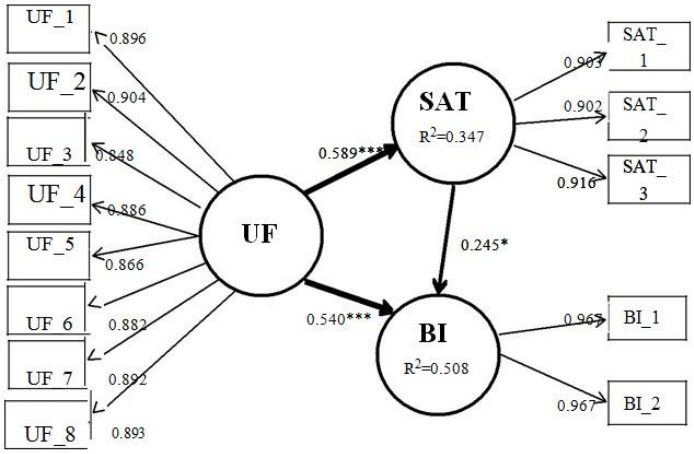

FIGURE 3. The Structural Model Results
Note: *P<0.05; ***P<0.001

TABLE 10. Summary of hypotheses conclusions in the research.

Hypotheses	Conclusions
H_1: Participants show averagely high level of UF of this course.	Supported
H_2: Participants show averagely high level of SAT of this course.	Supported
H_3: Participants show averagely high level of BI of this course.	Supported
H_4: Participants of different gender have no significant different levels of UF.	Not Supported
H_5: Participants of different ages have no significant different levels of UF.	Supported
H_6: Participants of different years of experience have no significant different levels of UF.	Supported
H_7: Participants in different sizes of schools have no significant different levels of UF.	Supported
H_8: Participants of different gender have no significant different levels of SAT.	Not Supported
H_9: Participants of different ages have no significant different levels of SAT.	Supported
H_{10}: Participants of different years of experience have no significant different levels of SAT.	Supported
H_{11}: Participants in different sizes of schools have no significant different levels of SAT.	Supported
H_{12}: Participants of different gender have no significant different levels of BI.	Not Supported
H_{13}: Participants of different ages have no significant different levels of BI.	Supported
H_{14}: Participants of different years of experience have no significant different levels of BI.	Supported
H_{15}: Participants in different sizes of schools have no significant different levels of BI.	Supported
H_{16}: UF has a significant influence on BI.	Supported
H_{17}: SAT has a significant influence on BI.	Supported
H_{18}: UF has a significant influence on SAT.	Supported
H_{19}: SAT is a mediator variable between UF and BI.	Supported
H_{20}: PLS model of UF, SAT, BI has a good model data-fit.	Supported
H_{21}: PLS model of UF, SAT and BI has measurement invariance between gender groups.	Supported
H_{22}: PLS model of UF, SAT and BI has measurement invariance between age groups.	Supported
H_{23}: PLS model of UF, SAT and BI has measurement invariance between experience groups.	Supported
H_{24}: PLS model of UF, SAT and BI has measurement invariance between school-size groups.	Supported
H_{25}: UTL significantly moderates the influence of UF on BI.	Supported
H_{26}: UTL significantly moderates the influence of SAT on BI.	Supported
H_{27}: UTL significantly moderates the influence of UF on SAT.	Not Supported

Table 10 shows the hypotheses conclusions (supported or not supported) in the research. Briefly, the main findings are as follows: (1) Participants have high levels of UF, SAT and BI of the programs. (2) Male and female participants show significant different levels of UF, SAT and BI. (3) UF and SAT have great influences on BI and UF has a great influence on SAT. (4) UF is much more influential than SAT in determining behavioral intention (5) SAT is a weak mediator variable between UF and BI. (6) PLS path modeling of UF, SAT, BI in this research has a good model data-fit. (7) PLS path modeling of UF, SAT and BI has measurement invariance across groups. (8) UTL is proved to have significant negative interacting effect with UF upon BI, and also have significant negative interacting effect with SAT upon BI.

5. Implications. According to the findings mentioned above, we believe principals who attended the NAER professional development programs felt helpful and useful to their leadership, were satisfied with the environment and arrangement, and had high willingness to come back for another NAER programs and even recommend them to other principals.

Besides, we find female principals, compared to male ones, show relatively lower levels on UF, SAT and BI. That is a very interesting finding in this research, because the programs were mostly designed by male, 90% of the program lecturers were male, and most important of all, female principals were always taught to be like male. Long-term and follow-up female principal case study are recommended in the future researches

In addition, UF and SAT both have great influences on BI, but UF is much more influential than SAT in determining BI. That implies usefulness is always the priority when designing a professional development program. We also find SAT is a weak mediator variable between UF and BI. That means indirect influences of usefulness through satisfaction on behavioral intention are weak although usefulness affects satisfaction strongly.

Although we prove PLS path modeling of UF, SAT, BI in this research has a good model data-fit, and has measurement invariance across groups, our empirical illustration of the use of PLS path modeling constitutes only a single study with limited generalizability. Therefore, we hope that our research will assist researchers with future applications of PLS path modeling for more complicated construct models. It would be useful for future research to compare PLS path modeling versus covariance-based SEM and compare the performance under a number of different conditions

Moreover, UTL is proved to have significant negative interacting effect with UF upon BI and significant negative interacting effect with SAT upon BI. That implies unidirectional teaching and learning not only does not meet the needs of learner, but lower the effect with usefulness and satisfaction upon behavioral intention.

Finally, this research collected data only through questionnaire survey, and some of them are possibly not showing the true thoughts and feelings due to various factors. Hence qualitative research methods, such as interview, field observation, and long-term follow-up case study are recommended in the future researches.

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