The Development of a Teachers' Self-Efficacy Instrument for High School Physical Education Teacher

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Abstract—The purpose of this study was to develop a "teachers' self-efficacy scale for high school physical education teachers (TSES-HSPET)" in Taiwan. This scale is based on the self-efficacy theory of Bandura [1], [2]. This study used exploratory and confirmatory factor analyses to test the reliability and validity. The participants were high school physical education teachers in Taiwan. Both stratified random sampling and cluster sampling were used to sample participants for the study. 350 teachers were sampled in the first stage and 234 valid scales (male 133, female 101) returned. During the second stage, 350 teachers were sampled and 257 valid scales (male 143, female 110, 4 did not indicate gender) returned. The exploratory factor analysis was used in the first stage, and it got 60.77% of total variance for construct validity. The Cronbach's alpha coefficient of internal consistency was 0.91 for sumscale, and subscales were 0.84 and 0.90. In the second stage, confirmatory factor analysis was used to test construct validity. The result showed that the fit index could be accepted ($\chi^2_{(75)}$ =167.94, p <.05, RMSEA =0.07, SRMR=0.05, GFI=0.92, NNFI=0.97, CFI=0.98, PNFI=0.79). Average variance extracted of latent variables were 0.43 and 0.53, which composite reliability are 0.78 and 0.90. It is concluded that the TSES-HSPET is a well-considered measurement instrument with acceptable validity and reliability. It may be used to estimate teachers' self-efficacy for high school physical education teachers.

Keywords—teaching in physical education, teacher's self-efficacy, teacher's belief

I. INTRODUCTION

TEACHER efficacy has proved to be powerfully related to many meaningful educational outcomes such as teachers' persistence, enthusiasm, commitment and instructional behavior, as well as student outcomes such as achievement, motivation, and self-efficacy [3]. Teacher efficacy is critical component for teacher beliefs, and it influence teachers' behavior and professional practice [4], [5]. Therefore, teacher self-efficacy has been important research issue for educational field. It is also concerned for physical education teachers [6]. The self-efficacy belief is an important concept in the understanding of teachers' thoughts, decisions, feelings, behaviors, performance, and attitudes towards their students [7]. Bandura proposed the self-efficacy theory in 1977, and the theory defined self-efficacy as a personal belief or expectation of a person's ability to accomplish certain activities and his own evaluation of the work achievement. Self-efficacy can generate inner drive and affect personal behaviors. For the field of education, Bandura (1997) believed that teachers must conduct various teaching activities but their self-efficacy would vary according to different courses [2].

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Therefore, the evaluation scale should be designed according to various subjects and teaching environments, because the teachers' self-efficacy has its particular relevance with the environment.

Martin, McCaughtry, Hodges-Kulinna, and Cothran (2008) also pointed out that the general teachers' self-efficacy scale was not applicable for physical education teachers [6]. The evaluation of teacher's self-efficacy contains possible factor alterations such as different environments and subjects. Therefore, it is essential to construct reliable and valid scales for those particular subjects. Teacher's self-efficacy has a huge influence on the practice of their teaching in physical education curriculum, so it is important to construct a physical education teachers' self-efficacy scale to estimate teachers' self-efficacy.

Some teacher self-efficacy scales have been developed and examined by different researchers. Erdem and Demirel (2007) developed a teacher self-efficacy scale with a single-factor model [7]. Gibson and Dembo (1984) developed a 30-item measure of teacher efficacy, divided teacher self-efficacy into two dimensions, one was personal teaching efficacy, referring to the teacher's own ability and skills of professional education that provide the teacher with confidence to play a suitable professional role, or his own evaluation on his teaching ability. Another is general teaching efficacy, referring to the teacher's expectation of how his teaching may affect the students' learning under the limitation of outside factors such as families, schools, and societies [10]. Bandura (2001) also developed a 30-item instrument for teacher self-efficacy based on his self-efficacy construct of social cognitive theory [11]. Generally speaking, most studies divided teacher's self-efficacy into two dimensions including personal teaching efficacy and general teaching efficacy [10], [12]. But there were other studies which divided teacher's self-efficacy into three or more dimensions [13]. Tschannen-Moran and Woolfolk (2001) developed a teachers' sense of efficacy scale with 3 dimensions including efficacy for student engagement, efficacy for instructional strategies and efficacy for classroom management [14]. To sum up the analysis mentioned above, it is more common for researchers to divide teacher's self-efficacy into two dimensions, including personal teaching efficacy (PTE) and general teaching efficacy (GTE). PTE is the level of confidence that a teacher has of his own teaching skill and ability. It is a teacher's self-evaluation about his teaching ability and a consciousness of his in improving students' positive changes. GTE refers to the teacher's belief of teaching outcomes, that is, the teacher's expectation of how the students could change in the process of learning under external environmental influences.

School physical education and physical activity has been specifically recognized as an important vehicle for delivering physical fitness and motor skill. Physical education teachers play a vital role in helping students develop the behaviors, active for a lifetime [15].

Gencay examined that validation of the physical education teachers' physical activity self-efficacy scale (PETPAS) with a Turkish sample, which results revealed that the PETPAS is a valid and reliable scale for Turkish culture, and there are significant gender differences in space, time, and institution subscales [16]. Gorozidis and Papaioannou indicated that high self-efficacious teachers had positive attitudes towards the new curriculum, implemented the biggest number of teaching plans and they intended to do the same in the future [17]. Martínez-López, Sánchéz, Alvarez, and Cruz conduct Self-efficacy expectations in teacher trainees and the perceived role of schools and their physical education department in the educational treatment of overweight students, whose results indicated that those trainees who possessed a higher level of perceived self-efficacy for the assessment of not only their own teaching, but also of the knowledge acquired by overweight students and of school intervention in their learning process, tended to show more favourable attitudes towards the educational treatment of child and youth obesity, and towards obese students' fitness and healthcare [18]. In Taiwan, new national physical education curriculum guidelines for senior high schools was issued in 2006, whose educational goals are different from curricular standard of the past. New physical education curriculum guidelines aim to construct a school-based curriculum, to develop sports skill and knowledge, to cultivate students' regular exercise habits, to improve students' fitness and knowledge of health management. Teachers should acquire new teaching professional knowledge and skills to face these educational reforms. Consequently, it is important to construct a physical education teachers' self-efficacy scale to estimate a teacher's self-efficacy that would help educational administrations to implement new training programs. Based on Bandura's social cognitive theory [2], that it is essential to know teachers' self-efficacy for teaching in physical education. In the past, most researchers applied mainly exploratory factor analysis to understand construct validity of scale, but now researchers have used confirmatory factor analysis to test construct validity of scale. Hofmann [18] indicated that confirmatory factor analysis is a deductive way to construct the scale. Applying the analysis would test the reliability of the hypothetic scale. Eudy pointed out that confirmatory factor analysis provides a chance for the researcher to examine whether the evaluation scale has validity, or whether it is suitable for the general parametric population [19]. Therefore, a new method of constructing scale which uses both exploratory and confirmatory factor analyses will have a higher validity. The construction of teacher's self-efficacy scale is mainly based on exploratory factor analysis; Robert and Henson was one of a few researchers who use confirmatory factor analysis to test and verify the construction of the scale [20]. Hence, this research used both exploratory factor analysis and confirmatory factor analysis to construct a self-efficacy scale suitable for high school physical education teachers in Taiwan.

II. METHODOLOGY

A. Participants

The participants were high school physical education teachers in Taiwan and random cluster sampling was used in the study. There were 300 teachers sampled in the first stage and 234 valid scales were returned (male 133, female 101) to be examined by the exploratory factor analysis. In the second stage, confirmatory factor analysis was used to analyze 257 valid scales (male 143, female 110, 4 did not indicate gender) that were sent back from 350 teachers.

B. Measurement Inventory

The purpose of this study was to construct a physical education teacher's self-efficacy scale for Taiwan's high schools. This scale was based both on self-efficacy theory of Bandura [1], [2] and teacher efficacy questionnaire of Gibson & Dambo [10]. The scale had two dimensions, including personal teaching efficacy and general teaching efficacy. The format of a typical six-level Likert item was used as follows: "completely agree," "roughly agree," "tentatively agree," "tentatively disagree," "roughly disagree," and "completely disagree," with scores from 6 to 1. Sampled teachers could choose one that was closest to their own feeling.

C. Procedure of Research

The developed process of the present scale included: 1. Collecting the relevant literatures. 2.Constructing a preliminary scale and consulting experts or scholars for advice. 3. Complete the preliminary scale, which contained thirty questions. 4. Analyzing the validity of the scale by using exploratory factor analysis. 5. Testing the validity by using confirmatory factor analysis.

D. Data Analysis

This study used the following statistical methods:

1. Description statistics: mean, standard deviation and percentage were used to analyze the various dimensions of the scale.
2. Validity analysis of the scale: item analysis, consistency reliability, exploratory factor analysis and confirmatory factor analysis were used. For confirmatory factor analysis, the statistic software LISREL was used to analyze the construct validity of the scale. The fit indexes in linear structural equation such as χ^2、RMSEA, GFI, AGFI, CFI, NFI, RMR, SRMR, ECVI were used to confirm the validity of the scale.
3. The parametric statistical tests level of this study was $\alpha= 0.05$.

III. RESULTS

A. Validity and reliability of TSES-HSPET in the first stage

1. Item analysis

350 teachers were sampled and 234 valid scales were returned in the first stage. The original scale included 26 statements. In item analysis, critical ratio (CR) of each statements reached statistically significant levels. These CRs were between 7.08 and 13.51. On the other hand, Item-total scale correlations were between 0.51 and 0.77, which were also statistically significant.

2. Validity of exploratory factor analysis

Exploratory factor analysis was used to analyze the scale's construct validity in the first stage of this research. Principal component analysis narrowed down all items into 2 factors and oblimin rotation was used to examine initial factor analysis. Some statements were eliminated if factor-loading absolute values were less than 0.40 or when statements with factor-loading across two dimensions were up to 0.35. Finally, 7 items were left in each dimension to be re-examined by factor analysis and all items are located at expected dimension. Only 14 items were selected from the original 26 items. The cumulative explained variance reached 60.77% of total variance (see Table I).

3. Testing Reliability

The Cronbach's alpha coefficient of internal consistency was 0.91 for sumscale, and subscales were 0.84 and 0.90.

TABLE I
ABSTRACT OF EXPLORATORY FACTOR ANALYSIS FOR PHYSICAL EDUCATION TEACHER SELF-EFFICACY SCALE

Number of Statements	PTE Factor loading	GTE Factor loading	Community
1.	0.64		0.51
2.	0.69		0.52
3.	0.64		0.42
4	0.68		0.60
5	0.68		0.55
6	0.75		0.56
7	0.58		0.62
8		0.78	0.56
9		0.80	0.68
10		0.80	0.71
11		0.81	0.71
12		0.76	0.64
13		0.79	0.70
14		0.78	0.68
Eigenvalue	4.18	3.11	
Explained Variance	34.84%	25.92%	
Accumulated variance	34.84%	60.76%	

Statements for TSES-HSPET
1. I am good at applying teaching materials, equipments, and facilities in physical education curriculum.
2. I am good at physical education curriculum design.
3. I am good at guiding students to acquire sport skills.
4. I am good at applying various teaching strategies to improve students' learning atmosphere.
5. I am good at applying different teaching methods to inspire students' learning interest and motivation.
6. I am good at applying various evaluative methods to understand students' learning results.
7. I am good at applying various methods to improve students' physical fitness.
8. Even though I spend much time, I still cannot motivate students who lack interests in physical education.
9. Even though physical education is not as important as other subjects in my school, I could still overcome obstacles to guide students to do their best in physical education.
10. I am able to overcome any barrier to guide students who lack exercise to actively participate in physical education.
11. I am able to change my students' attitude toward physical education and guide them to actively participate in class even if they are not strongly motivated.
12. For students who encounter difficulties in class, I am able to guide them effectively so they could achieve learning goals.
13. Even though there are not enough sports equipments and facilities, I am able to apply various methods to develop my students' skills.
14. If students are not physically fit, I am able to apply appropriate strategies to help them reach certain standards.

B. Validity and reliability of TSES-HSPET in the second stage

1. Validity of confirmatory factor analysis

This research used confirmatory factor analysis in the second stage to establish its construct validity. This second stage used a scale constructed with 14 statements from the exploratory factor analysis. Based on a final scale as Table 1 shows, personal teaching efficacy contained 7 statements from numbers 1 to 7 and general teaching efficacy also contained 7 statements from numbers 8 to 14. This stage sampled 350 teachers and 257 valid scales were returned. The skewness (-0.26 - -1.17) and kurtosis (-0.23 - -1.40) of scale parameters are the acceptable range of $\pm$ 1.96. Table 2 is Covariance Matrix of Obserable Variables. As for the suitability of the whole model ($\chi^2_{(75)}$=167.94 , p<0.05) did not meet the validity standard, but other fit indexes showed that the data adequately fit the hypothetical model (see Table 3). The observation index RMSEA=0.07 was smaller than 0.10; GFI=0.92 was greater than 0.90; AGFI=0.89 was close to 0.90; NFI=0.96 was greater than 0.90; CFI=0.98 was greater than 0.90; RMR=0.05 was as same as 0.05; SRMR=0.05 was as same as 0.05; ECVI=0.85, which reliable interval between 0.73 and 1.01. Although the AGFI did not reach 0.90, it was over 0.80, which is acceptable according to [21]. According to fig.1, it indicated that the factor loadings for individual items were PTE (0.66, 0.64, 0.51, 0.77, 0.70, 0.56) and GTE (0.51, 0.78, 0.75, 0.75, 0.78, 0.82, 0.80). All factor loadings were significant statistically for hypothetical model. Summary, the results of this study showed that fit indexes of TSES-HSPET reached the acceptable criteria, indicating that this pattern of evaluation was acceptable and in accordance with the verifying data, which means that this scale is valid.

TABLE II
COVARIANCE MATRIX OF OBSERVED VARIABLES

	X1	X 2	X3	X 4	X 5	X 6	X 7
X1	0.41						
X2	0.23	0.55					
X3	0.13	0.18	0.37				
X4	0.19	0.22	0.15	0.39			
X5	0.19	0.19	0.14	0.24	0.45		
X6	0.15	0.17	0.13	0.17	0.19	0.37	
X7	0.20	0.23	0.14	0.24	0.24	0.14	0.52
X8	0.19	0.13	0.03	0.10	0.20	0.08	0.21
X9	0.19	0.18	0.14	0.23	0.20	0.11	0.26
X10	0.25	0.22	0.13	0.23	0.21	0.12	0.28
X11	0.22	0.21	0.12	0.19	0.20	0.10	0.24
X12	0.25	0.08	0.40	0.37	0.32	0.62	0.16
X13	0.23	0.19	0.14	0.24	0.23	0.13	0.25
X14	0.17	0.19	0.12	0.24	0.23	0.13	0.34
	X 8	X 9	X 10	X 11	X 12	X 13	X 14
X8	0.35						
X9	0.23	0.70					
X10	0.22	0.40	0.65				
X11	0.22	0.40	0.50	0.60			
X12	0.23	0.15	0.20	0.17	0.13		
X13	0.23	0.43	0.37	0.37	0.44	0.63	
X14	0.16	0.40	0.38	0.37	0.37	0.39	0.59

TABLE III
ABSTRACT OF FIT INDEX FOR ABSOLUTE FIT MEASURES, INCREMENTAL FIT
MEASURES, PARSIMONIOUSFIT MEASURES

Absolute fit measures				
Test index	SRMR	RMSEA	GFI	AGFI
criterion	$\leqq 0.05$	<0.08	>0.90	>0.90
Index Coefficients	0.05	0.07	0.92	0.89
Result of test	yes	yes	yes	Close to acceptable criterion

Incremental fit measures					
Test index	NFI	RFI	IFI	NNFI	CFI
criterion	>0.90	>0.90	>0.90	>0.90	>0.90
Index Coefficients	0.96	0.95	0.98	0.97	0.98
Result of test	yes	yes	yes	yes	yes

parsimonious fit measures		
Test index	PNFI	CN	χ^2/df
criterion	>0.50	>200	<3.0
Index Coefficients	0.79	163	2.24 (168/75)
Result of test	yes	Close to acceptable criterion	yes

TABLE IV
ABSTRACT OF EACH ITEM RELIABILITY, AVERAGE VARIANCE EXTRACTED
AND COMPOSITE RELIABILITY

Variable	Item reliability (r^2)	Average variance extracted(AVE)	Composite reliability(CR)
PTE		0.43	0.78
X1	0.43		
X2	0.40		
X3	0.26		
X4	0.59		
X5	0.49		
X6	0.31		
X7	0.48		
GTE		0.53	0.90
X1	0.26		
X2	0.61		
X3	0.57		
X4	0.56		
X5	0.60		
X6	0.68		
X7	0.65		

2. Convergent validity

According to Table IV, item reliability showed that PTE were 0.43, 0.40, 0.26, 0.59, 0.49, 0.31, 0.48 (x_1-x_7), GTE were 0.26, 0.61, 0.57, 0.56, 0.60, 0.68, 0.65 (x_8-x_{14}) . On the other hand, Composite reliability (CR) were 0.78 and 0.90. The Average variance extracted (AVE) were 0.43 and 0.53. Convergent validity could be examine using average variance extracted and construct reliability. In this study, CR is more than 0.70, AVE of GTE is more than 0.50, Although the AVE of PTE did not reach 0.50, but its AVE coefficient (0.43) is close to 0.50, which is acceptable according to JÖreskog and SÖrborn [22].

3. Discriminate validity

JÖreskog and SÖrborn indicated that confidence interval of correlation coefficient could be used to test discriminate validity [22]. If the confidence interval could not contain 1.00, it revealed that the two dimensions were different dimension. The confidence interval formula of correlation coefficient is $r \pm 1.96 \times$ standard error. The confidence interval foumula was $0.34 \pm 1.96 \times 0.03$ for this study. Therefore, the confidence interval of correlation coefficient was estimated from 0.40 to 0.28, which not contain 1.00. It showed that TSES-HSPET had a acceptable discriminant validity.

4. Reliability test

14 individual item reliability (r^2) of observable variables from 0.26 to 0.68 which were higher than 0.20 (see TABLE 4). On the other hand, composite reliability of latent variables were 0.78 and 0.90 which were higher than 0.60. According to Bagozzi and Yi [23], the reliability of this scale reached acceptable criteria.
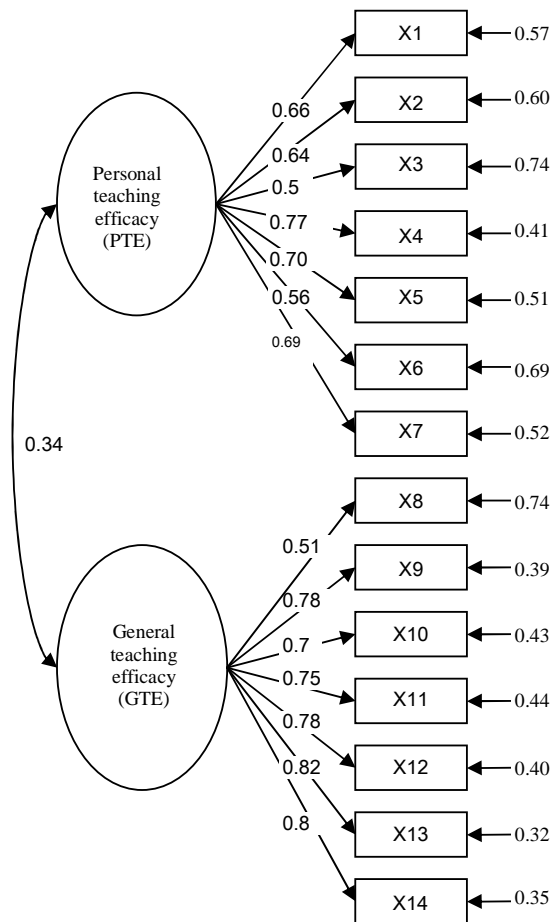
Fig. 1 Standardized Parameter Estimation of Hypothetical Model

IV. DISCUSSION AND CONCLUSIONS

The present study was to conduct and examined a 'teachers' self-efficacy scale for high school physical education teachers'. Through item analysis, reliability analysis, exploratory factor analysis and confirmatory factor analysis, the results of this study showed that TSES-HSPET has both reliability and validity. In the first stage, the cumulative explained variance reached 60.77% of total variance according to exploratory factor analysis. The Cronbach's alpha coefficient of internal consistency was 0.91 for sumscale, and subscales were 0.84 and 0.90. Exploratory factor analysis provided statistical support for two factor dimensions, including personal teaching efficacy (PTE) and general teaching efficacy (GTE). In the second stage, the study used confirmatory factor analysis to test construct validity of the scale. The results of this study showed that the hypothetical model could be accepted (RMSEA=0.07, GFI=0.92, AGFI=0.89, NFI=0.96, CFI=0.98, RMR=0.05, SRMR=0.05, ECVI=0.85). Average variance extracted was 0.43, 0.53. Composite reliability were 0.78 and 0.90. This study showed that physical education teacher's self-efficacy scale contained two potential factors, including personal teaching efficacy and general teaching efficacy. The outcome was identical to other studies of teacher's self-efficacy [10], [12]. It also verified Bandura's social cognitive theory and his construct of self-efficacy.

TSES-HSPET assumed that the two factors reflected the two expectancies of Bandura's theory: efficacy expectation and outcome expectancy. TSES-HSPET assuming PTE that it reflected efficacy expectation, and the GTE assuming that it was similar to outcome expectancy.

In present study, TSES-HSPET has two dimensions including PTE and GTE. PTE is the level of confidence that a teacher has of his own teaching skill and ability. It is self-evaluation about his teaching ability and a consciousness of his in improving students' positive changes. These statements of PTE includes 'I am good at applying teaching materials, equipments, and facilities in physical education curriculum', 'I am good at physical education curriculum design'. 'I am good at guiding students to acquire sport skills'…and so on. These statements mean general teaching skill and ability. PTE is similar to efficacy expectation of bandura's self-efficacy, which is the individual's conviction that he or she can orchestrate the necessary actions to perform a give task [2], that is , PTE would be teachers' evaluation of their abilities to bring about positive student change [10]. On the other hand, GTE refers to the teacher's belief of teaching outcomes, that is, the teacher's expectation of how the students could change in the process of learning under external environmental influences. These statements of GPE includes 'Even though I spend much time, I still cannot motivate students who lack interests in physical education'. 'Even though physical education is not as important as other subjects in my school, I could still overcome obstacles to guide students to do their best in physical education'. 'I am able to overcome any barrier to guide students who lack exercise to actively participate in physical education…, and so on. Outcome expectancy of Bandura's self-efficacy would essentially reflect the degree to which teachers believed that environment could be controlled, that is , the extent to which student can be taught given such factor as family background, IQ, and school conditions [10]. Teachers who express confidence in their ability to teach difficult or unmotivated students evidence a belief that reinforcement of teaching activities lies with the teachers' control or is internal [14]. Generally speaking, General teaching efficacy is higher teachers' ability, we could find more GET in experienced and capable teachers but novice teacher is difficult to get it.

It is concluded that TSES-HSPET is a good measurement instrument with validity and reliability, including two stable components: personal teaching efficacy and general teaching efficacy. It could be applied to test physical education teacher's self-efficacy for high school. In the future research, it is worth to understand development of physical education teachers' self-efficacy in their educational carrier, and what reasons would influence physical education teachers' self-efficacy.

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