

Factor Structure and Cross-Validation of a Professionalism Scale in Pharmacy Students

Sanguan Lerkiatbundit

ABSTRACT. The objectives of this study were to investigate factor structures of an attitudinal professionalism scale revised from the Schack-Hepler scale and cross-validate the findings. The students at a pharmacy school completed the scale twice, i.e., in 1998 (N = 464) and again in 1999 (N = 301). In 2004, another group of students (N = 486) at the same school also responded to the same scale. Factorial validity of the scale was assessed using structural equation modeling. The results showed that six subscales of the instrument were reliable (Cronbach alpha > 0.70). Based on 1998 data, the fit of the six-correlated factor model was better than those of the competing models. The parameter estimates suggested the convergent and discriminant validity of the scale. The six-correlated factor model had the highest degree of replicability in the 2004 sample. The analysis of panel data (using 1998-1999 samples) and the multi-group analysis indicated the invariance of factor loadings over time and across groups and classes. In conclusion, the professionalism scale is best represented by the six-correlated factor model. The respondents interpreted the scale items the same way across groups, time and classes. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <<http://www.HaworthPress.com>> © 2005 by The Haworth Press, Inc. All rights reserved.]

KEYWORDS. Professionalism scale, professionalism, pharmacy students, socialization, construct validity

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INTRODUCTION

Several forces drive the concern over pharmacy professionalism. The movement toward pharmaceutical care as the practice standard requires a higher level of professionalism from practitioners. Critical issues regarding current practice include patient safety, workload, limited manpower, and the sentiment that there has been a decline in the professionalism of pharmacists over the years as well as within society in general (1).

Professionalism can be measured in terms of structural, attitudinal or behavioral attributes. The structural attributes of a profession include the provision of socially necessary and important functions, the possession of specialized knowledge and skills requiring advanced theoretical training, an individualized, unstandardized service directly to clients/patients, autonomy for the definition, organization, and performance of work, internal controls of the behavior of its practitioners and formal organizations, code of ethics, and licensure requirements (1). However, the structural definition operates on the occupational level, attempts to reason from the occupational level to the individual level are seldom fruitful (2). The attitudinal and behavioral definitions operate on the individual level. They are logically and empirically more valid for the assessment of an individual's professionalism.

In terms of attitudinal attributes, professionalism could be described as: (1) Use of the professional organization as a major referent, (2) belief in public service or the belief that professional work is indispensable and beneficial to society, (3) belief in self-regulation or the belief that the performance of the professionals should be judged only by peers, (4) sense of calling or professional commitment, (5) autonomy or the belief that one has a right to make a professional decision without external pressures from clients, non-professionals, and employers, and (6) belief in continuing education or the belief that to maintain an adequate level of competence one must commit to the continuing extension of professional knowledge (2).

Hammer et al. defined behavioral professionalism as "behaving in a manner to potentially achieve optimal outcomes in professional tasks and interactions" (3). They employed exploratory factor analysis to develop a scale for this construct in pharmacy students. Four dimensions of behavioral aspects of professionalism emerged in their study: responsibility, interpersonal/social skills, communication skills, and appearance (3).

To enhance professionalism, colleges of pharmacy should "develop/utilize valid assessment instruments to measure professional development in the didactic and experiential components of the cur-

riculum” (1). The assessment should be comprehensive, including both attitudinal and behavioral aspects of professionalism. An instrument to measure behavioral professionalism has been recently developed (3). This study focuses on an instrument to measure attitudinal professionalism. The measurement of this aspect of professionalism is briefly reviewed below.

Measurement of Attitudinal Professionalism

Hall was the first researcher who developed a scale to measure attitudinal professionalism (4). Snizek, Schack and Hepler later refined this scale (2,5). Schack and Hepler modified the Hall-Snizek scale by replacing all “other-referent” items (such as “The dedication of people in this field is most gratifying”) with “self-referent” items (such as “The practice of pharmacy is gratifying and satisfying to me”) because the presence of other-referent items created ambiguity and confused the validity of the scale (5). They also added a sixth dimension (belief in continuing education) to the original set of five. The Schack-Hepler scale had been used in many studies of pharmacists (6-8) and pharmacy students (9). However, a confirmatory factor analytic study suggested the scale appeared in need of a significant revision before it could be recommended for widespread use (10). In one study, Cronbach alpha of all subscales was less than 0.7, except for sense of calling and belief in professional organization (11). A study using the Schack-Hepler scale questioned its sensitivity to detect changes in professionalism among students (9).

Lerkiatbundit revised the Schack-Hepler scale, but maintained its original six dimensions and meanings (11). The revision of the scale was described in detail in the studies by Lerkiatbundit (11,12). The scale modification is briefly reviewed here. The Schack-Hepler scale was translated into Thai language using the translation-back translation method. A pre-test of the translated scale in 197 pharmacy students showed that the Cronbach alpha of all subscales was less than 0.7, except for sense of calling and belief in professional organization. Poor reliability may result from the fact that the Schack-Hepler scale was developed for use with pharmacists. The scale was modified by changing or deleting the ambiguous items or items with low inter-item correlations, and adding new questions. Many questions in the Schack-Hepler scale were changed from self-referent to other-referent items in order to make the items more relevant to student subjects. For example, the question “My daily practice is all the continuing education I need” was changed to “Daily pharmacy practice is all the continuing education a pharmacist needs.” Interviewing

subjects during the pilot study revealed the presence of other-referent items did not create confusion. Sense of calling scale was replaced with the modified version of the Blau's professional commitment scale (13) because of its excellent psychometric properties when tested in pharmacy students (14). Moreover, the scores from the Blau's scale could be compared to those reported by previous studies.

The revised scale is in the appendix of this article. The test of the revised scale in 508 pharmacy students showed Cronbach alpha of the six subscales ranged from 0.76 to 0.86. This scale has been used in many studies, such as a study of change of attitudinal professionalism levels in pharmacy students and pharmacists, factors affecting the change and the effects of externship on attitudinal professionalism levels (12,15,16). These studies provided the evidence for construct validity of the scale because the pattern of the correlation between attitudinal professionalism subscales and various variables (e.g., academic development, faculty concern, satisfaction with peers and satisfaction with pharmacy job) was consistent to the theoretical predictions. A study in pharmacy students showed that the scale was sensitive to changes in the levels of attitudinal professionalism over the year (12).

However, some questions regarding the validity of the revised attitudinal professionalism scale still exist. What is the underlying factor structure of the instrument? For example, does the scale measure six distinct dimensions or one unitary concept of attitudinal professionalism? Is the scale invariant across groups of subjects and time? Does the scale have the same meaning when tested in a new group of subjects? Do students perceive attitudinal professionalism (as measured by the scale) differently after going through the socialization process in the school? The fourth and fifth years of the pharmacy curriculum expose students to more pharmacy practice experience than in earlier years of the program. As a result, they may or may not share the same concept of attitudinal professionalism. Therefore, the study also tested whether the professionalism scale measures the same thing when administered to upper classmen and lower classmen. This study was designed to answer these questions. The study results will provide insight on the psychometric properties of the attitudinal professionalism scale, which are useful to judge the merits of the scale.

Attitudinal professionalism and the revised attitudinal professionalism scale will be referred to as "professionalism" and "the professionalism scale," respectively, in the rest of the article. The methodology and results are divided into four studies according to research objectives. The

studies were reviewed and approved by the institutional review board at the study site.

STUDY 1

Objective: To determine the factor structure underlying the professionalism scale.

Subjects and data collection: The professionalism scale (as shown in the Appendix) was distributed in classes as a part of a larger survey to all pharmacy students (Classes of 1999-2003) at the Prince of Songkla University (PSU) in Thailand. The pharmacy curriculum at PSU was described in detail in a previous article (11). Each question was rated on a five-point Likert-type scale, from “1” = Strongly disagree to “5” = Strongly agree. Reliability and validity of the scale were mentioned in the introduction section.

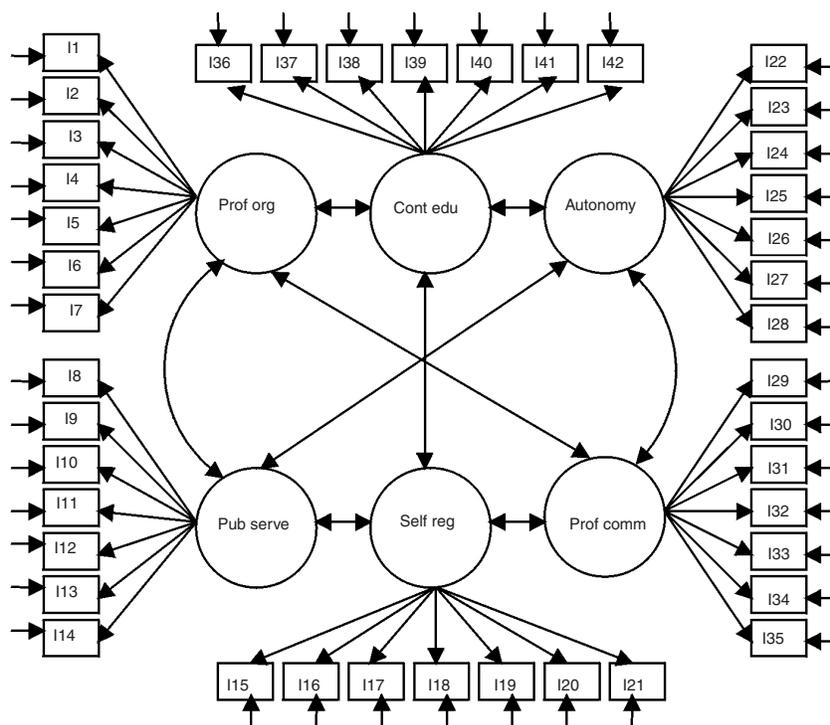
The survey was in Thai language and conducted during the first two weeks of the academic year 1998 (June 1998). The researchers explained to the student subjects that the objective of the study was to investigate their attitudes toward the pharmacy profession, and that participation was voluntary. The students were asked to independently complete the questionnaires whenever they wanted and return them within one week. Another copy of the questionnaire was sent to the non-respondents after one week. The data from this study is referred to as the “1998 sample” in this paper.

Model specification: Four models were hypothesized to represent the underlying structure of the professionalism scale.

Model 1 (six correlated factor model): Six factors as indicated by the six circles in Figure 1 represent the belief in professional organization, belief in public service, belief in self-regulation, professional commitment, autonomy and belief in continuing education. Each factor is hypothesized to correlate with the others, as indicated by the two-headed arrows. Each item loads on (measures) one and only one factor. For example, items 1-7 load onto belief in professional organization. Measurement error associated with each item, represented by short arrows pointing to items, is uncorrelated. This model hypothesizes that the scale measures six distinct but correlated concepts.

Model 2 (six uncorrelated factor model): This model is the same as model 1, but all factors are hypothesized to be independent. Graphic representation of model 2 is not shown because it is the same as Figure 1 but

FIGURE 1



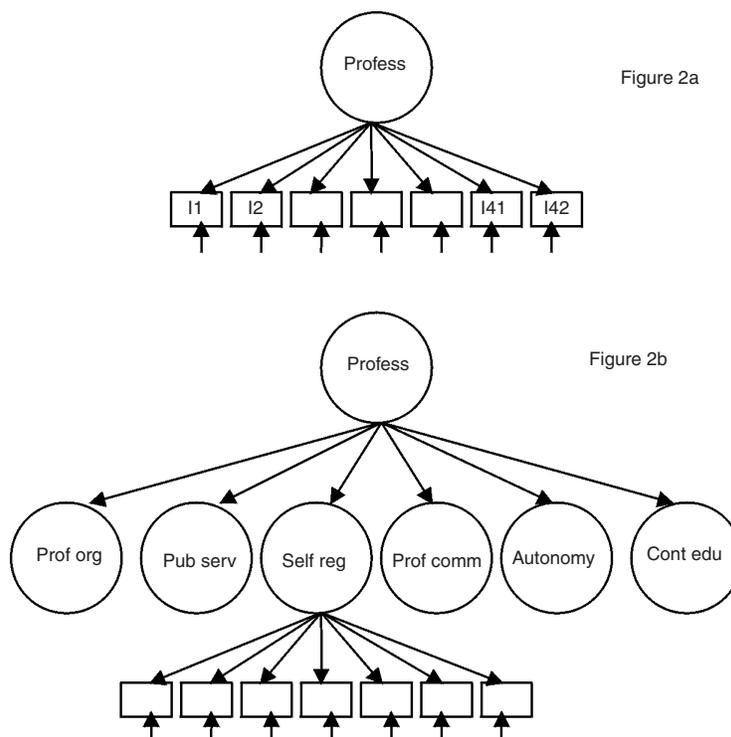
Note:

1. Prof org: Belief in professional organization Pub serv: Belief in public service
 Self reg: Belief in self regulation Prof comm: Professional commitment
 Autonomy: Belief in professional autonomy Cont edu: Belief in continuing education
2. I is abbreviated for item, for example, I1 is question number 1 in the scale.
- 3 Each factor or circle should be connected by double-headed arrows to other circles to represent their correlations. However, six double-headed arrows (such as the one connecting 'public service' and 'professional commitment') are omitted to simplify the figure.
4. Measurement errors are represented by arrows pointing from outside the model to indicators.

without the two-headed arrows connecting between factors. This model tests the interdependency among six hypothesized factors.

Model 3 (one-factor model): In this model, it is hypothesized that all 42 items of the scale are indicators of one concept called professionalism. In other words, the scale measures one unitary concept of professionalism, not six distinct attitudes. If this model holds, the scores from all 42 items could be summed to give a single score of professionalism. Figure 2a displays the structure of this model.

FIGURE 2. (a) Model 3 (one factor model) and (b) Model 4 (second order factor model)



Note:

1. Profess stands for professionalism.
2. Figure 2a is a simplified version by displaying only some of the indicators. The complete figure should display all 42 items of the professionalism scale.
3. Figure 2b is simplified version by displaying only the measurement model of 'self reg.' The complete figure should display measurement models of all six factors.

Model 4 (second order factor model): This model is the same as model 2. However, all factors are hypothesized to have a common higher factor which is represented by a second order factor called professionalism. Figure 2b shows the measurement model of model 4. If this model best fits the data, it implies that the six hypothesized factors are distinct and measure the same underlying higher order factor.

Data analysis: The variance-covariance matrix of items in the scale was analyzed using confirmatory factor analysis by maximum likelihood (ML) method of estimation in LISREL 8.52 (17). This method places an

assumption of multi-variate normality of the data. Mardia's estimates of "multivariate kurtosis and skewness" for the data were 22.06, and 46.92. This indicated a departure from the assumption. However, previous research indicates the ML is robust in situations of uni-variate or multi-variate non-normality (18). For sample size in the range of 200-500, ML is recommended when the distributions are not substantially non-normal (univariate skewness < 2 and univariate kurtosis < 7) (18). The distribution of the data in this study conformed to this requirement. As a result, ML was used as the estimation method.

Goodness-of-fit of the models to the data was evaluated using chi-square statistics and various indices as suggested by Hu and Bentler, (i.e., the root mean square error of approximation (RMSEA) and its 90% confidence interval, standardized root mean square residual (SRMR), comparative fit index (CFI), and the Tucker-Lewis index (TLI)) (19). The chi-square statistic is sample size dependent. Even if the discrepancy between the model and data is very small, almost any model with a large sample size will be rejected by the chi-square test (20). Therefore, the chi-square statistic was used with the other indices in selecting the best model. RMSEA, SRMR, CFI and TLI are indices recommended as sensitive to model misspecifications (19). For RMSEA, Browne and Cudeck suggested that values of 0.05 or less would indicate a "close fit," a value of 0.08 or less would indicate a "reasonable fit," and values greater than 0.10 would indicate "unacceptable fit" (21). The CFI and TLI with values close to 0.95 and SRMR less than 0.08 reflect a good fit of model to the data (19). Comparative fits of nested models were evaluated by chi-square difference tests.

Results and Discussion of Study 1

Of 519 pharmacy students, 464 students (89.4%) fully completed the questionnaire. The rest of the students partially answered the questionnaires or did not return their surveys. The response rates ranged from 80.8% for second-year students to 94.7% for first-year students. The age of the participants was between 18 to 22 years. About 78 percent of the subjects were female. Cronbach alphas of the six subscales of professionalism were acceptable, ranging from 0.76-0.86.

Goodness-of-fit indices for the 1998 sample are shown in Table 1. For models 1, 2 and 4, RMSEAs were near 0.05 and the upper bounds of 90% CIs were less than 0.08, indicating an acceptable fit to the data. For models 1 and 4, SRMRs were less than 0.08 and TLIs and CFIs were close to 0.95, suggesting a good fit of the model. It was apparent that model 2

TABLE 1. Confirmatory factor analyses of the professionalism scale (N = 464)

Model	χ^2 ^a	df	$\Delta\chi^2$ ^b	Δ df	RMSEA (90% CI)	SRMR	TLI	CFI
Null	15677	861	-	-	-	-	-	-
1) 6 correlated factors	1549	804	-	-	0.044 (0.041-0.048)	0.056	0.946	0.950
2) 6 uncorrelated factors	1862	819	313 ^c	15	0.052 (0.049-0.055)	0.118	0.926	0.930
3) One factor	5116	819	3567 ^c	15	0.106 (0.103-0.109)	0.123	0.695	0.710
4) Second order factor	1632	813	83 ^c	9	0.046 (0.043-0.049)	0.068	0.941	0.945

^aMaximum likelihood chi-square and $P < 0.001$

^b χ^2 of model 1 was used as a baseline to calculate $\Delta\chi^2$ for models 2-4 .

^c $P < 0.001$

(uncorrelated model) and model 3 (one-factor model) had a poor fit to the data (SRMR > 0.10 and CFIs-TLIs < 0.95). The results suggest a good fit for models 1 and 4.

Given that models 2-4 are nested versions of model 1, they can be directly compared to model 1 using the chi-square difference test (22). A significant result implies that the model with the lower chi-square statistics (and the lower df) shows a better fit. A non-significant result indicates equivalence of fit between the comparison models. According to this test, the fit of model 2 (6 uncorrelated factors) was significantly worse than that of model 1 ($\Delta\chi^2 = 313$, $df = 15$, $P < 0.001$) (Table 1). This implies that the factor structure of the professionalism scale was not well represented by the six uncorrelated factor model (model 2) compared to the correlated factor model (model 1). In other words, correlations among six factors were statistically significant. The comparison between models 1 and 3 ($\Delta\chi^2 = 3567$, $df = 15$, $P < 0.001$) strongly rejected the hypothesis of a one factor model. The fit of the six-correlated factors model (model 1) was also superior to that of model 4 (the second order model) ($\Delta\chi^2 = 83$, $df = 9$, $P < 0.001$). However, the fit indices for the second order model (model 4) was acceptable (RMSEA = 0.046, SRMR = 0.068, CFI and TLI close to 0.95), and comparable to those of model 1. The findings could not completely rule out the possibility of a hierarchical model of professionalism.

Based on the chi-square difference tests, attitudinal professionalism, as measured by this scale, is a multidimensional construct which comprises six correlated dimensions of belief in professional organization,

belief in public service, belief in self-regulation, professional commitment, autonomy, and belief in continuing education.

LISREL provided the indices which could be used to inform modification of the model to gain a better fit to the data. However, MacCallum, Roznowski and Necowitz have cautioned that “when an initial model fits well, it is probably unwise to modify it to achieve even better fit because modification may simply be fitting small idiosyncratic characteristics of the sample” (23). Therefore, the modification indices were not used to further modify model 1 because its RMSEA, SRMR, CFI and TLI already suggested an acceptable fit.

In model 1, each item measures a single factor (Figure 1). Therefore, the standardized loadings could be interpreted as the correlations between items and factors. High loadings on the hypothesized factors (or high item-factor correlation) indicate convergent validity of the items or a high probability that all items measure the same factor. The squared loadings are the proportions of explained item variances or the extent to which each item measures its underlying factor. For the majority of items, standardized factor loadings were more than 0.50 (Table 2). Support for convergent validity was moderate for six items (I15, I25, I29, I30, I31, and I41) because their loadings ranged from 0.36-0.46.

Low to moderate correlations among factors imply discriminant validity; the factors are distinct. The estimated correlations among six factors ranged from the low (0.05) to moderate (0.44) levels (Table 2) which suggested discriminant validity. Standard errors of these estimated correlations ranged from 0.046 to 0.056. Adding and subtracting the correlations in Table 2 with two times their corresponding standard errors will give 95% confidence intervals. The 95% CI of the largest correlation (between belief in self-regulation and autonomy) was 0.44 ± 0.046 or 0.348-0.532. The correlation at the size of 0.532 was not high enough to assume that belief in self-regulation and autonomy were the same construct. Overall, the result implies discriminant validity of the scale.

At this point, it was determined to submit model 1 to a more restrictive test using panel models with the data collected from the same sample of respondents at different points in time. This method was used to test whether the scale had the same “meaning” over time or whether the meaning of professionalism in the students’ view changes in the course of socialization.

TABLE 2. Parameter estimates from model 1 (Six-correlated factors model)

Standardized factor loadings ^a							
	I1	I2	I3	I4	I5	I6	I7
Belief in professional organization	0.58	0.61	0.67	0.62	0.66	0.52	0.61
	I8	I9	I10	I11	I12	I13	I14
Belief in public service	0.55	0.65	0.64	0.71	0.71	0.69	0.64
	I15	I16	I17	I18	I19	I20	I21
Belief in self-regulation	0.36	0.57	0.65	0.64	0.71	0.75	0.77
	I22	I23	I24	I25	I26	I27	I28
Professional commitment	0.67	0.76	0.78	0.46	0.86	0.72	0.73
	I29	I30	I31	I32	I33	I34	I35
Autonomy	0.43	0.39	0.43	0.67	0.76	0.80	0.55
	I36	I37	I38	I39	I40	I41	I42
Belief in continuing education	0.58	0.60	0.67	0.70	0.66	0.39	0.53

^a I stands for item. I1 means item 1 of the subscale for belief in professional organization with loading 0.58. All loadings in the table are significant, $P < 0.05$.

Standardized factor correlations

	(1)	(2)	(3)	(4)	(5)	(6)
Belief in professional organization (1)	1					
Belief in public service (2)	.29*	1				
Belief in self-regulation (3)	.05	.09	1			
Professional commitment (4)	.39*	.43*	.09	1		
Autonomy (5)	.07	.30*	.44*	.15*	1	
Belief in continuing education (6)	.21*	.40*	.07	.26*	.30*	1

*significant at $P < 0.05$

STUDY 2

Objective: To determine scale invariance of the professionalism scale over time.

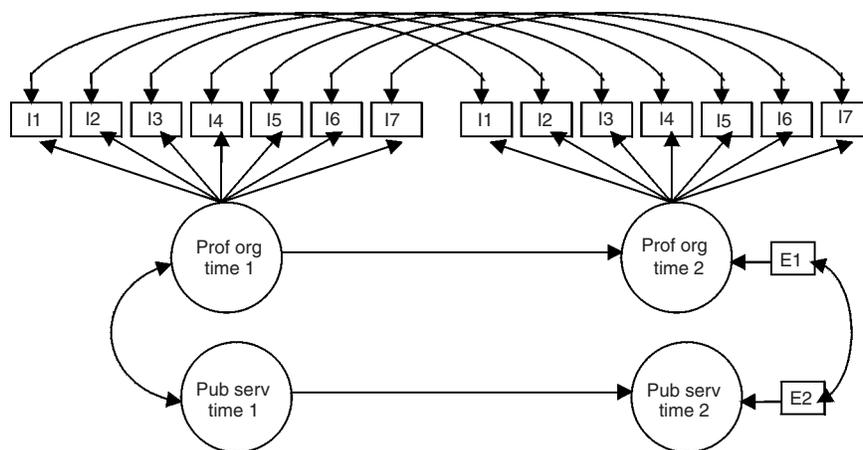
Subjects and data collection: The students in study 1 were asked to complete the professionalism scale again at the end of academic year (February 1999). The surveys in study 1 and study 2 were administered eight months apart. The procedures used were the same as those described in study 1.

Model specification: Increasingly restrictive models, as suggested by Byrne, were tested to assess the invariance of the scale over time (24).

Model 5 (correlated error model): This model is partially displayed in Figure 3. All factors at time 1 are hypothesized to affect the levels of the factors at time 2. The arrows pointing from the factors at time 1 to those at time 2 represent this effect. Because the same item was used repeatedly over time, the uniqueness in each item (e.g., negative worded content or content related to money in I25) might have systematic influence on the observed scores. This might occur because an item may have a specific meaning other than the underlying factor (25). Therefore, it is necessary to postulate item-specific factors by allowing correlated errors (two headed curved arrows) between the same items at time 1 and time 2, such as that for I1 at time 1 and time 2. In model 5, the factors at time 1 are intercorrelated. Residual variances of the factors at time 2 are also intercorrelated.

Model 6 (uncorrelated error model): This model is the same as model 5, but there are no correlated errors between pairs of same items at different times. The test of this model answers the question whether the correlated errors or item uniqueness contribute to the model fit. If they are

FIGURE 3. Panel model of professionalism scale



Note:

1. In order to simplify the figure, the measurement model and correlated errors are shown for belief in professional organization only. The complete figure should include measurement model and correlated errors of all six factors.
2. E stands for residual.
3. All six factors at time 1 and all six residuals at time 2 are modeled to be correlated. These correlations are represented by the double-headed arrows connecting between Prof org and Pub serv. The complete figure should include the correlation among six factors.

significant, they should be included in the model in order to properly estimate the model parameters (such as factor loadings).

Model 7 (model with the invariance of factor loadings): In model 7, the equality constraints are placed on all factor loadings over time. For example, the loading from belief in organization to I1 at time 1 is constrained to be equal to that from belief in organization to I1 at time 2. The test of this model answers the question whether items of the scale are measuring the same six factors in exactly the same way for both time or whether the scale has the same “meaning” over time. If the factor loadings are not invariance across time, it is possible that the professionalism in the students’ view changes during the course of socialization.

Model 8 (model with the invariance of measurement errors): This model is model 7 with an additional equality constraint on all measurement error variances over time. For example, the error variance of I1 at time 1 is constrained to be equal to that of I1 at time 2. The model tests if the scale is a parallel measure (having equal factor loadings and error variances) over time or if the item variances are stable over time.

Data analysis: Responses of the same subjects at time 1 and 2 were linked. The covariance matrix of all items at time 1 and 2 was analyzed using the same procedure as described in study 1. Listwise deletion was employed to handle the missing data. Multiple indices were used to determine model fit. Because the tested models are nested, the comparative fits were evaluated by chi-square difference tests.

Results and Discussion of Study 2

Three hundred and one students completed both surveys in 1998 and 1999. The overall rate of participation was 58% (301/519). Cronbach alphas of the six subscales of the instrument in the second survey were acceptable, ranging from 0.77-0.86.

According to RMSEAs, SRMRs, TLIs and CFIs, models 5-8 had excellent fit to the data (Table 3). The chi-square difference between model 5 (with correlated error) and model 6 (without correlated error) indicated a better fit for model 5 ($\Delta\chi^2 = 252$ df = 42, $P < 0.001$). This suggests that correlated errors between pairs of the same items should be included in the model to better represent the data. The $\Delta\chi^2$ between model 5 and model 7 (with equality constraints on factor loadings) was non-significant ($\Delta\chi^2 = 47$ df = 36, $P = 0.104$). Therefore, all items comprising the six factors of professionalism scale were measuring the same facets in exactly the same way for both time 1 and time 2. In other words, the subjects

TABLE 3. Goodness-of-fit indices in the analysis of the panel model (N = 301)

Model	χ^2 ^a	df	$\Delta\chi^2$	Δ df	RMSEA (90% CI)	SRMR	TLI	CFI
Null	30407	3486	-	-	-	-	-	-
5) Correlated errors	4071	3324	-	-	0.027 (0.024-0.030)	0.061	0.971	0.972
6) Uncorrelated errors	4323	3366	252 ^b	42	0.030 (0.028-0.033)	0.062	0.963	0.964
7) Model 5 with equality constraints on factor loadings	4118	3360	47 ^c	36	0.027 (0.024-0.030)	0.063	0.971	0.972
8) Model 7 with equality constraints on error variances	4224	3402	106 ^d	42	0.031 (0.028-0.034)	0.063	0.969	0.969

^a Maximum likelihood chi-square and $P < 0.001$

^b Model 5 as a baseline for calculating $\Delta\chi^2$, $P < 0.001$

^c Model 5 as a baseline for calculating $\Delta\chi^2$, $P = 0.104$

^d Model 7 as a baseline for calculating $\Delta\chi^2$, $P < 0.001$

interpreted the content comprising each item in the scale in the same way across time. This property is a prerequisite for a valid comparison of the factor means and the relationship among factors across times.

The difference in chi-square values between model 7 and model 8 (model 7 with equality constraints on error variances) was significant ($\Delta\chi^2 = 106$ df = 42, $P < 0.001$). Therefore, the hypothesis of the invariance of error variances must be rejected. The result implies that the variances of items of the scale changed over time.

Model 7 is considered the best-fitting model because its fit was comparable to the model with lowest chi-square (model 5), but having more degrees of freedom. Therefore, the discussion of factor loadings and relationships among factors is based on those in model 7. The parameter estimates (such as factor loadings and factor correlation) in the panel model (Figure 3) reflect the corrections for random and item specific errors and should be more reliable than those from cross-sectional models such as those in study 1 (26). All factor loadings at time 1 and time 2 were significant and showed the same pattern as those in the study 1 (similar to Table 2). Standardized factor loadings ranged from 0.52-0.83 for all but 6 items (I15, I25, I29, I30, I31, and I41). These six items had moderate and significant loadings ranging from 0.35-0.48. These results imply convergent validity of the professionalism scale. The inspection of factor correlations at time 1 and residual correlations at time 2 can assess discriminant validity (26). At time 1, the correlations among six factors of profession-

alism showed the same profile as those in study 1 with the significant correlations ranging from 0.15-0.43 and the insignificant correlations ranging from 0.05-0.08. For time 2, significant residual correlations ranged from 0.11-0.27, while insignificant correlations were 0.0-0.09. Residual correlations at time 2 also reflect corrections for random and specific errors (26). Relatively low correlations among factors at time 1 and low correlations among residuals at time 2 imply the distinctiveness of six factors or the discriminant validity of the scale.

Finally, it is interesting to examine the relationships of same factors across time. The path coefficients from time 1 to time 2 of belief in professional organization, belief in public service, belief in self-regulation, professional commitment, autonomy and belief in continuing education were 0.52, 0.43, 0.36, 0.70, 0.44 and 0.50, respectively. The coefficients were moderate to high, indicating a moderate to strong influence of factors at time 1 to those at time 2. The result suggests studies of factors affecting the change of professionalism levels should include the previous levels of professionalism as predictors, or the results may be biased because of misspecification or error of omitting important independent variables from the model.

STUDY 3

Objectives: (1) To cross-validate results from study 1 with an independent sample, i.e., to test whether the better fit of model 1, compared to those of the other models (models 2-4) is replicate in another sample, and (2) To determine the invariance of the professionalism scale in an independent sample.

Subjects and data collection: A new group of pharmacy students (Classes of 2004-2009) at the Prince of Songkla University completed the professionalism scale in 2004 with the same procedures described in study 1. The subjects in study 3 did not overlap with those in studies 1 and 2. The data is referred to as the "2004 sample."

Model specification: In the cross-validation study, factor structures as specified in models 1-4 (in study 1) were tested using the "2004 sample" as a validation sample. In the study of invariance of the scale (the second objective of this study), the covariance matrices among items from "1998 sample" and "2004 sample" were analyzed simultaneously using the multi-group technique (24). Four models with increasingly restrictive constraints (models 9-12) were compared.

Model 9 (no constraint): This model is the six-correlated factor model (model 1) with no equality constraints of parameter imposed.

Model 10 (with the constraint of factor loadings): This model is model 9 with factor loadings across two samples constrained to be equal. The model tests whether the patterns of factor loadings are equivalent across the samples.

Model 11 (model 10 with an additional equality constraint on error variances): This model tests if error variances of items are equivalent across the samples. If the model fits well, it implies the equality of item variances across samples.

Model 12 (model 10 with an additional constraint on factor variances and covariances): This model tests if factor variances and the relationship among six factors of professionalism are equivalent across groups.

Data analysis: For the cross-validation study (the first objective), a Cross-Validation Index (CVI) was calculated by LISREL v 8.54 (17) to determine which model from study 1 replicates best for the "2004 sample." For each model in study 1, a reconstructed covariance matrix was calculated from parameter estimates of the model. The CVI is the distance between the reconstructed covariance matrix in the calibration sample (1998 sample) and observed covariance matrix in the validation sample (2004 sample). The model that best replicates the validation sample is the one with the lowest CVI value (27). For the test of scale invariance across samples (the second objective), the same procedures as those in study 2 were used for model comparison.

Results and Discussion of Study 3

Of 622 pharmacy students surveyed in 2004, 509 (81.8%) completed the survey. Response rates ranged from 70.0% for second-year students to 89.1% for fifth-year students. Listwise deletion for handling missing data reduced the sample size to 486 (Table 4). The age of the participants ranged from 18 to 23 years. Approximately 71% of the subjects were female. Cronbach alphas of the six subscales of professionalism were acceptable, ranging from 0.72-0.86.

Cross-Validation Indices (CVI) of models 1-4 were 5.81, 6.63, 12.98 and 5.91, respectively, suggesting that model 1 (six-correlated factor model) had the highest degree of replicability across samples. Therefore, results from study 1 were well cross-validated with the "2004 sample."

The six-correlated factor model seemed to be the best model overall for representing the factor structure underlying the professionalism scale for two reasons. First, it showed the lowest CVI in study 3. Second, it had an

TABLE 4. Multiple group analysis of the professionalism scale: 1998 sample (N = 464) and 2004 sample (N = 486)

Model	χ^2 ^a	df	$\Delta\chi^2$	Δ df	RMSEA ^d (90% CI)	SRMR ^e	TLI ^d	CFI ^d
Null	36989	1722	-	-	-	-	-	-
9) No constraint	3545	1608	-	-	0.050 (0.048-0.052)	0.056 0.044	0.94 1	0.94 5
10) Constrain all loadings	3591	1644	46 ^b	36	0.050 (0.048-0.052)	0.058 0.070	0.94 2	0.94 5
11) Model 10 with constraints on error variances	3887	1686	296 ^c	42	0.052 (0.050-0.054)	0.062 0.072	0.93 6	0.93 8
12) Model 10 with constraints on factor variances and covariances	3657	1665	66 ^c	21	0.050 (0.048-0.052)	0.064 0.077	0.94 2	0.94 4

^a Maximum likelihood chi-square and $P < 0.001$

^b Model 9 as a baseline for calculating $\Delta\chi^2$, $P = 0.122$

^c Model 10 as a baseline for calculating $\Delta\chi^2$, $P < 0.001$

^d RMSEAs, CFIs and TLIs are pooled for two samples.

^e The first and second numbers are SRMRs in the 1998 sample and the 2004 sample, respectively.

acceptable fit to the data and its fit was better than those of the competing models (models 2-4) as indicated in study 1 by RMSEA, SRMR, TLI CFI and chi-square difference test (Table 1).

For the test of scale invariance across samples, four competing models showed an acceptable fit to the data with RMSEA and its upper bound of 90% CI close to 0.05, and SRMR less than 0.08. TLI and CFI of all models were slightly lower than 0.95 (Table 4). In model 9, all parameter estimates were allowed to be different across samples. In model 10, factor loadings were constrained to be equal across samples. The difference in chi-square values between models 9 and 10 was non-significant ($\Delta\chi^2 = 46$ $df = 36$, $P = 0.122$), suggesting that the fit of two models was comparable. The model with a higher degree of freedom (or the simplest model, model 10) was chosen for parsimony reason. The result supports the hypothesis of an invariant pattern of factor loadings. In other words, all items of the scale operated in the same way for both groups. This property of the scale is essential for making valid comparison of scores across groups. If factor loadings are not invariant, it is not appropriate to compare the scores across groups.

The comparison of models 10 and 11 showed a significant difference in chi-square ($\Delta\chi^2 = 296$ $df = 42$, $P < 0.001$), suggesting difference of vari-

ances and error variances of the scale items across samples. The chi-square difference between models 10 and 12 was significant ($\Delta\chi^2 = 66$ df = 21, $P < 0.001$). This result suggests the difference of factor variances and covariances across samples. These findings were not unexpected. It is very likely that different samples have different variances in scale items and different variances of factors. The difference of the relationship among factors (factor covariances) may result from the changes of curriculum and professional environments between 1998 and 2004. Such changes included the mandatory continuing education for Thai pharmacists in 2002, the advent of PharmD program at the school in 2002, the compulsory license examination for new pharmacy graduates in 2003, and the annulment of the requirement for new graduates to work for the government for two years. Additionally, the increasingly visible roles of the Thai Pharmacy Council since 1998 may contribute to the higher correlation of belief in pharmacy organization and belief in public service in the 2004 sample (factor correlation was 0.29 in the 1998 sample and 0.46 in 2004 sample). Even though there have been many changes in Thai pharmacy, the subjects in the 1998 and 2004 samples interpreted the items in the scale in the same way as indicated by the invariance pattern of factor loadings.

STUDY 4

Objective: To determine whether the scale items measure professionalism in the same way for upperclassmen and newer students. Socialization processes may change the meaning or conceptualization of professionalism. However, it is also possible that socialization changes only the 'quantity' of professionalism (i.e., students become more professional, but their conceptualization of professionalism remains unchanged). The invariance of the scale among more advanced students and students in the early years of their education provides evidence supporting the hypothesis that pharmacy socialization does not change the conceptualization of professionalism as measured by the scale.

Subjects and data collection: Data from the 1998 and 2004 samples were used in this study. Two data sets were not pooled because it was evident in study 3 that item variances and factor covariances between the two samples were different. Each data set generated two covariance matrices among scale items, one for the newer students (students in their first, second and third years) and the other for the upperclassmen (fourth- and

fifth-year students). The data of the fourth- and fifth-year students were pooled into the same group because, compared to the newer students, they had more formal exposure to pharmacy practice through the externship and profession-related coursework.

Model specification: The covariance matrices generated from “1998 sample” and “2004 sample” were analyzed using the multi-group technique (24). Four competing models with increasingly restrictive constraints (models 13-16) were tested.

Model 13 (no constraint): This model is the six-correlated factor model (model 1) without the equality constraints of parameters.

Model 14 (with the constraint of factor loadings): This model is model 13 with factor loadings for upperclassmen and newer students constrained to be equal.

Model 15 (model 14 with an additional equality constraint on error variances)

Model 16 (model 14 with an additional constraint on factor variances and covariances)

Data analysis: The test of scale invariance between upperclassmen newer students was done separately for “1998 sample” and “2004 sample.” The same procedures as those described for study 2 were used for model comparison.

Results and Discussion of Study 4

The results of the multi-group analysis based on the 1998 sample are in Table 5. For models 13-16, RMSEAs and their upper bounds were close to 0.05. SRMRs were lower than 0.08 for all models except for that of the upperclassmen in model 15. TLIs and CFIs for all models were slightly lower than 0.95 (Table 5). Therefore, all models except for model 15 appeared to have a satisfactory fit.

The difference in chi-square between models 13 and 14 was non-significant ($\Delta\chi^2 = 47$ df = 36, $P = 0.104$). The result suggests that the pattern of factor loadings was invariant across the groups of students, meaning that they interpreted scale items in the same way. As a result, scores from upperclassmen and newer students could be compared.

The error variances among items for the upperclassmen sample were different from those in the newer students sample as indicated by the significant chi-square difference between models 14 and 15 ($\Delta\chi^2 = 106$ df = 42, $P < 0.001$). The factor variances and covariances between the student groups were not significantly different ($\Delta\chi^2$ of models 14-16 = 21, df = 21,

TABLE 5. Multiple group analysis of the professionalism scale: Newer students (N = 293) and upperclassmen (N = 171) of the 1998 sample

Model	χ^2 ^a	df	$\Delta\chi^2$	Δ df	RMSEA ^e (90% CI)	SRMR ^e	TLI ^e	CFI ^e
Null	16575	1722	-	-	-	-	-	-
13) No constraint	2599	1608	-	-	0.051 (0.048-0.055)	0.067 0.077	0.929	0.933
14) Constrain all loadings	2646	1644	47 ^b	36	0.051 (0.047-0.055)	0.069 0.078	0.929	0.933
15) Model 14 with constraints on error variances	2752	1686	106 ^c	42	0.052 (0.048-0.056)	0.071 0.084	0.927	0.928
16) Model 14 with constraints on factor variances and covariances	2667	1665	21 ^d	21	0.051 (0.047-0.054)	0.071 0.077	0.930	0.933

^a Maximum likelihood chi-square, and $P < 0.001$

^b Model 13 as a baseline for calculating $\Delta\chi^2$, $P = 0.104$

^c Model 14 as a baseline for calculating $\Delta\chi^2$, $P < 0.001$

^d Model 14 as a baseline for calculating $\Delta\chi^2$, $P = 0.459$

^e The first and second numbers are SRMRs in the lower classmen and the upper classmen of the 1998 sample, respectively. RMSEAs, CFIs and TLIs are pooled indices for two samples.

$P = 0.459$). The results from the 2004 sample were parallel to those obtained from the 1998 sample and, therefore, are not presented.

LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDY

This study determined the invariance of the scale using a panel model with the two waves of data collected over eight months (study 2). However, the invariance of the scale is best studied if the data are collected from *the same subjects* every year over the entire course of study in pharmacy schools. Such a study would provide strong evidence for testing whether socialization processes change the meaning or conceptualization of professionalism as measured by the scale.

This study focuses on the psychometric properties of the measure, rather than on the change of professionalism. It is important for colleges of pharmacy to monitor professionalism levels in their students. Such data provide feedback on whether pharmacy socialization works in the intended way. Studies of rates of change of professionalism levels and factors affecting change should be conducted in the future. At least three

waves of data should be collected in order to be able to take advantage of an advanced technique like latent growth curve modeling (28).

Psychometric properties of the scale were investigated with the students in one school of pharmacy in Thailand. A topic for future research could be the study of scale properties in the students at the other schools of pharmacy, or pharmacists in Thailand or in other cultures or countries. Another interesting question is whether the conceptualization of professionalism changes once a pharmacist enters practice. Similar evidence as presented in this study is needed before comparing professionalism scores of pharmacists and pharmacy students.

It was surprising to find recent studies that used the Hall-Snizek scale (29-30) which has been criticized for its validity (2). The content of the attitudinal professionalism scale in this study is relatively generic and could be easily modified for using in the other health professionals. However, the psychometric properties of the scale should be examined before the intensive use in other professions.

The number of items in this scale is 42, which is considered large, especially when this scale is administered with other scales. A short version of this scale is needed to reduce the burden of subjects and improve response rates.

CONCLUSION

The study tested the factor structure of an attitudinal professionalism scale, which was modified by Lerkiatbundit from the Schack-Hepler scale and Blau's Professional Commitment scale (12). The six-correlated factor model better described the structure underlying the scale than the six-uncorrelated factor model, the one factor model or the second order factor model. The six-correlated factor model was also the model with the highest degree of replicability across samples.

The scale exhibited good psychometric properties. Reliabilities of the six subscales were greater than 0.70 for all samples. The relatively high factor loadings imply the convergent validity of the scale. The low to moderate correlations among six factors suggest the discriminant validity of the scale. Subjects interpreted the content of each scale item in the same way over time and across groups of subjects (1998 and 2004 samples), and classes (upperclassmen and newer students). This study provides evidence regarding the validity for the comparison of factor means and the relationship of factors over time and across classes. The results from the

study support the use of this scale for monitoring the change of professionalism levels in pharmacy students.

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APPENDIX. Professionalism scale (12)

Note: Please choose the answer that matches your level of agreement. Any reference to the professional organization refers to the single organization you most closely identify with.

Response items: Strongly disagree (1), Disagree (2), Uncertain or no opinion (3), Agree (4) and Strongly agree (5).

1. My professional organization competently represents my views on pharmacy issues.
2. My professional organization plays a major part in promoting the advancement of the profession.
3. My professional organization provides me with a better understanding of the values and belief of my profession.
4. I would be willing to use the official statements and standards issued by my professional organization as guides to my practice.
5. I agree with the pharmacy practice promoted by my professional organization.
6. I am (or intend to become) a member of a professional organization.
7. I agree to the statements and standards issued by professional organization.
8. If pharmacists fail to instruct patients concerning the proper use of medication, patients probably would be harmed.
9. The patient care would suffer without pharmacy services.
10. If there were no pharmacists to provide drug information to the physician, patient care would suffer.
11. Patient care would be inadequate without pharmacy services.
12. The pharmacy profession is essential for the society.
13. The pharmacy practices play a major role in patient care.
14. The pharmacists can help reduce the irrational drug use.
15. The pharmacy profession should be the only one who has an authority to regulate its members.
16. Only another pharmacist is qualified to judge the competence of a pharmacist.
17. The pharmacists who violate professional standards should be judged only by their pharmacy colleagues.
18. The pharmacy profession should be the one who establishes professional regulation.
19. Organizations outside pharmacy should not play a part in judging the pharmacists who violate professional standards.
20. Pharmacy colleagues should be the only ones who determine the standard for pharmacy practices.
21. Organizations outside pharmacy should not intervene with the self-regulation of the pharmacy profession.

22. If I could pick a different occupation that paid the same amount, I would probably change majors.
23. I definitely want a career in pharmacy.
24. If I could do it over again, I would still choose the same profession.
25. If I had all the money I needed without working, I would continue with my pharmacy education.
26. I like the profession of pharmacy too well to give up my pharmacy studies.
27. This is the ideal profession for a life's work.
28. I am disappointed that I ever entered pharmacy school.
29. The employer should have the right to change the professional decision of a pharmacist.
30. The employer should have the right to influence the pharmacy practice because employer is the one who pays salary.
31. The employer has no right to place limitations on the professional decisions of a pharmacist.
32. Professional work would result in a more favorable outcome if there is no pressure from the employer.
33. Influence of an employer over professional work is not desirable.
34. Pharmacists should have a right to exercise professional judgment without the interference from the employer.
35. Professional work would probably suffer if pharmacists follow employer's guidelines for making professional decisions.
36. After graduation, I could maintain an acceptable standard of practice without having any continuing education activities.
37. Continuing education after graduation such as seminars or journal reading is essential for working as a pharmacist.
38. Daily pharmacy practice is all the continuing education a pharmacist needs.
39. After graduation I would not attend continuing education seminars unless it is required for licensing or relicensing.
40. Continuing education is of little importance to pharmacy practice.
41. If a pharmacist does not have any continuing activities, his/her professional work would suffer.
42. After graduation, pharmacists should participate in continuing education activities.

Items for the use of the professional organization as a major referent: 1-7

Items for belief in public service: 8-14

Items for belief in self-regulation: 15-21

Items for professional commitment: 22-28. These items are the Blau's professional commitment scale as modified by Rascati (14).

Items for belief in autonomy: 29-35.

Items for belief in continuing education: 36-42

Items needing recoding: 22, 24, 28, 29, 30, 36, 38, 39, 40.

Note: The original scale is in Thai. The English version was translated by the author and has not been validated.