Development and Validation of an Instrument to Assess the Self-Confidence of Students Enrolled in the Advanced Pharmacy Practice Experience[1,2]

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The purpose of this study was to develop a reliable and valid instrument to measure pharmacy students' self-confidence and to determine the effect of selected student demographic variables as independent predictors of the students' level of self-confidence. The instrument was developed with an underpinning in the self-efficacy theory. Generated instrument items were based on literature review and informal interviews with preceptors/faculty members. Following content validation by internal and national content review panels, the instrument was pilot tested with a sample of 260 students from six colleges of pharmacy and revised based on the results of exploratory factor analysis. Subsequently, a revised instrument was administered to 837 students from 13 colleges of pharmacy and revised based on confirmatory factor analysis and replication of item analysis. The results indicated that the instrument had content validity, high internal consistency reliability, and convergent and discriminant validity. A three-factor structure was identified and interpreted as representing three subscales: knowledge base and pharmaceutical care, professionalism, and communication skills. Several demographic variables (*e.g.,* age, GPA, community service/volunteerism along with level of involvement) were found to be significant predictors of students' level of self-confidence ($P<0.05$). Further testing of the instrument would provide more comprehensive evidence for its construct validity when assessing students' level of self-confidence. Ultimately, the instrument may allow pharmacy educators to assess student confidence and when necessary, develop methods to balance student confidence with knowledge/skills prior to entering practice

INTRODUCTION

To function in clinical situations in any health care profession requires critical thinking and application of knowledge, a capability to reason, and an ability to contextualize a given situation(1). To be an effective practitioner, however, also requires a confidence in one's ability to use these cognitive skills when performing tasks. Confidence in the ability to perform tasks is an important quality for a pharmacy student to be successful while enrolled in Advanced Pharmacy Practice Experiences (APPE) (*i.e.*, clerkships/rotations) and to ultimately function as a practitioner(2-6).

Bandura has proposed the self-efficacy theory as a model to examine the role of an individual's belief in his competence and whether he would be capable of successfully performing a particular task(7). He defined perceived self-efficacy as peoples' judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. Historically, self-efficacy has been used interchangeably with self-confidence(7-8). Confidence in one's ability to perform a certain task parallels perceptions of self-efficacy in performing the task. Self-efficacy is not concerned with the skills a person possesses, but a person's judgment of what he can do with those skills. This implies that learning involves more than learning to obtain skills in the environment(7). One also learns about oneself and one's ability to perform certain actions in certain situations. In the pharmacy curriculum, the interaction between actual ability/skill and perceived ability/skill has important implications for a student as a learner during the APPE as well as a future competent practitioner. Bandura noted that effective, competent functioning requires knowledge/skills and self-efficacy beliefs to use them well(7-8). If an individual has the necessary skills and knowledge and positive outcome expectations, and personally values the outcome, the self-efficacy expectations ultimately determine an individual's decision to engage in a behavior, task choices, and quantity and quality of effort to be expended. It also determines an individual's willingness to persevere when confronting obstacles, and possess the resilience needed to face adverse situations(7-8).

From this perspective, many self-efficacy/confidence instruments have been developed and used in the study of health-related behaviors, in education, and in health professions (*e.g.*, especially medicine and nursing) for their specific purposes, populations, and hypotheses testing. Research studies have demonstrated that measurements of self-confidence have had a positive influence on and have been a strong predictor of health behavior change, academic performance, self-regulation, and clinical competence(6,9-15). These have also

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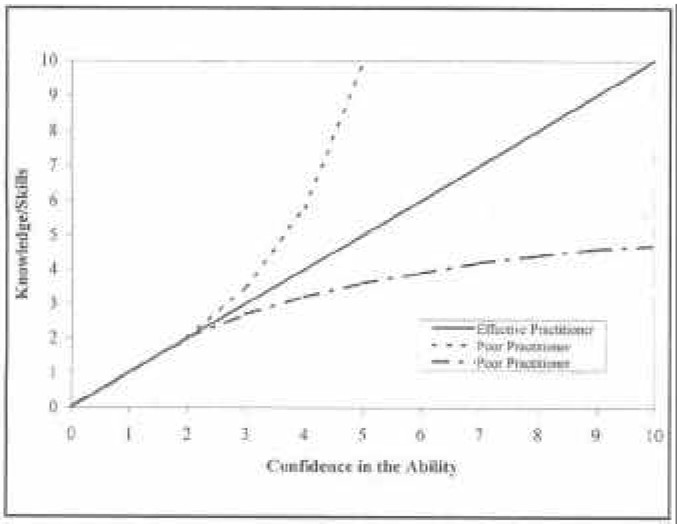

Fig. 1. The relationship between knowledge/skills base and confidence in the ability to use knowledg/skills.

supported the role of educational/teaching methods [*e.g.*, personal performance accomplishments, mentoring, direct patient-care experience, objective structured clinical examinations (OSCEs)] and their impact on the development of a student's self-confidence. Measurement of student self-confidence may be a more efficient estimate of long-range outcomes than actually collecting longitudinal data of the outcomes. This is because one would know the level of student confidence in performing targeted tasks so that effective instructional strategies/methods can be established and implemented earlier to balance students' self-confidence with their abilities during the curriculum or prior to entering practice.

As schools/colleges of pharmacy continue to expand APPE to prepare students as entry-level generalist practitioners in increasing numbers during the coming years, Popovich has argued that if the mission of the profession of pharmacy is to provide pharmaceutical care, pharmacy graduates must possess a broad knowledge/skill base and the confidence to utilize their abilities to optimally benefit the health outcomes of their patients(4-5). He argued that if pharmacists have a knowledge base but little or no self-confidence, predictably, they will be poor practitioners because they will not transmit and/or use their knowledge/skills for the good of the patient. Figure 1 illustrates this argument by the authors. Alternatively, practitioners with little knowledge, but much confidence, may pose a definite threat to those they attempt to serve. The result would be a stagnation of professional performance that never achieves the profession's ultimate goal of delivering pharmaceutical care. Maximizing the profession's contribution to society in its mission to deliver pharmaceutical care requires developing/balancing practitioners' self-confidence with knowledge/skills.

Guideline 11.6 of the Accreditation Standards for the Professional Program in Pharmacy leading to the Doctor of Pharmacy (PharmD) degree promulgated by the American Council on Pharmaceutical Education(16) also states that during the APPE students should "develop, in a graded fashion, the level of confidence and responsibility needed for independent and collaborative practice." In this context, for pharmacy educators to prepare competent practitioners, they must be able to properly assess students' self-confidence in addition to other areas of competence. Thus, an evaluative tool is needed in the pharmacy education environment that can accurately assess students' self-confidence. However, a thorough review of the pharmacy literature reveals no established instrument to measure pharmacy students' self-confidence in the APPE.

To address this deficiency, this study has conceptualized, developed, administered, and evaluated a self-confidence assessment instrument for schools/colleges of pharmacy and their students. This instrument was designed to assess the self-confidence of pharmacy students at predetermined times during their APPE. It was also intended to determine where an individual student's self-confidence may be lacking. Specific objectives of this study included: (*i*) develop a reliable and valid instrument to measure the self-confidence of PharmD students enrolled in the APPE (*i.e.*, clerkship rotations); and (*ii*) determine the effect of selected student demographic variables as independent predictors of the students' level of self-confidence (*i.e.*, high, medium, low).

METHODS AND RESULTS

This study was developed and implemented through four major steps over the course of a one and a half year period: (*i*) instrument development; (*ii*) expert review of the instrument; (*iii*) pilot testing of the instrument; and (*iv*) large scale testing of the instrument. Because the development of each step was dependent on the previous step, this section presents the methodological descriptions of each step and its subsequent results.

Step 1: Instrument Development

Purpose. To define self-confidence, to identify instrument sub-scales, to generate items for the instrument, and to design the instrument format.

Definition of Self-Confidence. The content domain of interest in this study was a student's self-confidence in general competencies when performing tasks during the APPE. A student's self-confidence was defined/explained by the self-efficacy theory(7). It was defined as the pharmacy student's belief in his capability to perform general tasks within the clerkship experience. Informal interviews with clerkship preceptors/faculty members were also conducted to identify needed general competencies when performing tasks during clerkships.

Identification of Subscales and Generation of Items. Tentative subscales and an item pool for each subscale of the content domain were based extensively on the pharmaceutical literature related to the concept of pharmaceutical care and professional competencies, nineteen pharmacy schools' developed evaluation forms to assess students' professional competencies during the clerkship experience, and informal interviews with preceptors/faculty members. The information was analyzed and instrument items that assessed the aspect/domain of tasks/activities were extracted, pooled, and generated. Items measuring similar activities/tasks were categorized together. Based on the literature review, the initial 57-item instrument was created and intended to represent four subscales believed to represent the domain of self-confidence needed when performing tasks in clerkships: (*i*) pharmaceutical care; (*ii*) communication skills; (*iii*) knowledge base; and (*iv*) professionalism.

Instrument Format and Design. The instrument was designed for use by students as a self-assessment tool. The format and design of the scale, including selection of response choices, were based on the standard methodology for measuring self-efficacy beliefs from the self-efficacy theory(7). For this study, a single-judgment format using a single unit interval range from 0 to 10 was employed for every instrument item. The instrument was administered to pharmacy students who would be requested to judge confidence in their ability at the present time to complete tasks on a rating scale (*i.e.,* a 10-point scale, 0 = not at all confident, 5 = moderately confident, to 10 = completely confident). A student's demographic form was also created during this step and reviewed by selected Purdue School of Pharmacy and Pharmacal Sciences APPE program faculty.

Step 2: Expert Review of the Instrument

Purpose. To obtain content validity of the instrument items that was relevant and representative of each subscale's domain by an internal and a national expert panel.

Internal Expert Panel. Sixteen Pharmacy Practice Department clinical faculty and affiliated Purdue University clerkship preceptors were asked to constitute an internal expert content panel to review the initial version of the instrument. The initial 57 items were prepared and formatted to facilitate review of the items. Ten of 16 clinical faculty and preceptors agreed to review the initial 57 pool items. Each item was reviewed for content, grammatical correctness, organization, readability, and clarity. The internal expert panel members were also asked to share/suggest any additional items/tasks that were related to the subscales and/or germane to the general competencies expected during the APPE that should be considered for inclusion in the instrument. This process increased the original 57-item instrument to 73 items. The 73 items were then prepared and formatted to facilitate review by a national expert panel.

National Expert Panel. A national expert panel was recruited through the guidance from deans of several schools/colleges of pharmacy. Fourteen deans (*i.e.,* seven public and seven private schools/colleges) were randomly selected from the 81 nationwide pharmacy colleges/schools (*i.e.,* 57 public and 24 private colleges/schools) based on US geographic areas (*i.e.,* pacific, mountain, central, eastern). They were contacted via email and asked to identify within their respective college/school an educator and/or practitioner to serve on a national content review panel. Six public and six private colleges/schools of pharmacy deans responded and recommended 14 experts from their colleges/schools to participate in the content review of the developed instrument. These fourteen experts, representing 12 colleges/schools of pharmacy nationwide, were then contacted and asked to participate in the content review process. Thirteen out of the 14 contacted agreed to review the content of the developed instrument. The majority of experts were male (eight out of 13) and had earned the PharmD degree (nine PharmD, two MS, two PhD). Eleven out of 13 expert panelists were currently precepting students.

A set of forms including the 73 items was forwarded to the 13 national content review panel members. The panel was asked to rate each proposed item's relevance in measuring a student's self-confidence in general competencies when performing tasks during clerkships using a content validity index (CVI)(17). The CVI was a four-point ordinal scale: 1 = not relevant, 2 = unable to assess relevance without item revision or item is in need of such revision that it would no longer be relevant, 3 = relevant, but needing minor alteration, and 4 = very relevant. A CVI was then calculated for each item. The CVI for each item is the proportion of experts who rated the item as content valid, *i.e.,* a rating of three or four. For the thirteen experts used in this study, the proportion whose endorsement was required to establish content validity beyond the 0.05 level of significance was 0.77(17). In other words, ten experts out of thirteen had to rate the item either a three or a four before it would be judged to have content validity.

The expert panelists were asked to suggest any additional components or tasks related to pharmacy students' general competencies in performing clerkship tasks that should be included in the instrument, but were unintentionally omitted. They were also asked to suggest modifications for the individual items (*e.g.,* reword, revise, grammatical corrections). Based on the national expert review panel, four items were deleted from the 73-item instrument because these neither met the CVI nor related/represented the four subscale domains of the instrument. This then left 69 items. There were some minor suggestions made by the reviewers to improve the clarity of the remaining 69 items (*i.e.,* wording changes, grammatical corrections). Sixty-nine items were accordingly revised and five new items were included in the instrument. This resulted in a 74-item instrument. The 74 items were then formatted (*i.e.,* Clerkship Student Self-Confidence Assessment Instrument) and used in the pilot test step of the study. Each item was randomly placed in the instrument so that there would be no effect of item order on the self-confidence ratings.

Step 3: Pilot Test of the Instrument

Purpose. To explore the subscale/factor structure of the 74-item developed instrument and to further reduce items for the developed instrument.

Subjects. Subjects consisted of a convenience sample of 260 fourth professional year PharmD students from six schools/colleges of pharmacy (*i.e.,* four public and two private colleges/schools) participating in experiential rotations during spring 2000 (*i.e.,* April 1 to May 10, 2000). To mirror the national statistics of all 81 colleges/schools of pharmacy in the U.S. (*i.e.,* 57 public and 24 private colleges/schools, a ratio of 2.3:1.0)(18), the ratio of four public and two private colleges/schools (*i.e.,* 2:1) was chosen for this step. The experiential coordinators and/or pharmacy deans at each of the six colleges/schools were contacted via email and asked to participate in the pilot step of this study. Specifically, they were asked if they would be willing to volunteer their enrolled clerkship students during the spring 2000 to complete the instrument. All six colleges/schools of pharmacy agreed to participate and indicated no anticipated problems with gathering data from the students on this study.

Social Desirability Scale. Because the developed instrument was a personality variable(19), there was concern about the possible biasing effect of social desirability. Thus, the short version of the Marlowe-Crowne Social Desirability Scale (MCSDS)(20) was included with the developed instrument so that it could be used as an external criterion for item selection. The internal consistency coefficient of the MCSDS using a Kuder-Richardson 20 formula was 0.76. The MCSDS reflected an individual's tendency to respond to scale items in a socially desirable direction. Each of the 74 items for the developed instrument was correlated with scores on the social desirability scale. It was decided that items that significantly correlated with it would be deleted from the instrument. Spector suggested that by using external criteria in item selection, an instrument was more likely to be free of the social desirability bias(21). That is, responses to the instrument would be unaffected by the social desirability of respondents.

Procedures. A faculty coordinator at each of the six colleges/schools of pharmacy received and administered the 74-item Clerkship Student Self-Confidence Assessment Instrument, a student demographic form, and the short form of the MCSDS to participating students. Students were informed that the returned responses to the instruments were treated anonymously and would have no bearing on their clerkship grade and graduation. The investigators worked with each faculty coordinator to determine the number of instruments needed and when and how the instruments would be collected (*i.e.,* either completed survey were returned directly to the investigators in a self-addressed stamped business reply mail or returned directly to the experiential coordinators who then mailed completed surveys back in bulk to the investigators).

Data collected from the students were obtained on a cross-sectional basis. The collection dates, however, were varied slightly because the time of each clerkship among various colleges/schools might be different. To minimize the history and maturation effects, the investigators would attempt to coordinate with each school/college's experiential coordinators an appropriate time to collect student data to ensure that students respond at relatively similar stages of their APPE clerkships. For this study, a selected time for data collection was at the end of three weeks of clerkship for all schools/colleges of pharmacy.

Statistical Analyses. Data were analyzed and managed using the Statistical Analysis System (SAS) software system V 8.1(22). Descriptive statistics of students' demographic variables were computed. The level of significance for any statistical tests was established at a = 0.05. Pearson correlation coefficients were calculated for scores on each of the 74 items for the developed instrument with the total scores on the MCSDS to eliminate items that might contribute to a possible biasing effect of social desirability before performing exploratory factor analysis (EFA).

EFA (*i.e.,* using PROC FACTOR in SAS) was used to explore the four tentative subscales within the group of items. In this study, the term "factor" was used interchangeably with "subscale". To determine factorability of the data (*i.e.,* the appropriateness of factor analysis), correlation matrices [*i.e.,* observed, partial (anti-image)], the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMOMSA) for all of items and each item, and squared multiple correlation were determined. A principal factor analysis was used as a method of factor extraction with an oblique (*i.e.,* Promax) rotation. The squared multiple correlations (SMC) were used as an initial communality estimate. An eigenvalue (Kaiser's criterion) cutoff of one, the Cattell's scree test, the proportion of the common variance accounted for a factor and the factor solution, and residual correlation matrix were used to determine the number of factors to be retained. An item was retained on a given factor/subscale if the factor loading was > 0.60 for that factor. The simple structure, interpretability criteria, and at least three to four items per factor were used to interpret a factor solution. Item analysis (*i.e.,* Cronbach's coefficient alpha, corrected item-subscale correlation) was also performed after the factor analysis procedure.

Objective One Results. Of 260 student instruments mailed, 137 student instruments (*i.e.,* 52.7 percent response rates) were returned and determined usable. Fifty-five male students (40.1 percent) and 82 female students (59.9 percent) responded. The mean and SD age of students (N=137) was 27.32±5.16. The median and mode of age were 25 and 24. The range of age was 23-53. The majority of students were white (N=100, 73 percent), 16.8 percent (N=23) were Asian-American, 5.1 percent (N=7) were Hispanic-American, 0.7 percent (N=1) were African-American, 0.7 percent (N=1) were Native-American, 0.7 percent (N=1) were International (Non-U.S.), and 2.9 percent (N=4) were other ethnicity/race. One hundred and eleven of the student respondents (81 percent) were enrolled in a traditional PharmD program, 23 (16.8 percent) were enrolled in a postbaccalaureate PharmD program, and 3 (2.2 percent) were enrolled in a nontraditional PharmD program. The mean and SD GPA (N=128) was 3.27±0.32. The median and mode were 3.25 and 3.00. The range of GPA was 2.10-4.00.

Pearson correlation coefficients demonstrated that 19 items correlated significantly (P<0.05) with the total scores on the social desirability scale. These were automatically eliminated before performing EFA because of a possible biasing effect of social desirability, resulting in 55 items. The internal consistency coefficient of the MCSDS using a Kuder-Richardson 20 formula on 137 students' raw data was 0.7012. EFA was performed to explore possible subscales within the remaining 55 items. Most of items in the observed correlation matrix (*i.e.,* correlation between items) were in excess or equal to 0.30 and correlated significantly at P<0.05. The partial (anti-image) correlation matrix was small (close to zero) and/or demonstrated negative values. The SMC was very high and ranged between 0.6930 and 0.9240. The KMOMSA for each item ranged between 0.8393 and 0.9605. The KMOMSA for all of items was 0.9207. This value indicated desired factorability and factor analysis(23,24). Factor extraction results demonstrated seven factors with eigenvalues greater than one, accounting for 84.6 percent of the total variance in the remaining 55 items. Because the eigenvalues of the last three factors (*i.e.*, factors 5, 6, 7) did not differ from each other by more than 0.20, they did not account for a substantive amount additional variance(19). An examination of the Cattell's scree test was inconclusive and suggested factor solutions ranging from three to six factors. Therefore, three to six factors were retained and considered for oblique rotations.

A three-factor solution appeared to be the best approximate simple structure and conceptual meaning of the factor underlying a set of items. The proportion of the common variance accounted for three factors still accounted for 72.3 percent of the total variance. Factors one, two, and three accounted for 56.6 percent, 10.8 percent, and 4.9 percent of the total variance, respectively. The coefficients of the residual correlation matrix demonstrated small and negative values, which supported the three-factor solution fit the data

When interpreting the rotated three-factor pattern matrix and removing ineffective items from the original 55 items, an item was retained on a given factor if the factor loading was > 0.60 for that factor. Using this criterion, the revised instrument consisted of 34 items. All factor loading values ranged from 0.6003 to 0.9581. Sixteen of these items were found to load onto factor one. This was interpreted as representing the knowledge base and pharmaceutical care subscale. Eleven items loaded onto factor two, which was interpreted as representing the professionalism subscale. Seven items loaded onto factor three. Although the third factor accounted for only 4.9 percent of the total variance, it was relatively well defined, with a clear-cut marker variable that had a factor loading of 0.85. This factor was interpreted as representing the communication skill subscale. Communality values that demonstrated how well items' variance were explained by the three-factor solution ranged from 0.4089 to 0.7686. These values were above 0.30 and indicated that the variance of each item was adequately explained by the three-factor solution(24).

The overall coefficient alpha of the 34-item instrument was 0.9612. Subscale one (16 items), two (11 items), and three (seven items) had coefficient alphas of 0.9570, 0.9234, and 0.9305, respectively. The coefficient alpha did not increase with the deletion of any item for each subscale. All items on the three subscales had the corrected item-subscale correlation coefficients > 0.30. To complete the instrument revision, the 34 items were randomly ordered and formatted again to ensure that there was no anchoring influence by any item order before large scale testing of the instrument.

Step 4: Large Scale Testing of the Instrument

Purpose. To replicate item analysis on the 34-item instrument, to determine the adequacy of fit of the three-subscale structure/model obtained from the pilot test using first-order confirmatory factor analysis, and to perform an analysis of study objective two.

Subjects. Subjects consisted of a sample of 837 fourth professional year PharmD students from 13 schools/colleges of pharmacy (*i.e.,* nine public and four private colleges/schools) participating in experiential clerkships during the fall 2000 (*i.e.,* October 1 to December 31, 2000). Schools/colleges were recruited to correspond to the national statistics of public to private colleges/schools of pharmacy ratio(18) (*i.e.,* 2.3:1.0). Deans and/or experiential program coordinators from 24 colleges/schools of pharmacy (*i.e.,* sixteen public and eight private schools/colleges) were randomly selected from the 81 nationwide colleges/schools (*i.e.,* 57 public and 24 private colleges/schools) based on geographic areas (*i.e.,* pacific, mountain, central, eastern). They were then contacted via email and asked to participate in the large scale testing step of this study. Specifically, they were asked if they would be willing to volunteer their enrolled clerkship students to complete the instrument. Thirteen out of the 24 contacted colleges/schools of pharmacy (54 percent) agreed to participate in this study (*i.e.,* nine public and four private colleges/schools) yielding a public to private colleges/schools of pharmacy ratio that corresponded to the national statistics(18).

Procedures. A faculty coordinator at each of the 13 colleges/schools of pharmacy received and administered the 34-item Clerkship Student Self-Confidence Assessment Instrument and a student demographic form for completion by participating students. Data collected from students were obtained on a cross-sectional basis and would follow the same procedure as the pilot test step.

Statistical Analyses. Item analysis was conducted on: (*i*) the 34-item instrument, and (*ii*) the items remaining after performing confirmatory factor analysis (CFA) on the 34-item instrument. Using PROC CALIS in SAS, first-order CFA was conducted to develop a measurement model that demonstrated an adequacy of fit of the three-subscale structure/model to the data(22). The Maximum Likelihood Method was used to estimate the CFA measurement model. The covariance matrix was used as input for the CFA. The variances of the factors were fixed at one. Multiple criteria were used to assess the goodness of fit of the factor model: the chi-square ($?^2$) test statistic, the chi-square ($?^2$)/df ratio, the non-normed fit index (NNFI), the comparative fit index (CFI), the standardized root mean squared residual (SRMR). When the goodness of fit was poor, the modification indices (*i.e.*, the Wald test and the Lagrange Multiplier test) were used to identify improvements in model fit.

In the CFA measurement model, convergent validity was assessed by reviewing: (*i*) the significance testing of the standardized factor loadings on a particular subscale; (*ii*) the reliabilities of each subscale (*i.e.,* composite reliability and Cronbach's coefficient alpha); (*iii*) variance extracted estimates (VEE) for each subscale (*i.e.,* the amount of variance that was captured by an underlying factor/subscale in relation to the amount of variance due to measurement error); and (*iv*) corrected item-subscale correlation for each subscale. Discriminant validity was operationally assessed by four procedures: (*i*) the estimated correlations between the subscales; (*ii*) the variance extracted test; (*iii*) the chi-square difference test; and (*iv*) the 95 percent confidence interval test of the estimated correlation between the subscales.

Using PROC LOGISTIC in SAS, polytomous logistic regression with cumulative logit model was performed to test study objective two on the items remaining after performing the CFA(25). The Maximum Likelihood (ML) Method was used to estimate the cumulative logit model. Students' self-confidence scores on each subscale/all subscales were calculated by adding the raw scores on each subscale/all items on all subscales and then dividing it by the total number of items for that subscale/all subscales. Then, students' self-confidence scores were arbitrarily assigned to one of three categories: high (rating from > 8 to < 10), medium (rating from > 5 to < 8), and low (rating from 0 to < 5). The reason for employing this classification was that the third professional-year students who have completed their didactic coursework and were ready to enroll in the APPE in colleges/schools of pharmacy should be expected to have a level of confidence above five. Ideally, students should demonstrate a level of confidence in performing tasks during clerkships in the medium to high categories. Odd ratios for each of the selected demographic variables were calculated along with their 95 percent confidence interval.

Objective One Results. Of 837 student instruments mailed, 324 student instruments (*i.e.,* 39 percent response rates) were returned and determined usable. Ninety-two male students (28.4 percent) and two hundred and thirty-two female students (71.6 percent) responded. The mean and SD age of students (N=323) was 25.61±3.51. The median and mode of age were 24 and 23. The range of age was 22-49. The majority of students were white (N=258, 79.6 percent), 12 percent (N=39) were Asian-American, 3.4 percent (N=11) were African-American, 1.8 percent (N=6) were Hispanic-American, 1.2 percent (N=4) were International (Non-U.S.), and 1.8 percent (N=6) were other ethnicity/race. Two hundred and seventy-three of the student respondents (84.3 percent) were enrolled in a traditional PharmD program, 41 (12.7 percent) were enrolled in a post-baccalaureate PharmD program, and 10 (3 percent) were enrolled in a nontraditional PharmD program. The mean and SD GPA (N=305) was 3.32±0.33. The median and mode of GPA were 3.33 and 3.00. The range of GPA was 2.25-4.00.

Based on the replication of item analysis on the 34-item instrument, the overall coefficient alpha of the instrument was 0.9442. Subscales one, two, and three had overall coefficient alphas of 0.9597, 0.7788, and 0.8841, respectively. The coefficient alpha did not increase with the deletion of any item for subscales one and three. However, the coefficient alpha of subscale two (*i.e.,* professionalism) increased with the deletion of item 33. All items on the three subscales had the corrected item-subscale correlation coefficients > 0.30, except item 33. Therefore, item 33 was eliminated and 33 items were retained. The 33-item instrument

Table 1. Fit indices analysis of the initial (34 items) and revised (22 items) measurement models (N=324)

Measurement model	df	?^{2}	?^{2}/df ratio	Contrast with initial model: ?^{2} difference	Contrast with initial model: df difference	CFI	NNFI	SRMR
Initial Model (34 items)	524	2113.1494*	4.0327			0.7866	0.7716	0.1656
Revised Model (22 items)	206	478.2853*	2.3217	1634.8641	318	0.9308	0.9224	0.0640

Note: df = degree of freedom; ?^{2} = chi-square test statistic; CFI = comparative fit index; NNFI = non-normed fit index; SRMR = standardized root mean squared residual.

* = *P*<0.0001.

Table II. The correlation, square of correlation, VEE, Chi-square difference test, and 95 percent confidence interval between factors/subscales of the revised 22-item model (N=324)

Between factor (F)	Correlation	Square of correlation	VEE Factor F1	VEE Factor F2	VEE Factor F3	?^{2} Difference test[3] (degree of freedom)	95 % Confidence interval
Fl andF2	0.4292	0.1842	0.6229	0.3139	0.5058	287.20* (1)	0.3216 -0.5368 0.4598
Fl andF3	0.5522	0.3049	0.6225	0.3139	0.5058	245.53* (1)	- 0.6446 0.5189-
F2 and F3	0.6169	0.3805				130.18* (1)	0.7149

Note: F1=knowledge base and pharmaceutical care subscale; F2=professionalism subscale; F3=communication skills subscale; VEE = variance extracted estimate.

[a]calculated by subtracting the chi-square value of the initial model from the chi-square value of the second model that allowed the two factors to be fixed at 1.00; chi-square value of the initial 22-item model allowed all factors to be correlated = 478.28 with df = 206; chi-square value of the model allowed F1 and F2 to be fixed at 1.00 = 765.49 with df = 207; chi-square value of the model allowed F1 and F3 to be fixed at 1.00 = 723.82 with df = 207; chi-square value of the model allowed F2 and F3 to be fixed at 1.00 = 608.47 with df = 207.

*Chi-square difference test was significant at *P*<0.001.

would be henceforth known as the long version of the instrument. Cronbach's coefficient alpha for the 33-item instrument, subscales one, two, and three were 0.9459, 0.9597, 0.7889, 0.8841, respectively. All items on each subscale demonstrated the corrected item-subscale correlation coefficients > 0.30. A listing of the 33 revised items (*i.e.*, long version of the instrument) after performing this item analysis is included in the Appendix.

The initial three-subscale measurement model identified in the EFA from the pilot test (34 items) was submitted and analyzed using CFA with the ML method. All fit indices suggested a very poor fit of the model (Table I). Based on a review of standardized factor loading of 34 items and a justification of the modification indices (*i.e.*, Wald test and the Lagrange Multiplier test), elimination of 12 items (*i.e.*, items 1, 2, 3, 5, 8, 11, 14, 17, 22, 29, 31, 33) and reestimation of the 22-item measurement model demonstrated that the three-subscale model [*i.e.*, (*i*) knowledge base and pharmaceutical care; (*ii*) professionalism; (*iii*) communication skills] provided a satisfactory fit to the data (Table I). Standardized factor loading of the 22 items with t-tests indicated that all factor-loading values ranged from 0.4143 to 0.9127 and were statistically significant at *P<0.*001. All composite reliabilities (i.e., measures of internal consistency comparable to coefficient alpha) for subscale one, two, and three were 0.9471, 0.7514, and 0.8021 respectively. These values of reliability, with coefficients in excess of 0.70, indicated that the specified items were sufficient in their representation of the three subscales.

The Cronbach's coefficient alphas for the 22-item instrument, subscales one (11 items), two (seven items), and three (four items) were 0.9200, 0.9458, 0.7452, and 0.7994, respectively. These values were also congruent with the composite reliabilities for each subscale. The coefficient alpha did not increase with the deletion of any item for each subscale. All items on each subscale had the corrected item-subscale correlation coefficients of 0.30 or greater. Variance extract estimates (VEE) for factors/subscales one, two, and three were 0.6229, 0.3139, and 0.5058, respectively. Factor/subscale two was short of the recommended 0.50 or 50 percent. This indicated that 31 percent of the variance was captured by factor two and 69 percent was due to measurement error. However, this test is quite conservative and estimates would frequently be below 0.50 even when reliabilities are acceptable. Fornell and Larcker(26) argued that on the basis of composite reliabilities alone, the researcher may conclude that the convergent validity of the factor is adequate, even though more than 50 percent of the variance is due to error. The above results of factor loadings, reliabilities, VEE, and the corrected item-subscale correlation coefficients provided evidence supporting the convergent validity of the revised 22-item instrument.

Table II illustrates the results of four discriminant validity procedures for the 22-item instrument. The correlation coefficients between each factor were not high and less than unity or 0.85. All VEEs for each of the three factors were greater than the square of the correlation between factors with the exception of factor two and factor three. The chi-square difference test of each of the two factors/subscales was significantly lower (*P*<0.001) for the 22-item instrument model, which allowed all factors/subscales to correlate, but less than unity. All of the 95 percent confidence intervals around the correlation estimates between each factors/subscales did not include one. This indicated that each subscale was separated but correlated. These results revealed reasonable levels of discriminant validity of the revised 22-item instrument. A listing of the 22 revised items (*i.e.*, short version of the instrument) after performing CFA and item analysis is included in the appendix.

Objective Two Results. Table III presents the results of the polytomous logistic regression with cumulative logit model results of significant demographic variables associated with students' level of confidence scores on the 22-item instrument for subscale one (knowledge base and pharmaceutical care, 11 items), subscale two (professionalism, 7 items), subscale three (communication skills, 4 items), and the combined three sub-scales as general competencies (22 items).

DISCUSSION

Step 1: Instrument Development. According to standards for educational and psychological testing for instrument/test development(27), evidence based on content (*i.e.*, content validity) must first be obtained from an analysis of the relationship between instrument content and the construct it is intended to measure. In this step, this evidence was carefully obtained by first defining the content domain of students' self-confidence in performing tasks during clerkships, which was based on the self-efficacy theory. Then, identification of needed general competencies when performing tasks during clerkships, subscales of the instrument, and generation of items were comprehensively based on the pharmaceutical literature, pharmacy colleges/schools' evaluation forms to assess students' professional competencies during the clerkship experience, and informal interviews with preceptors/faculty members. The instrument was designed for use by students as a self-assessment tool. Subsequently, a single-judgment format from self-efficacy methodology was chosen as the format and response choices of the developed instrument. The investigators felt that this step was thoroughly conducted and logically described. The initial instrument appeared to have some evidence of validity based on content.

Step 2: Expert Review of the Instrument. To strengthen the evidence of validity based on content, the developed instrument was first reviewed by an internal expert panel and then forwarded to a national expert panel. Based on the internal and national panels' suggestions, some items were either deleted or

Table III. The polytomous logistic regression analysis results of selected demographic variables associated with the level of self-confidence[a]

Variable	Category	Low N (%)	Medium N (%)	High N (%)	Odds ratio	Wald 95 % Confidence interval (CI)	Significance
Subscale 1: Knowledge Base and Pharmaceutical Care							
Age	22-25	8 (2.48)	124 (38.39)	82 (25.39)	3.29	1.26 – 8.59	0.0149 *
	26-30	4 (1.24)	46 (14.24)	37 (11.46)	3.79	1.37 – 10.44	0.0099 *
	31-55	2 (0.62)	17 (5.26)	3 (0.93)	Reference group		
Grade point	3.51 – 4.00	0 (0)	34 (11.15)	49 (16.07)	5.03	2.62 – 9.67	< 0.0001 *
Average	3.01 – 3.50	5 (1.64)	103 (33.77)	52 (17.05)	1.70	0.96 – 3.01	0.0668
(GPA)	2.00 – 3.00	8 (2.62)	41 (13.44)	13 (4.26)	Reference group		
Amount of	> 8 weeks	11 (3.42)	160 (49.69)	113 (35.09)	2.12	1.037 – 4.36	0.0394 *
full-time school-related PharmD rotations	< 8 weeks	3 (0.93)	26 (8.07)	9 (2.8)	Reference group		
Amount of prior part-	> 6 months	4 (1.24)	103 (31.89)	78 (24.15)	1.66	1.00-2.77	0.0500 *
time non-academic	< 6 months	4 (1.24)	29 (8.98)	15 (4.64)	0.92	0.45 – 1.90	0.8330
related pharmacy work experience	0 day/month	6 (1.86)	55 (17.03)	29 (8.98)	Reference group		
Type of prior part-time non-academic related	Community pharmacy - chain/ independent	7 (2.17)	88 (27.24)	68 (21.05)	1.56	0.92 – 2.62	0.0941
pharmacy work experience	Hospital – inpatient/out-patient	1 (0.31)	37 (11.46)	16 (4.95)	1.04	0.52 – 2.08	0.8945
Other[8]		0 (0)	7 (2.17)	9 (2.79)	2.95	1.01 – 8.62	0.0476 *
None		6 (1.86)	55 (17.03)	29 (8.98)	Reference group		
Type of primary	Distributive	8 (2.48)	125 (38.7)	80 (24.77)	1.34	0.81 – 2.22	0.2409
function on prior part-time non-academic	Clinical and Other [b]	0 (0)	7 (2.17)	13 (4.02)	4.21	1.52 – 11.59	0.0054 *
related pharmacy work experience performed	None	6 (1.86)	55 (17.03)	29 (8.98)	Reference group		
Pharmacy student organization level	Extensive (leadership position)	2 (0.62)	58 (17.9)	51 (15.74)	5.76	2.43 – 13.68	< 0.0001 *
of involvement	Moderate (member only)	8 (2.47)	102 (31.48)	67 (20.68)	3.96	1.73 – 9.09	0.0011 *
	None	4 (1.23)	28 (8.64)	4 (1.23)	Reference group		
University/College organization level	Extensive (leadership position)	4 (1.23)	46 (14.2)	43 (13.27)	2.31	1.31 – 4.07	0.0037 *
of involvement	Moderate (member only)	3 (0.93)	68 (20.99)	50 (15.43)	1.99	1.17 – 3.40	0.0108 *
	None	7 (2.16)	74 (22.84)	29 (8.95)	Reference group		
Community service/ volunteerism activities level of involvement	Regular and Regular/ leadership Position	0 (0)	36 (11.11)	28 (8.64)	2.42	1.23 – 4.77	0.0102*
	Occasional	10 (3.09)	96 (29.63)	75 (23.15)	1.96	1.13 – 3.41	0.0165 *
	None	4 (1.23)	56 (17.28)	19 (5.86)	Reference group		

Table III. The polytomous logistic regression analysis results of selected demographic variables associated with the level of self-confidence[a] (con't)

Variable	Category	Low N (%)	Medium N (%)	High N (%)	Odds ratio	Wald 95 % Confidence interval (CI)	Significance
Subscale 2: Professionalism							
Age	22-25	0 (0)	10 (3.1)	204 (63.16)	4.29	1.22 – 15.00	0.0224 *
	26-30	0 (0)	2 (0.62)	85 (26.32)	8.94	1.52 – 52.46	0.0152 *
	31-55	0 (0)	4 (1.24)	18 (5.57)	Reference group		
English as a first Language	Yes	0 (0)	11 (3.4)	279 (86.11	4.37	1.42 – 13.45	0.0101 *
	No	0 (0)	5 (1.54)	29 (8.95)	Reference group		
Pharmacy student organization level of involvement	Extensive (leadership position)	0 (0)	3 (0.93)	108 (33.33)	5.80	1.31 – 25.66	0.0203 *
	Moderate (member only)	0 (0)	8 (2.47)	169 (52.16)	3.40	1.04 – 11.10	0.0419 *
	None	0 (0)	5 (1.54)	31 (9.57)	Reference group		
Community service/ volunteerism activities level of involvement	Regular and Regular/ leadership position	0 (0)	2 (0.62)	62 (19.14)	3.49	0.71 – 17.06	0.1223
	occasional	0 (0)	6 (1.85)	175 (54.01)	3.28	1.10 – 9.81	0.0330 *
	None	0 (0)	8 (2.47)	71 (21.91)	Reference group		
Subscale 3: Communication Skill							
Age	22-25	0 (0)	86 (26.63)	128 (39.63)	13.88	4.93 – 39.07	< 0.0001 *
	26-30	0 (0)	26 (8.05)	61 (18.89)	21.58	7.16 – 65.03	< 0.0001 *
	31-55	9 (2.79)	6 (1.86)	7 (2.17)	Reference group		
Amount of prior non-pharmacy work experience	> 6 months	9 (2.79)	85 (26.32)	149 (46.13)	0.73	0.39 – 1.38	0.3401
	< 6 months	0 (0)	17 (5.26)	12 (3.72)	0.37	0.15 – 0.94	0.0371 *
	0 day/month	0 (0)	16 (4.95)	35 (10.84)	Reference group		
Pharmacy student organization level of involvement	Extensive (leadership position)	2 (0.62)	31 (9.57)	78 (24.07)	4.36	2.01 – 9.42	0.0002 *
	Moderate (member only)			105 (32.41)	2.71	1.32 – 5.56	0.0064 *
	None	3 (0.93)	20 (6.17)	13 (4.01)	Reference group		
University/College organization level of involvement	Extensive (leadership position)	1 (1.31)	30 (9.26)	62 (19.14)	2.12	1.20 – 3.73	0.0093 *
	Moderate (member only)	3 (0.93)	38 (11.73)	80 (24.69)	2.02	1.20 – 3.42	0.0083 *
	None	5 (1.54)	51 (15.74)	54 (16.67)	Reference group		
Community service/ volunteerism activities level of involvement	Regular and Regular/ leadership position	1 (0.31)	17 (5.25)	46 (14.2)	2.06	1.02 – 4.14	0.0424 *
	Occasional	7 (2.16)	67 (20.68)	107 (33.02)	1.14	0.67 –1.94	0.6134
	None	1 (0.31)	35 (10.8)	43 (13.27)	Reference group		
All Combined Three Subscales							
Age	22-25	0 (0)	90 (27.86)	124 (38.39)	3.14	1.24 – 7.79	0.0155 *
	26-30	0 (0)	36 (11.15)	51 (15.79)	3.23	1.20 – 8.67	0.0194 *
	31-55	0 (0)	15 (4.64)	7 (2.17)	Reference group		
Grade point average (GPA)	3.51 – 4.00	0 (0)	21 (6.89)	62 (20.33)	3.17	1.64 – 6.14	0.0006 *
	3.01 – 3.50	0 (0)	79 (25.9)	81 (26.56)	1.10	0.64 – 1.88	0.7164
	2.00 – 3.00	0 (0)	34 (11.15)	28 (9.18)	Reference group		
Type of prior part-time non-academic related pharmacy work experience	Community pharmacy – chain/ independent	0 (0)	70 (21.67)	93 (28.79)	1.19	0.71 – 1.99	0.5079
	Hospital – inpatient/out-Patient	0 (0)	27 (8.63)	27 (8.36)	0.89	0.45 – 1.75	0.7490
	Other[b]	0 (0)	2 (0.62)	14 (4.33)	6.27	1.34 – 29.18	0.0193 *
	None	0 (0)	42 (13)	48 (14.86)	Reference group		
Type of primary function on prior part-time non-academic related pharmacy work experience performed	Distributive	0 (0)	95 (29.41)	118 (36.53)	1.11	0.68 – 1.82	0.6707
	Clinical and Other[c]	0 (0)	4 (1.24)	16 (4.95)	3.58	1.11 – 11.55	0.0326 *
	None	0 (0)	42 (13)	48 (14.86)	Reference group		

Table III. The polytomous logistic regression analysis results of selected demographic variables associated with the level of self-confidence[3] (con't)

Variable	Category	Low N (%)	Medium N (%)	High N (%)	Odds ratio	Wald 95 % Confidence interval (CI)	Significance
Pharmacy student organization level of involvement	Extensive (leadership position)	0 (0)	34 (10.49)	77 (23.77)	5.88	2.55 – 13.55	< 0.0001 *
	Moderate (member only)	0 (0)	82 (25.31)	95 (29.32)	3.01	1.37 – 6.61	0.0060 *
	None	0 (0)	26 (8.02)	10 (3.09)	Reference group		
University/College organization level of involvement	Extensive (leadership position)	0(0)	32 (9.88)	61 (18.83)	2.65	1.49 – 4.69	0.0008 *
	Moderate (member only)	0(0)	46 (14.2)	75 (23.15)	2.26	1.33 – 3.84	0.0023 *
	None	0(0)	64 (19.75)	46 (14.2)	Reference group		
Community service/ volunteerism activities level of involvement	Regular and Regular/ leadership position	0(0)	20 (6.17)	44 (13.58)	3.59	1.78 – 7.21	0.0003 *
	Occasionl	0 (0)	73 (22.53)	108 (33.33)	2.41	1.40 – 4.15	0.0014 *
	None	0(0)	49 (15.12)	30 (9.26)	Reference group		

Note: * = Significance at $P<0.05$.
[a]Scores [i.*e.,* low (0 to < 5), medium (> 5 to < 8), high (> 8 to 10)]
[b]Breakdown: drug information (N=4), home health care (N=1), health maintenance organization (N=1), conducting research (N=2), student health center (N=1), missing (N=1), nursing home/long-term care (N=6).
[c]Breakdown: cashier (N=1), drug information (N=3), conducting research (N=2), missing (N=1).

revised. This resulted in item improvement of content and relevance to the developed instrument. In retrospect, it would have also been helpful to conduct a focus group of students to review the instrument for content, grammatical correctness, organization, readability, and clarity after the national expert panel review of the developed instrument. This process would have provided important information about whether students understood the instrument items. In addition, it would have facilitated the revision of the instrument prior to conducting the pilot test step.

Because the instrument was designed for use by students as a self-assessment tool, five biases or response sets might affect students' responses(28): (*i*) acquiescence (*i.e.*, the tendency to always agree with items/statements); (*ii*) extremity (*i.e.*, the tendency to respond to the highest or lowest response alternative); (*iii*) evasiveness (*i.e.*, the tendency to respond to the middle alternative); (*iv*) carelessness (*i.e.*, the tendency to respond randomly or thoughtlessly to items/statements); and (*v*) social desirability (*i.e.*, the tendency to respond in a conventional rather than truthful manner). Prior to conducting step three after the national expert panel review, all items were then randomly placed and formatted so that there would be no effect of item order, acquiescence, extremity, and evasiveness. Carelessness was controlled by providing instruction in the cover letter as well as on the top of the instrument to students that encouraged them to respond candidly and honestly when completing the instrument(28). Social desirability bias was also controlled by assuring students of anonymity and confidentiality and by including the Social Desirability Scale(20) to the developed instrument when conducting the pilot test step. The social desirability scale was used as an external criterion for item selection. The investigators felt that the second step was successfully conducted and provided adequate, empirical evidence of validity based on content for the developed instrument. Construct underrepresentation (*i.e.*, the degree to which an instrument failed to capture important aspects of the construct that the instrument was intended to measure) and construct irrelevance were also addressed and considered by internal and national expert review panels. Finally, five response biases of the self-report instrument were taken into consideration and addressed.

Step 3: Pilot Test of the Instrument. Evidence based on internal (subscale) structure (*i.e.*, construct validity) and internal consistency reliability(27) of the developed instrument were obtained in this step by conducting an EFA and performing an item analysis, respectively. EFA requires a large sample to achieve a good factor solution. One hundred and thirty-seven (*i.e.*, 52.7 percent response rates) of 260 students (*i.e.*, four public and two private colleges/schools of pharmacy) completed and returned the instrument. Based on the empirical tests established by Guadagnoli and Velicer(29) and MacCallum, Widaman, Zhang, and Hong(30), this sample size was adequate to warrant performing an EFA in this study because: (*i*) factor loadings were in the 0.60 range; (*ii*) each factor/subscale contained at least four items loadings at 0.60; (*iii*) communalities of items were high (*i.e.*, ranging from 0.40 to 0.77); and (*iv*) factorability procedures revealed that the data had sufficient correlations to perform an EFA.

Students' demographic variables in this step (*i.e.*, gender, type of PharmD student, ethnicity/race) were not similar to the national pharmacy student population from 81 colleges/schools of pharmacy(18). National statistics for doctor of pharmacy degrees awarded as the first professional degree and as a post-baccalaureate degree showed approximately 32.4 percent male, 67.6 percent female; 72.2 percent enrolled in the PharmD degree, 27.8 percent enrolled in the post-baccalaureate PharmD degree; 66.2 percent white, 6.4 percent black, 2.1 percent Hispanic, 20.4 percent Asian or other Pacific Islander, 0.2 percent Native, 2.5 percent foreign, and 1.0 percent other/unknown. No national statistics were available for nontraditional PharmD students and other student demographic variables. These indicated that students who participated in the pilot test step were not representative of all doctor of pharmacy students from 81 pharmacy schools and could limit the generalizability of the results.

To achieve a representation of the 81 pharmacy schools, the investigators attempted to select a public to private colleges/schools, ratio (*i.e.,* 2:1), to correspond with the national statistics of all 81 colleges/schools of pharmacy (*i.e.,* 57 public and 24 private colleges/schools, a ratio of 2.3:1.0) (18). In addition, because students were not sampled randomly and the subjects and items assumed to represent the target population of interest (*i.e.,* fourth professional PharmD students enrolled in colleges/schools of pharmacy), principal factor analysis (*i.e.,* descriptive-exploratory factor extraction) was an appropriate method of factor extraction to perform as suggested by Tinsley and Tinsley(31). Therefore, students' representation was not a major concern for the first objective and replication of the developed instrument after performing the EFA with another independent sample in large scale testing of the instrument would increase the generalizability of the instrument. Further, an oblique rotation was an appropriate method of factor rotation, because it provided better approximations of simple structure and provided a better representation of psychological reality(24,31). In addition, the results from this step supported that there was enough variance to warrant using an oblique rotation in this study.

Results of the EFA indicated that there were three subscales (*i.e.,* knowledge base and pharmaceutical care, professionalism, communication skills) and the accounted proportion of the common variance for the three subscales (34 items) was 72.3 percent of the total item variance. This value indicated that the three-subscale solutions explained most of the total variance quite well(22). The coefficient alpha of the 34-item instrument, subscales one, two, and three were in the range of 0.90. The values of the coefficient alpha were well above the desired criterion of 0.70(32). This indicated strong support and very good internal consistency reliabilities of the instrument and each of its three subscales. The unidimensionality of each subscale was also confirmed from a high internal consistency and corrected item-subscale correlations. Prior to conducting step four, all 34 items were then randomly placed and formatted to minimize the biasing response effect of item order and the self-reporting instrument; the same as previously mentioned in step two discussions.

Step 4: Large Scale Testing of the Instrument. In similar fashion to the pilot test step, evidence based on the internal (subscale) structure and internal consistency reliability of the developed instrument were obtained for this step by replication of item analysis on the 34-item instrument, conducting confirmatory factor analysis (CFA) to test the adequacy of fit of the three subscale structure on the 34-item instrument, and performing an item analysis on the items remaining after performing CFA, respectively.

Students' demographic variables in this step (*i.e.,* gender, type of PharmD student, ethnicity/race) were also not similar to the national statistics(18) and the pilot test step. These results indicated that students participating in the large scale test step were not representative of all doctor of pharmacy students from the 81 pharmacy schools and could limit the generalizability of the results. However, to enhance the representativeness of the sample, 24 colleges/schools (*i.e.,* 16 public, eight private) were initially randomly selected and contacted. This approximated the 81 colleges/schools of pharmacy (*i.e.,* 57 public and 24 private colleges/schools, a ratio of 2.3:1.0). From this, three hundred and twenty-four students representing 13 colleges/schools of pharmacy (*i.e.,* nine public and four private) participated, completed, and returned the instrument. This ratio of public and private colleges/schools of pharmacy was consistent with the national statistics(18).

In general, the EFA techniques that were used to develop the instruments may result in factors that are sample specific and inclined toward high reliability(33). The use of a new, independent sample to replicate the item analysis of the instrument would enhance its generalizability and confirm that the results obtained were not a one-time chance occurrence(32-33). Thus, replication of item analysis on the 34-item instrument was conducted and revealed that the instrument could be reduced further to 33 items (*i.e.,* long version of the instrument) and represented the three-subscale structure. Cronbach's coefficient alphas for the 33-item instrument and subscales one, two, and three were very good and provided strong support for the internal consistency reliability of the instrument and each of three subscales(32). Unidimensionality of each subscale was also confirmed from the high internal consistency and corrected item-subscale correlations. In addition, the three-subscale structure of the instrument was highly replicable even though there were differences in students' demographic variables among national demographics, the pilot test and large scale test steps.

CFA necessitated a large sample. Thus, it was important to target a sample size that would be minimally adequate for the analysis. For this study, three hundred and twenty-four of 837 students (39 percent response rate) completed and returned the instruments. This provided a sufficient number of samples to conduct a CFA(22,33-34). The CFA with model modification indices indicated that the 34-item instrument could be revised to 22 items (*i.e.,* short version of the instrument) and the three-subscale/factor provided a satisfactory fit to the data. It also supported evidence of convergent and discriminant validity. Cronbach's coefficient alpha for the 22-item instrument and subscales one, two, and three were very good and acceptable for instrument development(32). The 22-item instrument (*i.e.,* short version of the instrument) demonstrated a high internal consistency reliability and each of three subscales demonstrated a good unidimensionality of subscale.

The three-subscale model fit adjustments in CFA were conducted post hoc. These were based on model improvements suggested by model modification indices and because of these, one needs to be cautious when interpreting the CFA results in this study(35). Using CFA in this (*i.e.,* exploratory) manner could possibly capitalize on chance and sample-specific variance. Cole pointed out that CFA estimates were only as good as the underlying data(35). If the model were misspecified even if it produced a good fit to the data, the parameter estimates (*e.g.,* factor loadings) might be quite inaccurate. There might also be many alternative models that fit the data equally well. Thus, any CFA results with post hoc model modifications are quite tentative and required replication or cross-validation with an independent or new sample(34,35).

It is important to note here that convergent validity and discriminant validity are usually associated with the use of the multitrait-multimethod (MTMM) approach to validation in which multiple constructs are each assessed using more than one assessment method(36). It has been argued that the MTMM approach provides a more rigorous test of convergent and discriminant validity than the CFA procedures, because the variance estimates can be partitioned into trait, method, and random error factors. However, the MTMM approach was not possible in this study because a single method (*i.e.,* self-report confidence assessment) was used and there is no established instrument that measures students' self-confidence in pharmaceutical education.

The investigators were convinced that evidence based on the internal (subscale) structure was successfully obtained and confirmed by replication of item analysis and CFA. Internal consistency of the 33-item and 22-item instruments was also strongly supported by Cronbach's coefficient and corrected item-subscale correlation. The instrument and its three-subscale structure were highly replicable and stable with a new independent sample.

For study objective two, several demographic variables were found as significant predictors of students' level of confidence (*i.e.,* low, medium, high) for each subscale and all combined three subscales as general competencies. These results were exploratory in nature and in the future need to be replicated to enhance the generalizability, because the investigators performed an analysis on the same data that were used to perform CFA for instrument revision. In addition, the students were nonrandom and not representative to national demographics(24). Selection and non-responses biases could threaten the external validity of the results. Thus, these results should be viewed cautiously. Some selected, significant predictors are discussed below.

Students who were in the 22-25 and 26-30 age groups were more likely to demonstrate higher self-confidence for knowledge base and pharmaceutical care subscale, professionalism subscale, communication skills subscale, and all combined three subscales than those who were in the 31-55 age group. These results were surprising. Students who are younger probably are more apt to make a greater effort to act and learn to perform tasks related to the three subscales more than those who were older. Older, adult learners are sometimes reticent to perform tasks and are less apt to make changes in their orientation.

Students who had higher GPA were more likely to have higher self-confidence than those who had lower GPA for knowledge base and pharmaceutical care subscale and all combined three subscales. These results were not surprising. Based on sources of self-efficacy beliefs within the self-efficacy theory(7), Bandura emphasized that one's performance accomplishments or mastery experiences were the most influential source of raising self-confidence/efficacy. Thus, one might expect that students who performed well in colleges/schools and earned higher grades were likely to develop a strong sense of confidence and engage in behaviors and task choices in which they felt competent and confident during their APPE.

Students who had more than eight weeks experience in full-time school-related PharmD rotations were more likely to be in the highly self-confidence group than those who had less than or equal to eight weeks for knowledge base and pharmaceutical care subscale. This result was expected and suggested that the APPE was helpful in developing a student's sense of confidence in performing tasks related to the knowledge base and pharmaceutical care. It could also have been explained by the influential sources of self-efficacy beliefs from self-efficacy theory(7). Students who completed more clerkship rotations were exposed to many sources of self-confidence beliefs (*e.g.,* performance accomplishment, vicarious observation of preceptors and/or other health professionals, verbal/social persuasion from preceptors or peers) that could strengthen or increase their confidence when compared to those with less rotations. Students who had English as their first language were more likely to demonstrate higher self-confidence in professionalism subscale than those who had none. As expected, students' self-confidence level of behavioral professionalism was influenced by the students' first language. Students with English as their second language may feel intimidated, be reticent, and lack confidence to demonstrate professional behavior during clerkship rotations due to English skills and cultural differences.

Students who were extensively and/or moderately involved in pharmacy student or university organizations or community service/volunteerism activities were more likely to demonstrate higher self-confidence for knowledge base and pharmaceutical care subscale, professionalism subscale, communication skills subscale, and all combined three subscales than those with no level of involvement. These results were not surprising. One might expect that students who were more active in pharmacy student or university organizations or community service/volunteerism activities would have more opportunity to develop and employ knowledge/skills and attitudes (*e.g.,* knowledge base, pharmaceutical care, professionalism, communication skills, problem-solving skills, leadership characteristics) when dealing with members of organizations or allied health professionals or patients than those who had no experience. Therefore, they would have a high level of self-confidence in each subscale and/or all combined three subscales during their APPE. Another explanation is that students who had occasional and regular community service/volunteerism activities may have developed a habit of caring which was an essential component of providing pharmaceutical care to the patient. They might make a greater effort and spend more time to learn and develop more skills/tasks in patient care during their early didactic courses and APPE in colleges/schools.

LIMITATIONS

Instrument development is an ongoing, evolutionary process. Although this study has shown promising results, it does have several limitations that should be addressed. One such limitation involved the content domains of the instrument. The content domains did not include all possible areas of students' self-confidence in professional competencies during the APPE such as critical thinking skills, self-directed/assessing learning, clinical reasoning skills, leadership skills. Thus, the instrument has limited generalizability for its use to only the three content areas/subscales.

A second limitation involved the representativeness of the doctor of pharmacy students and colleges/schools of pharmacy in the U.S. Students who participated in this study for the pilot test and the large scale test steps were volunteers, a nonrandom sample and not entirely representative of national demographics(18). Further, the response rates for the pilot test step (52.7 percent) and the large scale test (39 percent) were moderate. Non-responders were not contacted and assessed for nonresponse bias. Although this may limit the generalizability of the use of the instruments (*i.e.,* 22-item and 33-item instrument) to the whole population of doctor of pharmacy students, the investigators believed that it was not a major concern in this study. This was because the instruments demonstrated good external validity with high three-subscale replication in different, independent samples, different colleges/schools of pharmacy, and different clerkship rotations for the pilot test and the large scale test steps. However, future cross-validation of the instruments with new, representative, independent samples could help to determine whether this limitation would threaten the use of the instruments or enhance their generalizability. Beyond this limitation, the generalizability of the results to all doctor of pharmacy students, particularly, with respect to study objective two may be further limited. This is because the data may be influenced by selection and non-response biases that could threaten the external validity of the results.

A third limitation was specific to the exploratory factor analysis (EFA). The decision about the number of subscales/factors to be retained, the rotational methods, and the factor interpretation were somewhat subjective rather than based on specific, theoretical criteria. Other investigators might have manipulated and interpreted data analyses differently. However, the three-subscale structure of the instrument after EFA was highly replicable and similar with a new independent sample on the large scale test step, even though there were differences in students' demographic variables among national demographics, the pilot test, and large scale test steps. A fourth limitation pertained to the CFA. As previously mentioned in the forth step discussions, CFA results with post hoc model modifications in this study were quite tentative and required replication or cross-validation with an independent or new sample in the future.

IMPLICATIONS AND RECOMMENDATIONS

This study demonstrated initial reliability and validity of instruments that could be used to assess students' self-confidence in performing professional tasks/competencies during experiential clerkship rotations. These instruments could be applied and used as a formative and/or a summative assessment of students' confidence within subscale domains during APPE. They could also be utilized during the first three professional years of the pharmacy curriculum (*e.g.*, integrated laboratories, recitation courses). This would allow pharmacy educators/programs to identify students' confidence deficits within the subscale domains, develop educational interventions/strategies to address identified students' deficits throughout the curriculum, and have programmatic assessment data within the subscale domains of the instrument that a college/school of pharmacy could use to evaluate curriculum effectiveness toward the development of students' confidence with knowledge/skills prior to entering the APPE and ultimately practice.

Several significant demographic variables were found to predict students' level of confidence within each subscale domain and all combined subscales would be useful for a college/school of pharmacy. A college/school of pharmacy can focus on those demographic variables to design and/or adopt specific instructional methods [*e.g.*, Bandura's sources of self-confidence/efficacy(7), the three confidence (C) subcategories and their motivational strategies from the ARCS model(37), cultivating intellectual confidence(5)] to assist students develop or balance their level of confidence. Bandura(7) proposed that one's perception of self-confidence is dynamic and developed in response to cognitive processing of information from four sources. These sources are: (*i*) performance accomplishment (*i.e.*, successfully performing a behavior); (*ii*) vicarious observation (*i.e.*, observing another person's performance of a behavior); (*iii*) verbal/social persuasion (*i.e.*, encouragement received from another that points out one's capabilities); and (*iv*) physiological/psychological states (*i.e.*, emotional arousal such as anxiety, stress, fatigue), that influence how an individual judges his capability. Of these mentioned, performance accomplishment is the most influential source of confidence/efficacy information because it is based on actual mastery experiences. Confidence in the ARCS model refers to the student's perceived likelihood of achieving success through personal efforts and control(37). The three confidence subcategories are: (*i*) learning requirements (*i.e.*, developing a positive expectation for success); (*ii*) success opportunities (*i.e.*, supporting or enhancing student's belief in his/her competence); (*iii*) personal responsibility (*i.e.*, establishing student's effort and ability as his/her basis for success). Many motivational strategies that help to develop the student's confidence for each subcategories can be found in reference 37. Implications of some selected, example predictors are addressed below.

Results showed that students who had lower GPA were more likely to demonstrate lower self-confidence than those who had higher GPA for the knowledge base and pharmaceutical care subscale and all combined three subscales. A college/school of pharmacy should direct more attention to students who have lower GPAs while they are enrolled in the APPE by employing strategies to develop self-confidence and/or use the ARCS model through a preceptor's supervision to balance their level of confidence. In this case, a preceptor could illustrate to those students the process of integration of his/her knowledge, skills, and attitudes to solve patient problems by using the actual patient case while the students enroll in his/her APPE (*i.e.*, vicarious observation). He/she should assign the actual patient cases using a sequencing strategy from simple to difficult problems as the rotation moves forward. This would help the students' learning experience with increasing their degree of mastery of knowledge/skills and enhancing their belief in themselves and their competence (*i.e.*, performance accomplishment, success opportunities).

Results also revealed that students who had English as their second language were more likely to demonstrate lower self-confidence in the professionalism subscale than those who had English as their first language. As the enrollment of international students in the schools/colleges of pharmacy has steadily increased in recent years, this result may suggest that a school/college of pharmacy focus on developing and implementing educational interventions (*e.g.*, courses in listening, writing, and speaking English during early didactic course-work) that enhance English skills in these students to improve their behavioral professionalism before entering APPE and ultimately practice.

Another finding also demonstrated that students who had been involved in occasional and/or regular community service/volunteerism activities were more likely to have higher self-confidence for the knowledge base and pharmaceutical care subscale, professionalism subscale, communication skills subscale, and all three subscales combined than those with no level of involvement. This result provides support for the importance of having service-learning courses or activities in the curriculum. Service-learning experiences do not only contribute to a student's development in several of general outcomes/competencies (*e.g.*, communication competence, aesthetic sensitivity, professional ethics, contextual competence, and social interaction and leadership/citizenship), but also the level of self-confidence in the ability to perform professional tasks.

In addition to its application, the instrument could be a foundation for the advancement of research in the critical areas of pharmacy student self-confidence. Future research could be directed toward instrument development, refinement, and validation, and hypothesis testing of the instrument. First, with regard to instrument development, refinement, and validation, these instruments should be tested further for their reliability and item analysis by cross-validation and should be performed with an independent, representative sample of doctor of pharmacy students to enhance their generalizability.

A second direction for future research is to investigate each instrument in terms of the measurement method used from the self-assessment reporting by the students and its use with faculties/preceptors as observation-based ratings. Self-reporting may reflect only vested interest by the students (*e.g.,* over- or underestimate of their self-confidence) and would not reflect the preceptor assessment of the students. Preceptor evaluations would help identify those students who overvalue or undervalue their confidence. This would serve to help identify a "blind" spot that the student possesses with respect to their self-confidence. If both self-assessment and preceptor-ratings methods are used in evaluating students' confidence in performing tasks during clerkships (*i.e.,* at the beginning, midpoint, and end of the rotation), this would provide more comprehensive objective data when assessing students' confidence. A third direction for future research would be to further establish other construct validities such as differentiation between groups (i.e., known-groups validation), correlations between a measure of the construct and a designated construct/criteria/instrument (*e.g.,* self-regulated learning, GPA), and differentiation of each subscale item using the item response theory.

With regard to hypothesis testing of the instrument, a fourth direction for future research could be to use the instrument to assess the effect of educational methods [*e.g.,* performance feedback, peer influences, vicarious observation, verbal/social persuasions, objective structured clinical examination (OSCE), role model] on the development of students' self-confidence in preparation for and during clerkship rotations and/or other didactic performance areas/courses (*e.g.,* integrated laboratories, recitation courses) throughout the curriculum. A fifth direction for future research is the investigation of the relationship between student self-confidence and clinical performance during clerkship rotations. Instruments could be used to examine the level of confidence score and/or the self-confidence subscales that best predict a student's clinical competence and performance. Further, it could be used to investigate the relationships between selected student demographics (*e.g.,* age, gender, ethnicity, GPA, amount and extent of rotation/work experience, extracurricular activities) and self-confidence over rotation time intervals. Structural equation modeling or path analysis with growth curve modeling could achieve this.

A sixth direction for future research could be to use the instalment to identify student underconfidence or overconfidence. Future research should include the investigation of what student factors help to create an inaccurate self-perception of confidence, what are the likely outcomes/effects of such inaccuracies, and what interventions could be developed and used within or throughout the curriculum to improve and calibrate students' self-confidence to make it correlate with one's knowledge/skills or actual professional performance abilities. Finally, preliminary demographic variables (*e.g.,* community service/volunteerism activities level of involvement, GPA, age) that significantly predict students' level of confidence (*i.e.,* high, medium, low) within each subscale domain and all combined subscales should be further investigated to build a multivariate logit model in predicting students' level of confidence.

CONCLUSIONS

This study created and evaluated two students' self-confidence instruments *[i.e.,* long version (33 items), short version (22 items)]. The results indicated that these instruments had built-in content validity, demonstrated a high internal consistency reliability, a factor/subscale structure, convergent validity, and discriminant validity. Several demographic variables were identified as significant predictors of students' level of self-confidence. Further refinement and testing of the instrument would provide more comprehensive evidence for its construct validity when assessing students' level of self-confidence. This would ultimately allow schools/colleges to use and strengthen their curricula to help develop or balance student confidence with knowledge/skills prior to the time he/she enters practice.

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APPENDIX. INSTRUCTIONS AND A LISTING OF THE 33 REVISED ITEMS AFTER REPLICATION ITEM ANALYSIS AND THE 22 REVISED ITEMS AFTER CFA

(* indicates the items on the 22-item instrument; F1=knowledge base and pharmaceutical care subscale; F2=professionalism subscale; F3=communication skills subscale)

Instructions: This instrument is NOT a test. There are NO right or wrong answers. Rather, it is an instrument designed to measure how confident you are as a pharmacy student in performing certain tasks/activities related to your clerkship activities. Please respond to the statements as honestly as you can. Your responses will be treated anonymously. Do not respond with how you wish you could perform each task/activity. Rather, respond in a way that accurately reflects your confidence level at the present time. For each of the following statements, please CIRCLE the appropriate number on the scales from 0 = Not At All Confident, 5 = Moderately Confident to 10 = Completely Confident.

I am confident in my ability to:

1. use knowledge from basic pharmaceutical sciences courses/instruction to identify the important adverse effects and monitoring parameters for a specific patient's drug therapy. (F1)
2.* collect objective and subjective data relevant to the patient's diagnosis(es) and medication use from the patient, family members, and/or other caregivers (*e.g.*, spouse, adult children). (F1)
3. follow through with assigned responsibilities. (F2)
4.* identify the patient's potential drug-related problems. (F1)
5. whenever needed, redesign the pharmaceutical care plan based on the patient's current status to assure effective, safe, and economical patient care. (F1)
6.* be tactful when dealing with patients, preceptors, colleagues, and other personnel. (F2)
7.* use media (*e.g.*, slides, transparencies, audiovisual equipment) effectively when presenting in-services, patient case presentations, journal article reviews, and lectures to other health professionals (*e.g.*, physicians, nurses, dietitians). (F3)
8. learn from constructive criticism and divergent opinions received from my preceptor and/or peers. (F2)
9.* be fair when dealing with patients, preceptors, colleagues, and other personnel. (F2)
10.* use necessary drug information knowledge and skills when responding to specific drug-related request/questions from my preceptor or other health professionals (*e.g.*, physicians, nurses, dietitians). (F1)
11. use media (*e.g.*, slides, transparencies, audiovisual equipment) effectively when presenting in-services, patient case presentations, journal article reviews, and lectures to peers (*i.e.*, fellow pharmacy professionals and/or students). (F3)
12.* put the patient's best interests and needs first, ahead of personal interests and needs. (F2)
13.* whenever needed, use media (*e.g.*, visual aids, pictures) effectively when providing counseling and education to the patient about the proper use of medications and therapeutic self-management. (F3)
14. employ knowledge and skills of the physical assessment/examination to obtain subjective data (*e.g.*, history taking/interview skills, review of systems) from the patient. (F1)
15.* use knowledge from basic pharmaceutical sciences courses/instruction to explain pharmacotherapeutic effectiveness of specific drugs. (F1)
16.* use effective verbal communication skills (*e.g.*, easily heard, proper rate of speech, proper pronunciation) when presenting in-services, patient case presentations, journal article reviews, and lectures to other health professionals (*e.g.*, physician, nurses, dietitians). (F3)
17. initiate discussion with the physician and/or other health professionals (*e.g.*, nurses, dietitians) whenever a patient is or might be experiencing a drug-related problem. (F1)
18. wear appropriate attire at the clerkship site. (F2)
19.* accept constructive criticism and divergent opinions received from my preceptor and/or peers. (F2)
20.* use knowledge of basic pharmaceutical sciences to determine the risk/benefit of various therapeutic modalities. (F1)
21. communicate effective oral messages clearly, concisely, and accurately to other heath professionals (*e.g.*, physicians, nurses, dietitians) when responding to a drug-related request/question. (F3)
22.* act in accord with the profession's and practice site's code of ethics. (F2)
23.* employ knowledge and skills of the physical assessment/examination to obtain objective data (*e.g.*, vital signs) from the patient. (F1)

24.* define pharmacotherapeutic goals for each drug-related problem. (Fl)

25.* document information related to the provision of pharmaceutical care in the patient's medical record, written pharmacy notes, and/or computerized notes in a form that could be read and inter preted by other health care professionals (*e.g.,* physicians, nurses, dietitians). (Fl)

26.* use the laboratory and diagnostic test results to evaluate the patient's drug therapy. (Fl)

27. use objective and subjective patient data obtained from the physical assessment/examination to evaluate the patient's drug therapy. (Fl)

28.* design a monitoring plan to determine the safety of the pharmacotherapeutic regimen. (Fl)

29.* maintain grooming habits that are acceptable to the clinical practice setting. (F2)

30.* design a pharmacotherapeutic regimen/plan that meets the pharmacotherapeutic goals for each drug-related problem. (Fl)

31.* use effective nonverbal communication skills (e.g., gestures, mannerisms, listening skills, eye contact) when presenting in-services, patient case presentations, journal article reviews, and lectures to other health professionals (*e.g.,* physician, nurses, dietitians). (F3)

32. use effective verbal communication skills (*e.g.,* easily heard, proper rate of speech, proper pronunciation) when presenting in-services, patient case presentations, journal article reviews, and lectures to peers (*i.e.,* fellow pharmacy professionals and/or students). (F3)

33.* maintain confidentiality of patient-and/or site-specific documents/information. (F2)