

Training Program Reformation May Improve Self-efficacy of Pharmacy Student

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Background: The Bachelor of Science (B.S.) program at the National Taiwan University School of Pharmacy (NTUSP) has been transformed into a six-year entry-level Doctor of Pharmacy (Pharm.D.) program with a transitional period of 2009 to 2017. We aimed to develop an instrument to measure students' perceived self-efficacy as an indicator to evaluate their learning outcomes and to compare the differences of professional competency among the fourth (PharmD-4), fifth, and sixth year (PharmD-6) of pharmacy school. **Methods:** Our scale was developed based on a literature review, input from focus groups, expert reviews, and beta-testing. Self-efficacy was evaluated using a cross-sectional survey for PharmD-4 through PharmD-6 and fourth-year B.S. students (BS-4) in May of 2017. **Results:** The original 119-item self-efficacy scale consisted of five domains including interpersonal and communication skills, professionalism, pharmaceutical care, systems-based practice, and practice-based learning and improvements. The content validity index, using beta-testing, revealed satisfying results for the 116 items selected. After item analysis and stratified exploratory factor analysis based on 81 respondents (94% response rate) were performed, 53 items were retained in the short form with Cronbach's alpha scoring 0.969. The criterion-related validity indicated that students with better academic performance had higher scores in overall self-efficacy and in the professionalism and pharmaceutical care domains ($p < 0.05$). The scale revealed that PharmD-6 tended to express the highest self-efficacy levels in all domains except for the interpersonal and communication skills domain. They also showed significantly superior self-efficacy in the pharmaceutical care domain compared to BS-4 ($p < 0.05$). **Conclusion:** The validated scale measuring pharmacy students' self-efficacy in professional competency suggested that PharmD-6 demonstrated the highest self-efficacy in comparison to students in the B.S. program.

Key words: competency, self-efficacy, scale, pharmacy education, Pharm.D.
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INTRODUCTION

The scope of pharmacy services has changed gradually from product-oriented to patient-centered care worldwide. The role of pharmacists has also expanded beyond the traditional duties of dispensing and distributing medicines to encompass the task of managing medication therapy.^[1-3] The implementation of the Doctor of Pharmacy (Pharm.D.) program, which has fostered the development of clinical pharmacists in the United States since the 1950s, was followed by the evolution of pharmacy education in Thailand, the Netherlands, Japan, and Korea after the year 2000.^[4]

Approximately 1,000 pharmacy students graduated with Bachelor of Science (B.S.) degrees from seven pharmacy schools (a total of nine schools after 2014) annually in Taiwan, including 50 students from the National Taiwan University School of Pharmacy (NTUSP). After graduates pass the licensure examination, which is held twice a year, two thirds of them go on to practice as entry-level registered pharmacists in hospitals and community pharmacies.^[5-6] Less than 5% of graduates have pursued clinical training in two-year master's programs with advanced-pharmacy-practice-experience-(APPE)-equivalent clinical rotations since 1993.^[5]

The NTUSP implemented the first six-year Pharm.D. program in Taiwan since 2009. Meanwhile, the four-year B.S. program continued the admission process until 2014. The competence-based Pharm.D. program paralleled with the B.S. program until 2017.^[2,4,5,7] The aim of this reformed Pharm.D. program is to train competent healthcare professionals to be able to provide state-of-the-art pharmacy services, engage in public health, and be involved in research activities. Courses in the first

through third years include basic sciences, as well as biomedical and pharmaceutical sciences. The curriculum, which emphasizes imparting clinical knowledge and skills during the final three years of the program, consists of more in-depth teachings of therapeutics and clinical pharmacokinetics, the inclusion of social pharmacy and pharmacy administration, and APPE.^[5,7] The outcomes of the program have been evaluated by monitoring students' academic performances and employment statuses.

During the transitional period at the NTUSP, undergraduate students were able to choose between entering the Pharm.D. program or continuing the B.S. program at the end of their second year. Early exposure, in the form of shadowing experiences, was offered to guide students in making their decisions. Students who chose the Pharm.D. program had to enroll in clinical pharmacy courses and an additional 23 credit hours of integrated therapeutic courses for the next three years of the degree. They were also required to dedicate 180 hours and then 640 hours to pharmacy practice experiences (PPEs) in community pharmacies and hospital pharmacies during their fourth and fifth years, respectively. Full-time APPEs for 36 weeks took place during their final year. Students are required to complete APPEs in intensive care units, general wards, and specialized pharmacy services. Elective APPEs include work in community pharmacy/long-term care, pharmacy administration, industrial pharmacies, pharmaceutical companies, research or academic work, and international rotations.^[5,7]

A Pharm.D. candidate is expected to possess a high level of competence to perform pharmacy practices with great confidence upon graduation.^[8] Self-efficacy, or "an individual's belief in their ability to perform well in a variety of situations", is crucial for student motivation and successful

participation in active learning.^[9] Students with high self-efficacy in professional competencies not only motivate themselves to achieve, but their subjective assessments also contribute powerful evidence to assess the effectiveness of the teachings imparted on them.^[10-12] Pharmacists comfortable with providing care to patients directly and who were willing to overcome challenges were found to have satisfactory self-efficacy levels and educational backgrounds.^[13,14]

Outcome measurements and course improvements have been performed using self-efficacy scales for students in the following aspects: pharmacy services, didactic courses, the pharmacy skills laboratory, and clinical rotations.^[10,12,15-30] Artino et al. developed a validated survey questionnaire that adopts the six core competencies proposed by the Accreditation Council for Graduate Medical Education (ACGME). They found that medical students' self-efficacy improved in the patient care and evidence medicine aspects with more years in school, but the interpersonal skills aspect did not increase over time.^[15] Pharm.D. graduates in Thailand generally felt they were more competent in clinical practice but less competent in regulatory affairs than those who graduated with B.S. degrees either focusing on pharmaceutical sciences or on pharmaceutical care.^[17]

In this study, we aimed to 1) develop a self-efficacy scale and identify domains and relevant items to measure pharmacy students' self-efficacy as an indicator of educational outcomes; 2) exam the reliability and validity of the scale; and 3) compare self-efficacy between Pharm.D. and B.S. graduates in the NTUSP and explore the differences among the fourth, fifth, and sixth years of school in the Pharm.D. program using a cross-sectional survey.

METHODS

Instrument Development

Self-efficacy indicates that someone can do clinical tasks, demonstrate professional attitude or perform specific techniques in this study. A four-step approach, written in Mandarin, was applied to develop the 119-item self-efficacy scale for pharmacy students. First, a literature review was conducted to identify potential items for use from previous research and from statements made by professional societies. Then, we designed a draft of survey items in the corresponding essential domains associated with different aspects of self-efficacy. The draft underwent minor modification after it was reviewed by focus groups and experts and tested using a cognitive interview. Finally, the anonymous survey consisting of the scale, demographic information, and self-reported academic performances was distributed to pharmacy students in the B.S. and Pharm.D. programs. The students evaluated their confidence toward these competencies and rated themselves with Likert scale (1-5 points). The results were collected and analyzed by the first author, a graduate student from the Graduate Institute of Clinical Pharmacy.

Instrument Development – Literature Review

Pharmacists' core competencies have been defined by international and domestic pharmacy societies over the course of the past decades. The most frequently cited statements come from the International Pharmaceutical Federation (FIP),^[31] American College of Clinical Pharmacy (ACCP),^[32] American Society of Health-System Pharmacists (ASHP),^[33] Accreditation Council for Pharmacy Education (ACPE),^[34] American Association of

Colleges of Pharmacy (AACP),^[35] Center for the Advancement of Pharmacy Education (CAPE),^[36] Pharmaceutical Society of Australia,^[37] and ACGME.^[38] The Taiwan Society of Health-System Pharmacists (TSHP) also proposed seven core competencies to guide pharmacy practice and education.^[39] We integrated the abovementioned competencies and omitted duplicate items, as well as those too advanced, beyond the scope of local pharmacy practice, geographically specific, and specific knowledge-based. The following five domains were constructed: interpersonal and communication skills, professionalism, pharmaceutical care, systems-based practice, and practice-based learning and improvement. The details of each domain were given to focus groups and experts for review and modification.

Instrument Development – Focus Group Interviews and Expert Reviews

Focus groups consisted of pharmacy graduates from either the B.S. or Pharm.D. programs, faculty members of the NTUSP, and preceptors of pharmacy practice experiences. During two semi-constructive interview sessions, participants were prompted to provide personal opinions and comments on the five domains of core competencies. Conversations and suggestions from the meetings were documented and incorporated into developing the scales.

Six experts in pharmacy education and questionnaire development were consulted to evaluate the content validity index. The five domains consisted of interpersonal and communication skills, professionalism, pharmaceutical care, systems-based practice, and practice-based learning and improvement. All items employed a 5-point, Likert-type response scale with “5” referring to “most confident” and “1” referring to “least confident”.

Instrument Development – Beta-Testing with Cognitive Interviews

Five pharmacists or graduate students were invited to complete the scale, which was followed by a cognitive interview carried out by an investigator. Some items in the scale were modified slightly to improve understanding for the interviewees. For example, the translation of “drug dispensing and distribution” in Mandarin was revised based on interviewees' responses.

Participants and Procedures

The written survey was conducted in May 2017 after the project was approved by the Research and Ethics Committee of NTU Hospital (ID number: 201704037RIND). A total of 86 students consisting of Pharm.D. graduates (graduating class of 2017, PharmD-6, N = 20), students from the class of 2018 (PharmD-5, N = 17), students from the class of 2019 (PharmD-4, N = 23), and B.S. graduates (class of 2017, N = 26) were invited to complete the self-efficacy scale. A description of this study was introduced to the participants by the first author who also provided the survey and the return address for voluntary responses.

Data Analysis

The item analysis, stratified exploratory factor analysis, criterion-related validity, and Cronbach's alpha were performed to validate the scale. The differences in self-efficacy across programs and years were also compared using the Student's t-test, Mann-Whitney U test, and Kruskal-Wallis one-way analysis of variance ranks. Microsoft Excel 2010 (Microsoft Corp. Redmond, WA, USA) and SPSS 20.0 (IBM, New York, USA) were applied.

RESULTS

The original self-efficacy survey, which consisted of 119 items, was established based on the literature review and input from focus groups and experts. After the beta-test, three items were omitted based on the findings of differentiation and congeniality exams (Table 1). Five items regarding students' basic information, as well as 116 self-efficacy survey items, remained in the scale. These 116 items were divided into the following five domains: interpersonal and communication skills (28 items), professionalism (24 items), pharmaceutical care (23 items), systems-based practice (29 items), and practice-based learning and improvement (12 items). The Cronbach's alpha was 0.984. The content validity index showed satisfying results with all I-CVIs higher than 0.83 and the S-CVI/Ave, 0.98.

A total of 81 students (94% response rate) responded to the survey. Following item analysis and stratified exploratory factor analysis, 53 self-efficacy items had been retained in the short-form scale. The highest rate of item retention occurred in the pharmaceutical care domain (65.2%), followed by the domains of practice-based learning and improvement (58.3%), professionalism (41.6%), systems-based practice (37.9%), and interpersonal and communication skills (35.7%). The following analysis including Cronbach's alpha, criterion-related validity and comparisons of self-efficacy among students from different program and different grade were all based on the 53-item scale. The Cronbach's alpha was 0.969 for the whole scale. Results for individual domains were all above 0.9 (see details in Table 2).

The demographics of B.S. graduates and of the three classes of Pharm.D. students who participated in the cross-sectional survey are listed

in Table 3. The survey revealed the trend of more female students in the B.S. program and more male students in the Pharm.D. program during the transitional period.

For criterion-related validity, the correlation between self-efficacy and self-reported academic performance in the last two years is illustrated in Table 4. Because the score distribution for the domain of interpersonal and communication skills was normally distributed, the Student's t-test was applied. The Mann-Whitney U test was used to examine the other four domains and the overall scale. Students who reported having superior performance in academia demonstrated significantly higher self-efficacy in the domains of professionalism, pharmaceutical care, and in the overall scale ($p < 0.05$).

We then further analyzed the self-efficacy of four groups of students (Figure 1-1 to 1-6). PharmD-6 students presented the highest self-efficacy levels in all five domains, with a higher total score than the rest of the students. Specifically, the PharmaD-6 students demonstrated significantly higher self-efficacy than PharmD-4 in the domains of professionalism, pharmaceutical care, systems-based practice, practice based-learning and improvement, and in their total scores ($p < 0.05$). PharmD-6 students also showed significantly higher self-efficacy than fourth-year B.S. graduates in the domain of pharmaceutical care ($p < 0.05$). These results indicate that a relationship exists between the student's current year in pharmacy school and their level of self-efficacy in 4 domains. However, no significant differences were identified across student groups in the domain of interpersonal and communication skills.

The self-efficacy in individual domain varied significantly. For example, lower self-efficacy was demonstrated by PharmD-6 candidates

Table 1. Development of 116 items scale after beta-test

| Item | Differentiation | Congeniality | | | Action |
|--------|---------------------|------------------------------|--------------|--------------------------------|----------|
| | Critical Ratio (CR) | Item-Total Correlation (ITC) | Adjusted ITC | Reliability after item removed | |
| Comm1 | 5.809** | 0.641** | 0.633 | 0.984 | Reserved |
| Comm2 | 5.336** | 0.602** | 0.593 | 0.984 | Reserved |
| Comm3 | 4.515** | 0.608** | 0.600 | 0.984 | Reserved |
| Comm4 | 5.761** | 0.578** | 0.567 | 0.984 | Reserved |
| Comm5 | 4.536** | 0.617** | 0.607 | 0.984 | Reserved |
| Comm6 | 3.522** | 0.521** | 0.513 | 0.984 | Reserved |
| Comm7 | 5.928** | 0.571** | 0.561 | 0.984 | Reserved |
| Comm8 | 3.584** | 0.480** | 0.467 | 0.984 | Reserved |
| Comm9 | 3.754** | 0.513** | 0.502 | 0.984 | Reserved |
| Comm10 | 6.241** | 0.615** | 0.607 | 0.984 | Reserved |
| Comm11 | 4.854** | 0.592** | 0.585 | 0.984 | Reserved |
| Comm12 | 4.778** | 0.540** | 0.532 | 0.984 | Reserved |
| Comm13 | 4.284** | 0.424** | 0.413 | 0.984 | Reserved |
| Comm14 | 3.906** | 0.430** | 0.418 | 0.984 | Reserved |
| Comm15 | 5.873** | 0.551** | 0.539 | 0.984 | Reserved |
| Comm16 | 5.32** | 0.542** | 0.532 | 0.984 | Reserved |
| Comm17 | 5.186** | 0.561** | 0.553 | 0.984 | Reserved |
| Comm18 | 3.147** | 0.431** | 0.420 | 0.984 | Reserved |
| Comm19 | 4.439** | 0.632** | 0.624 | 0.984 | Reserved |
| Comm20 | 5.231** | 0.481** | 0.471 | 0.984 | Reserved |
| Comm21 | 5.512** | 0.566** | 0.555 | 0.984 | Reserved |
| Comm22 | 5.139** | 0.743** | 0.738 | 0.984 | Reserved |
| Comm23 | 4.591** | 0.587** | 0.578 | 0.984 | Reserved |
| Comm24 | 4.416** | 0.526** | 0.515 | 0.984 | Reserved |
| Comm25 | 5.669** | 0.601** | 0.592 | 0.984 | Reserved |
| Comm26 | 5.146** | 0.673** | 0.666 | 0.984 | Reserved |
| Comm27 | 8.122** | 0.771** | 0.765 | 0.984 | Reserved |
| Comm28 | 4.989** | 0.527** | 0.517 | 0.984 | Reserved |
| Pro29 | 3.987** | 0.582** | 0.573 | 0.984 | Reserved |
| Pro30 | 3.434** | 0.591** | 0.583 | 0.984 | Reserved |
| Pro31 | 3.721** | 0.558** | 0.547 | 0.984 | Reserved |
| Pro32 | 4.515** | 0.555** | 0.545 | 0.984 | Reserved |
| Pro33 | 6.062** | 0.719** | 0.712 | 0.984 | Reserved |
| Pro34 | 5.822** | 0.641** | 0.632 | 0.984 | Reserved |

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| Item | Differentiation | Congeniality | | | Action |
|--------|---------------------|------------------------------|--------------|--------------------------------|----------|
| | Critical Ratio (CR) | Item-Total Correlation (ITC) | Adjusted ITC | Reliability after item removed | |
| Pro35 | 6.321** | 0.741** | 0.735 | 0.984 | Reserved |
| Pro36 | 4.299** | 0.511** | 0.500 | 0.984 | Reserved |
| Pro37 | 4.23** | 0.441** | 0.433 | 0.984 | Reserved |
| Pro38 | 5.359** | 0.518** | 0.508 | 0.984 | Reserved |
| Pro39 | 5.439** | 0.592** | 0.585 | 0.984 | Reserved |
| Pro40 | 4.515** | 0.614** | 0.606 | 0.984 | Reserved |
| Pro41 | 3.134** | 0.458** | 0.449 | 0.984 | Reserved |
| Pro42 | 4.139** | 0.583** | 0.573 | 0.984 | Reserved |
| Pro43 | 4.721** | 0.639** | 0.631 | 0.984 | Reserved |
| Pro44 | 4.32** | 0.534** | 0.524 | 0.984 | Reserved |
| Pro45 | 4.361** | 0.498** | 0.486 | 0.984 | Reserved |
| Pro46 | 3.182** | 0.483** | 0.471 | 0.984 | Reserved |
| Pro47 | 5.127** | 0.629** | 0.620 | 0.984 | Reserved |
| Pro48 | 5.432** | 0.614** | 0.604 | 0.984 | Reserved |
| Pro49 | 5.042** | 0.705** | 0.699 | 0.984 | Reserved |
| Pro50 | 5.359** | 0.678** | 0.671 | 0.984 | Reserved |
| Pro51 | 1.517 N.S. | 0.323** | 0.310 | 0.984 | Deleted |
| Pro52 | 2.192* | 0.441** | 0.432 | 0.984 | Reserved |
| Pro53 | 5.822** | 0.706** | 0.700 | 0.984 | Reserved |
| Phar54 | 6.526** | 0.754** | 0.748 | 0.984 | Reserved |
| Phar55 | 7.137** | 0.675** | 0.666 | 0.984 | Reserved |
| Phar56 | 6.027** | 0.632** | 0.622 | 0.984 | Reserved |
| Phar57 | 5.815** | 0.693** | 0.685 | 0.984 | Reserved |
| Phar58 | 5.108** | 0.658** | 0.650 | 0.984 | Reserved |
| Phar59 | 6.468** | 0.658** | 0.649 | 0.984 | Reserved |
| Phar60 | 5.282** | 0.637** | 0.628 | 0.984 | Reserved |
| Phar61 | 4.116** | 0.618** | 0.610 | 0.984 | Reserved |
| Phar62 | 6.372** | 0.724** | 0.718 | 0.984 | Reserved |
| Phar63 | 5.795** | 0.701** | 0.693 | 0.984 | Reserved |
| Phar64 | 6.404** | 0.682** | 0.673 | 0.984 | Reserved |
| Phar65 | 4.732** | 0.605** | 0.595 | 0.984 | Reserved |
| Phar66 | 3.979** | 0.569** | 0.559 | 0.984 | Reserved |
| Phar67 | 2.957** | 0.512** | 0.502 | 0.984 | Reserved |
| Phar68 | 3.526** | 0.555** | 0.545 | 0.984 | Reserved |

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| Item | Differentiation | Congeniality | | | Action |
|--------|---------------------|------------------------------|--------------|--------------------------------|----------|
| | Critical Ratio (CR) | Item-Total Correlation (ITC) | Adjusted ITC | Reliability after item removed | |
| Phar69 | 6.418** | 0.677** | 0.669 | 0.984 | Reserved |
| Phar70 | 8.729** | 0.721** | 0.713 | 0.984 | Reserved |
| Phar71 | 5.631** | 0.648** | 0.640 | 0.984 | Reserved |
| Phar72 | 5.713** | 0.697** | 0.689 | 0.984 | Reserved |
| Phar73 | 4.528** | 0.662** | 0.655 | 0.984 | Reserved |
| Phar74 | 4.548** | 0.541** | 0.531 | 0.984 | Reserved |
| Phar75 | 4.424** | 0.570** | 0.561 | 0.984 | Reserved |
| Phar76 | 3.825** | 0.531** | 0.521 | 0.984 | Reserved |
| Sys77 | 4.114** | 0.516** | 0.507 | 0.984 | Reserved |
| Sys78 | 3.14** | 0.426** | 0.413 | 0.984 | Reserved |
| Sys79 | 3.407** | 0.483** | 0.472 | 0.984 | Reserved |
| Sys80 | 4.01** | 0.459** | 0.447 | 0.984 | Reserved |
| Sys81 | 4.39** | 0.562** | 0.552 | 0.984 | Reserved |
| Sys82 | 3.976** | 0.599** | 0.588 | 0.984 | Reserved |
| Sys83 | 4.306** | 0.568** | 0.555 | 0.984 | Reserved |
| Sys84 | 5.078** | 0.511** | 0.499 | 0.984 | Reserved |
| Sys85 | 3.335** | 0.451** | 0.437 | 0.984 | Reserved |
| Sys86 | 2.877** | 0.484** | 0.471 | 0.984 | Reserved |
| Sys87 | 4.577** | 0.561** | 0.550 | 0.984 | Reserved |
| Sys88 | 4.772** | 0.621** | 0.610 | 0.984 | Reserved |
| Sys89 | 4.867** | 0.508** | 0.494 | 0.984 | Reserved |
| Sys90 | 3.745** | 0.369** | 0.354 | 0.984 | Deleted |
| Sys91 | 5.088** | 0.605** | 0.594 | 0.984 | Reserved |
| Sys92 | 6.561** | 0.687** | 0.678 | 0.984 | Reserved |
| Sys93 | 7.492** | 0.699** | 0.690 | 0.984 | Reserved |
| Sys94 | 6.431** | 0.682** | 0.674 | 0.984 | Reserved |
| Sys95 | 4.964** | 0.649** | 0.641 | 0.984 | Reserved |
| Sys96 | 8.017** | 0.724** | 0.716 | 0.984 | Reserved |
| Sys97 | 7.575** | 0.652** | 0.643 | 0.984 | Reserved |
| Sys98 | 4.218** | 0.618** | 0.608 | 0.984 | Reserved |
| Sys99 | 4.673** | 0.562** | 0.551 | 0.984 | Reserved |
| Sys100 | 3.407** | 0.604** | 0.595 | 0.984 | Reserved |
| Sys101 | 4.87** | 0.643** | 0.635 | 0.984 | Reserved |
| Sys102 | 5.839** | 0.731** | 0.726 | 0.984 | Reserved |

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| Item | Differentiation | Congeniality | | | Action |
|----------|---------------------|------------------------------|--------------|--------------------------------|----------|
| | Critical Ratio (CR) | Item-Total Correlation (ITC) | Adjusted ITC | Reliability after item removed | |
| Sys103 | 3.167** | 0.507** | 0.497 | 0.984 | Reserved |
| Sys104 | 5.913** | 0.685** | 0.677 | 0.984 | Reserved |
| Sys105 | 5.949** | 0.669** | 0.661 | 0.984 | Reserved |
| Sys106 | 6.261** | 0.686** | 0.679 | 0.984 | Reserved |
| Learn107 | 4.463** | 0.603** | 0.594 | 0.984 | Reserved |
| Learn108 | 4.8** | 0.533** | 0.525 | 0.984 | Reserved |
| Learn109 | 4.694** | 0.340** | 0.330 | 0.984 | Deleted |
| Learn110 | 4.189** | 0.598** | 0.589 | 0.984 | Reserved |
| Learn111 | 4.6** | 0.629** | 0.621 | 0.984 | Reserved |
| Learn112 | 4.938** | 0.635** | 0.627 | 0.984 | Reserved |
| Learn113 | 5.775** | 0.533** | 0.525 | 0.984 | Reserved |
| Learn114 | 4.157** | 0.583** | 0.575 | 0.984 | Reserved |
| Learn115 | 3.356** | 0.548** | 0.538 | 0.984 | Reserved |
| Learn116 | 3.687** | 0.595** | 0.587 | 0.984 | Reserved |
| Learn117 | 4.872** | 0.660** | 0.652 | 0.984 | Reserved |
| Learn118 | 7.312** | 0.728** | 0.721 | 0.984 | Reserved |
| Learn119 | 4.869** | 0.634** | 0.624 | 0.984 | Reserved |

** Significant at level 0.01

* Significant at level 0.05

Note: Comm: interpersonal and communication skills; Pro: professionalism; Phar: pharmaceutical care; Sys: systems-based practice; Learn: practice-based learning and improvement.

Table 2. Reliability of the short form

| Domain | Item | Cronbach's α |
|--|------|---------------------|
| 1. Interpersonal and Communication Skills | 10 | 0.905 |
| 2. Professionalism | 10 | 0.912 |
| 3. Pharmaceutical Care | 15 | 0.958 |
| 4. Systems-Based Practice | 11 | 0.917 |
| 5. Practice-Based Learning and Improvement | 7 | 0.915 |
| Overall | 53 | 0.969 |

Table 3. Demographics of survey respondents

| Character | Category | B.S. graduates n (%) | PharmD-4 n (%) | PharmD-5 n (%) | PharmD-6 n (%) | p-value |
|---|-----------------|-------------------------------|-----------------------|-------------------------------|--|---------|
| Number | - | 26 | 22 | 16 | 17 | - |
| Gender | Male | 8 (30.8) | 14 (63.6) | 8 (50) | 11 (64.7) | 0.074 |
| | Female | 18 (69.2) | 8 (36.4) | 8 (50) | 6 (35.3) | |
| Admission | Application | 7 (26.9) | 10 (45.4) | 1 (6.3) | 3 (17.7) | 0.111 |
| | Examination | 10 (38.5) | 8 (36.4) | 11 (68.8) | 10 (58.8) | |
| | Transfer/Others | 9 (34.6) | 4 (18.2) | 4 (25.0) | 4 (23.5) | |
| Academic performance in the last 2 years* | Higher Scores | 10 (38.5) | 11 (50.0) | 9 (56.3) | 5 (29.4) | 0.379 |
| | Lower Scores | 16 (61.5) | 11 (50.0) | 7 (43.7) | 12 (70.6) | |
| Academic performance in the last 2 years (scores) | < 80 | 8 (30.7) | 7 (31.8) | 0 | 0 | 0.005 |
| | ≥ 80 | 18 (69.3) | 15 (68.2) | 16 (100) | 17 (100) | |
| Pharmacy practice experiences | Mean | 82.94 ^a | 82.95 ^b | 85.66 | 90.80 ^{a,b} | - |
| | IPPE/APPE | IPPE (hospital and community) | IPPE (only community) | IPPE (hospital and community) | IPPE (hospital and community) and APPE | |
| Graduation in 2017 | Yes | 23 (88.5) | - | - | 17 (100) | - |

* "Higher scores" refer to students with academic grades higher than the median score in the specific group, whereas "lower scores" refer to students with scores less than or equal to the median in the specific group. Respondents were requested to report GPAs in the previous school year and last Fall semester. These GPAs were then transformed to numerical scores (per university policy) which lead to the mean score.

Table 4. Correlation between self-efficacy and self-reported academic performance in the last 2 years

| | | Student's t-test | | | | | |
|---|---------------|---------------------|------|-------|--------|--------------|--------------|
| Domain | Group | N | Mean | S.D. | t | Significance | |
| Interpersonal and Communication Skills | Higher Scores | 35 | 3.84 | 0.58 | 0.793 | 0.430 | |
| | Lower Scores | 46 | 3.73 | 0.64 | | | |
| | | Mann-Whitney U-test | | | | | |
| Domain | Group | N | Mean | U | W | Z | Significance |
| Professionalism | Higher Scores | 35 | 3.98 | 511 | 1592 | -2.81 | 0.005** |
| | Lower Scores | 46 | 3.62 | | | | |
| Pharmaceutical Care | Higher Scores | 35 | 3.87 | 505 | 1586 | -2.865 | 0.004** |
| | Lower Scores | 46 | 3.42 | | | | |
| Systems-Based Practice | Higher Scores | 35 | 3.63 | 616.5 | 1697.5 | -1.799 | 0.072 |
| | Lower Scores | 46 | 3.35 | | | | |
| Practice-Based Learning and Improvement | Higher Scores | 35 | 4.25 | 688 | 1769 | -1.123 | 0.261 |
| | Lower Scores | 46 | 4.06 | | | | |
| Overall | Higher Scores | 35 | 3.89 | 544.5 | 1625.5 | -2.484 | 0.013* |
| | Lower Scores | 46 | 3.59 | | | | |

** Significant at level 0.01

* Significant at level 0.05

in the domains of systems-based practice and interpersonal and communication skills than in the other domains (3.78 and 3.84 vs. 4.07-4.45).

DISCUSSION

This study established and then validated the essential domains and items in Mandarin for a scale used to measure pharmacy students' self-efficacy. The 53-item scale, with items extracted from 119 original items, indicated the sixth-year Pharm.D. students demonstrated the highest levels of self-efficacy. Students who reported having superior performances in academia demonstrated significantly higher self-efficacy in the domains of professionalism, pharmaceutical care, and overall competency.

Significantly lower self-efficacy was

demonstrated by Pharm.D. candidates in the domains of systems-based practice and interpersonal and communication skills than in the other domains. The Pharmaceutical Affairs Act in Taiwan regulates the dispensation of medications and requires it to be performed by pharmacists.^[40] Because of this, pharmacy interns and technicians are not allowed to dispense medications to patients. Therefore, very few pharmacy students choose to work in pharmacies as interns outside of the IPPE or APPE requirements due to the limited scope of work; this may lead to pharmacy students lacking experience and confidence in their abilities to work in healthcare systems upon graduation. However, students' self-efficacy in the systems-based practice domain did improve significantly across groups over the years following IPPE and APPE trainings (3.78 in PharmD-6 vs. 3.12 in PharmD-4,

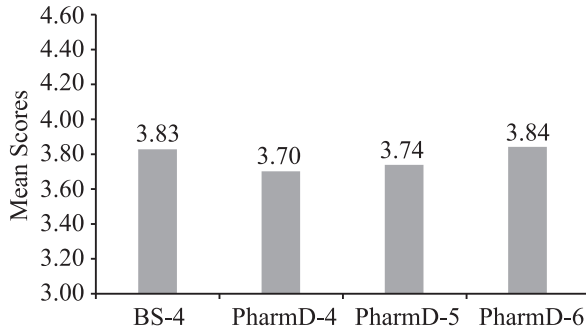


Figure 1-1. Comparison of interpersonal and communication skills among groups

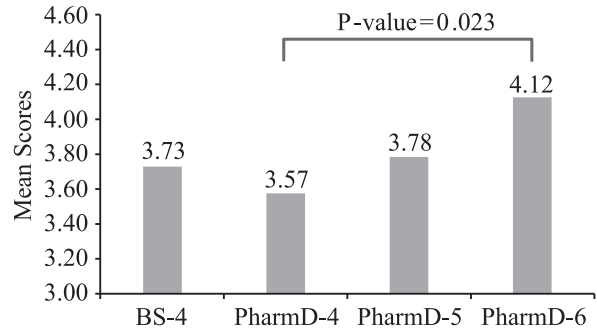


Figure 1-2. Comparison of professionalism

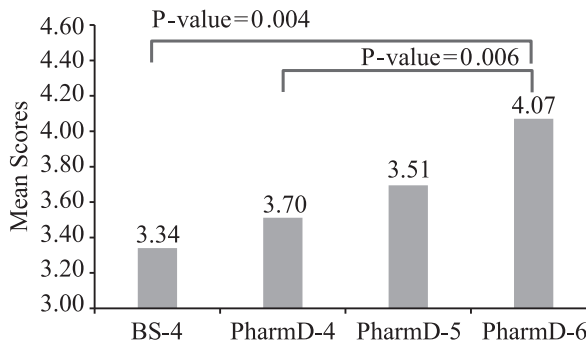


Figure 1-3. Comparison of pharmaceutical care

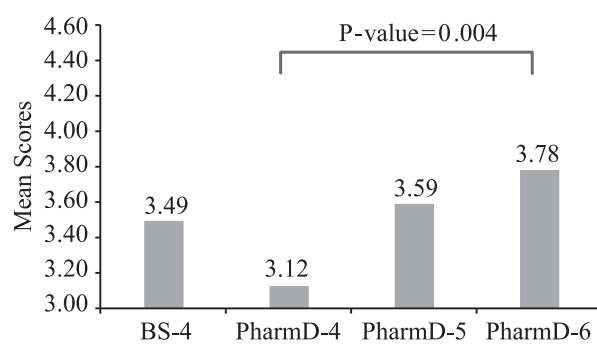


Figure 1-4. Comparison of systems-based practice

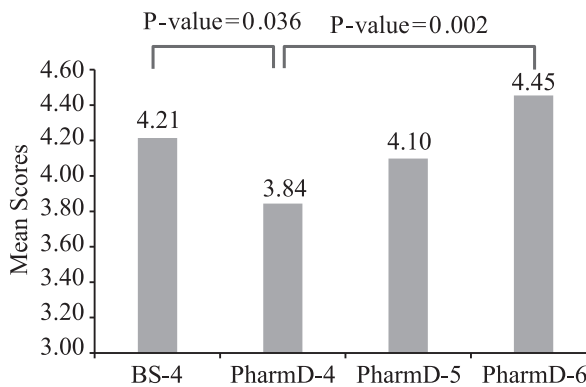


Figure 1-5. Comparison of practice-based learning and improvement

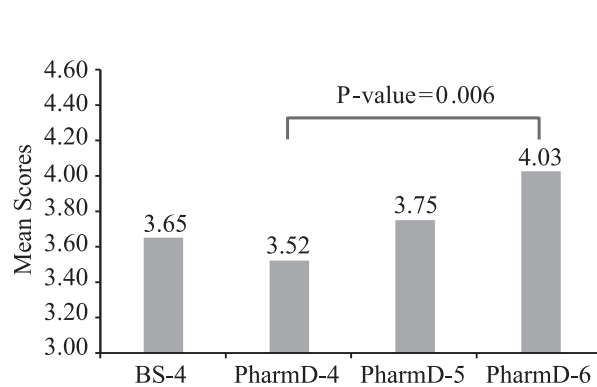


Figure 1-6. Comparison of overall scores

p = 0.004).

On the other hand, this study found the additional two years of education and extra pharmacy experience included in the Pharm.D. program only slightly enhanced the interpersonal and communication skills of Pharm.D. candidates compared to Pharm.D. students in their early years with the program and B.S. graduates (3.84 vs. 3.70-3.74 vs. 3.83, $p > 0.05$). Artino et al. identified a similar phenomenon in medical students who reported consistently high self-efficacy in interpersonal skills across all four years of medical school in the United States.^[15] They exhibited scores in this domain above four on a five-point scale, which were much higher scores than those exhibited in self-efficacy of patient care and evidence-based medicine. The current curriculum in our study only includes a few hours of lectures, including role playing, on communication skills. The incorporation of more courses and pharmacy practice laboratories for students to master necessary skills is planned for the near future. Required assignments during APPE in 2017 required students to document medication history and perform discharge counseling to ensure all students had the opportunity to refine their communication skills.

The BS-4 students had significantly higher self-efficacy than PharmD-4 in practice-based learning and improvement. We speculated that the difference was due to lack of IPPE for PharmD-4 (They would undertake IPPE on 5th grade). Yamamura et al. suggested that practical training programs help increase the learning motivation.^[49]

The BS-4 students showed comparable self-efficacy to PharmD-5 students in most domains. BS-4 students were approaching to graduation at the time of the survey undertaken, so they might possess high self-confidence and perhaps tended to overestimate themselves. On the other hand,

the PharmD-5 students might tend to evaluate themselves more conservatively after taking their pharmaceutical care lectures and IPPE on the 4th and 5th grades. More respondents and longitudinal follow-up would be required to draw any conclusions.

The limitations of this study include the research only being performed on a single site, a small number of participants studied, and the study's cross-sectional design without long-term follow-up. Without longitudinal data of a same cohort, we could not rule out the chance that students overestimated their confidence due to older age or senior grade. However, we plan to extend the current study into a longitudinal cohort study with students enrolled in additional Pharm. D. programs in pharmacy schools in Taiwan, as five more Pharm.D. programs have since been launched. As of December 2018, four public schools and three private schools in Taiwan offer Pharm.D. or B.S. programs only, respectively. Both the Pharm.D. and B.S. programs parallel each other in only two schools, both private schools.^[5,41-48] Even though no pharmacy-specific accreditation body currently exists in Taiwan, the pharmacy education council is supported by the Ministry of Education to establish a consensus for the educational framework among schools.

CONCLUSION

The self-efficacy scale we developed in our study demonstrates good reliability and validity. It can potentially serve as a psychometrically sound tool for pharmacy educators and researchers to measure pharmacy students' self-efficacy in professional competency to be used as evidence for educational outcome evaluations. The scale indicates that PharmD-6 demonstrated the highest self-efficacy compared with BS-4 and PharmD-4

and PharmD-5 in the overall scale and the domains of professionalism, pharmaceutical care, systems-based practice, and practice-based learning and improvement. However, no differences were found in the interpersonal and communication skills domain across groups. Further, students who reported having superior performances in academia demonstrated significantly higher self-efficacy in the domains of professionalism, pharmaceutical care, and overall competency.

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