ORIGINAL RESEARCH

Factors Affecting Leadership in Pharmacy Students: A Nationwide Survey

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Purpose: Leadership is increasingly becoming a priority in the forms of higher education associated with the Fourth Industrial Revolution; however, few studies have examined it in the context of pharmacy education. This study investigated the levels of communication competence, critical thinking disposition, problem-solving ability, and leadership of pharmacy students, and identified factors related to leadership.
Methods: This study was conducted using a nationwide cross-sectional online survey with a self-administered questionnaire. A total of 416 third-to-sixth-year pharmacy students from all 35 pharmacy schools in South Korea, completed the survey from September 1 to 15, 2019. Data were analyzed using descriptive statistics, t-tests, Pearson's correlations, and multiple regression analysis. We verified construct validity by performing an exploratory factor analysis.
Results: The pharmacy students revealed a moderate level of communication skills, critical thinking disposition, problem-solving ability, and leadership. Significant positive correlations were found among communication competence ($r=0.724$, $p<0.001$), critical thinking disposition ($r=0.615$, $p<0.001$), problem-solving ability ($r=0.599$, $p<0.001$), and leadership. After adjustment for control variables, communication competence ($\beta=0.319$, $p<0.001$) was found to be the most significant predictor of leadership ($F=104.12$, $p<0.001$, $R^2=0.756$).
Conclusion: This study showed that the students' leadership was influenced by their competence in communicating effectively, thinking critically, and solving problems. Pharmacy educators should acknowledge and implement innovative curriculum and assessment approaches in preparing pharmacy students for their professional paths.
Keywords: leadership, communication competence, critical thinking disposition, problem-solving ability, pharmacy students

Introduction

In the current era of the Fourth Industrial Revolution (IR 4.0), the rapid advancement of cutting-edge information technology (IT) and artificial intelligence (AI) is expected to change the nature of work and maintain job security. In response to the demands of IR 4.0, the education sector is proactively preparing students to manage technology and understand the associated requirements of this rapidly advancing technological revolution.[1] Additionally, as social interaction and cognitive functions such as strategic thinking become increasingly intertwined and complex, the importance of these skills is becoming increasingly recognized, especially as individuals with this competence are less likely to be replaced by automation.[2,3] According to previous studies, soft skills known as the "4Cs"—critical thinking, creativity, communication, and collaboration—alongside other essential skills, such as leadership, emotional intelligence, and problem-solving, are emphasized.[4]

Critical thinking refers to the ability to identify and analyze information to make appropriate judgments and decisions,[5] and it includes the essential ability to distinguish evidence-based information from inaccurate or false information, a key component of healthcare education. Problem-solving is a complex cognitive process that enables learners to promptly identify

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and resolve actual and potential issues in daily life and learning.[6] In addition, effective communication is vital for team collaboration, conflict resolution, and goal achievement in both their personal lives and workplaces, now and in the future.[7] Therefore, numerous universities worldwide are expected to cultivate dynamic students possessing these skills to fit into this new era, using certain approaches such as active learning and group activities.[1,8]

Similarly, in the field of pharmacy education, there is a growing realization that emerging curriculum reforms have enabled students to adapt to professional roles in their future careers and meet the evolving healthcare demands of the population.[9–11] This involves engaging in more intricate responsibilities, such as delivering personalized medication therapy and providing health counseling services while empathizing with each patient, all of which rely on high-level cognitive abilities and social intelligence. Within this context, effective leadership has become a professional obligation and a highly valued component in healthcare education, such as medicine, pharmacy, and nursing, as well as in interprofessional collaborations.[12–16] The eight-star pharmacist model and the Center for the Advancement of Pharmacy Education (CAPE) Educational Outcomes have previously identified leadership as an important attribute for a pharmacist.[17,18] Furthermore, the Accreditation Council for Pharmacy Education (ACPE) Standards placed special emphasis on the importance of leadership development, reflecting the need to expand its scope and foster leadership skills among all pharmacy students, rather than only those in formal positions.[19] Therefore, certain studies have explored implementation methods and competencies concerning the incorporation of student leadership development into PharmD programs, focusing on curricular and co-curricular activities throughout their education.[20–22]

Since 2011, the pharmacy school system in Korea has undergone two major transitions: first, from a 4-year BSc program to a 2+4-year Doctor of Pharmacy (PharmD) program, and more recently, the integration of 6-year pharmacy programs in 2022, which is expected to advance the pharmacy role toward specialized, comprehensive, and systematic healthcare services. Consequently, within the newly reformed PharmD curriculum, all pharmacy schools have incorporated an interpersonal and communication skills course as a core component of their programs. Education in leadership, critical thinking, and problem-solving skills, which require advanced teaching strategies, is currently under discussion at various universities. Despite the increasing significance of nurturing these competencies, to the best of our knowledge, these skills have not yet been standardized among pharmacy schools and no studies have assessed these factors in pharmacy students or examined their influence on leadership, although they are considered to be interrelated and to have a significant impact on it.

Accordingly, the objective of our study was to investigate all these factors combined—communication competence, critical thinking disposition, problem-solving ability, and leadership levels of Korean pharmacy students as well as leadership factors—to provide a basis for curriculum design and development and its broader application in the global context, particularly in pharmacy and other professional healthcare education.

Methods
Study Design and Setting

This nationwide cross-sectional study was conducted from September 1 to 15, 2019, and electronic questionnaires were distributed to all 35 pharmacy schools across South Korea. Before the data were collected, the purpose of the research and the survey plan were explained by the researchers via phone calls or by sending official letters to the heads of the relevant departments at the colleges. After obtaining permission, the researchers posted recruitment advertisements on bulletin boards with the assistance of student representatives from each school. Only students who agreed to participate in the study and consented to provide their email addresses to the researchers were sent a study information sheet, consent form, and link to the online questionnaire. Each participant read the form and provided digital consent before answering the questionnaire. Each student received 10,000 won (approximately US$8) in cash for participation. A preliminary survey of 60 pharmacy students from a Seoul-based university indicated that the participants encountered no significant difficulties in understanding the questionnaire or completing the form.

Participants

This study pooled 423 students in their 3rd to 6th year of a Doctor of Pharmacy (PharmD) program from a total student population of approximately 6700 across the 35 pharmacy colleges in 2019. Prepharmacy (1st- and 2nd-year) students

were not included because they were considered prospective students pursuing various allied health-related majors. Participants were selected through proportional stratified sampling, focusing on demographic (pharmacy school size, gender, and grade) factors, to ensure that participants were chosen in proportion to each school's enrollment, with efforts to achieve a balanced gender ratio and even representation across the four years of study through a proportionate distribution within each stratified group.

Measures
Leadership
Leadership ability was analyzed using a tool developed by the Korean Educational Development Institute (KEDI),[23] which comprises 50 items across five subscales: goal achievement (10 items), recreative ability (10 items), command (10 items), social relationships (10 items), and sense of purpose (10 items). Each item was measured from 1 (strongly disagree) to 5 (strongly agree), with a higher score indicating a higher level of leadership. The questions comprised both positive and negative options to reduce response bias, and negative choices were scored using reverse scoring. Cronbach's alpha was 0.94 in the KEDI study,[23] with each leadership subscale demonstrating adequate internal consistency (range: 0.80–0.88). In this study, the overall Cronbach's alpha was 0.94, and each leadership subscale demonstrated high internal consistency (range: 0.79–0.91).

Communication Competence
Participants' communication competence was measured using the Global Interpersonal Communication Competence (GICC) scale, developed by Hur[24] as a modified version of the Interpersonal Communication Competence (ICC) scale by Rubin et al.[25] The GICC scale comprises 15 items: self-disclosure, empathy, social relaxation, assertiveness, interaction management, expressiveness, supportiveness, immediacy, concentration, efficiency, social appropriateness, conversational coherence, goal detection, responsiveness, and noise control. The items are rated on a five-point scale (1=strongly disagree; 5=strongly agree), with a higher score indicating higher communication competence. Cronbach's alpha was 0.86 in Hur's study[24] and 0.84 in the present study.

Critical Thinking Disposition
Critical thinking disposition was measured using the scale developed by Kwon et al,[26] which comprises 35 items divided into eight subscales: intellectual integrity (six items), creativity (four items), challenge (six items), open-mindedness (three items), prudence (four items), objectivity (four items), truth-seeking (three items), and inquisitiveness (five items). Each item is scored from 1 (strongly disagree) to 5 (strongly agree), with a higher score indicating a higher level of critical thinking. The questions include both positive and negative choices to minimize response bias, with negative choices scored using reverse scoring. The overall Cronbach's alpha in the study by Kwon et al[26] was 0.89, and each of the eight subscales reflected adequate internal consistency (range: 0.62–0.84). In the present study, the overall Cronbach's alpha was 0.89, and each subscale demonstrated adequate internal consistency (0.62–0.85).

Problem-Solving Inventory
Problem-solving ability was measured using a scale originally developed by Heppner and Petersen[27] and translated by Yim et al.[28] The tool comprises 32 items across three subscales: problem-solving confidence (11 items), approach–avoidance style (16 items), and personal control (5 items). Items are rated on a five-point scale ranging from 1 (strongly disagree) to 6 (strongly agree), with a higher score indicating a higher level of problem-solving ability. Prior to analysis, reverse scoring was applied to negatively keyed items. Cronbach's alpha for the scale was 0.90 in Heppner and Petersen's study,[27] 0.896 in Yim et al's study,[28] and 0.85 in this study, with the internal consistency of each subscale ranging between 0.70 and 0.85.

Personality
To measure personality traits, this study utilized the 60-item NEO Five-Factor Inventory (NEO-FFI), a Big Five personality trait scale originally developed by Costa and McCrae[29] and further developed by Kim.[30] As a condensed

version of the NEO-PI-R, the NEO-FFI was designed to provide a faster and more convenient measurement of the Five-Factor Model domains: Neuroticism (N), Extroversion (E), Openness (O), Agreeableness (A), and Conscientiousness (C). Based on a five-point scale (1=strongly disagree; 5=strongly agree), respondents were asked to indicate how accurately each statement described them. In Kim's study, each of the five domains of the NEO-FFI demonstrated adequate internal consistency (α = 0.70–0.87).[30] The overall Cronbach's alpha coefficient for this study was 0.88, and the subscales reflected the following internal consistencies: E = 0.89, C = 0.85, N = 0.83, and O = 0.77. Agreeableness was excluded from the final scale as determined by our factor analysis approach (see the Results section).

The general characteristics of the participants included seven items: demographic and sociological features (gender, age, grade, and school location), GPA, satisfaction with their pharmacy major (satisfied or unsatisfied), and quality of interpersonal relationships (bad or good). Additionally, a structured questionnaire was used consisting of 50 items on leadership, 15 on communication competence, 35 on critical thinking tendencies, 32 on problem-solving abilities, and 60 on personality, which took approximately 20 minutes to complete.

Ethical Considerations

This study was approved by the Institutional Review Board of Seoul National University (IRB No. 1905/001-011). The participants provided electronic informed consent before completing the questionnaire. The consent form included information about the study's purpose, content, and confidentiality, and participants could withdraw from the study at any time without penalty.

Statistical Analysis

All analyses were performed using SPSS 29 (IBM Co., Armonk, NY, USA); we examined descriptive statistics, including frequency, percentage, mean, and standard deviation. Differences in communication competence, critical thinking disposition, problem-solving ability, and leadership according to participants' general characteristics were analyzed using a t-test. Statistical significance was set at p-value <0.05. Correlations between these factors were analyzed using Pearson's correlation coefficient. Multiple linear regression analysis was performed to further understand the factors that contribute to leadership ability. Two variable groups were entered into the regression models as predictor variables. The first group comprised communication competence, critical thinking disposition, and problem-solving ability; the second group comprised control variables such as personality, age, grade, GPA, satisfaction with the pharmacy major, and interpersonal relationships. We added a dummy variable coded as 1 if the respondent indicated that they were seniors, had a good GPA, were satisfied with their major, and maintained good interpersonal relationships; the other responses were coded as 0.

In addition, reliability was analyzed using Cronbach's alpha, and construct validity was examined using exploratory factor analysis (EFA). Sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test for sphericity. Factors were extracted using principal component analysis (PCA) with Varimax rotation, and the number of retained factors was determined by examining the Eigenvalue thresholds and scree plots. The criteria for maintaining the factor for this study were extraction values above 0.4 and eigenvalues above 1.0.[31]

For sample size determination, G Power 3.1.9 was employed for the sampling process.[32] Given that the required sample size was 353, with a medium effect size of 0.15, power of 0.95, and significance level of 0.05, 423 students were selected as study participants, considering a potential dropout rate of 20%, ensuring a sufficient and representative number of participants.

Results

General Characteristics of Participants

Participants' demographics characteristics are presented in Table 1. All 423 respondents from all 35 pharmacy schools agreed to participate in the study, resulting in a 100% response rate. After excluding seven students with incomplete responses, the study measured the responses of 416 students. The mean age of the students was 25.18 years (SD=2.63; range: 20–43 years). The mean GPA score was 3.5. A large proportion of students (71.6%) reported "good" interpersonal

Table 1 Participants' Demographic Characteristics (n = 416)

Characteristics	Categories	n (%)
Gender	Male Female	188 (45.2) 228 (54.8)
Age (in years)	20–25 26–30 ≥31	258 (62.0) 144 (34.6) 14 (3.4)
Grade	Junior (3rd-4th) Senior (5th-6th)	219 (52.6) 197 (47.4)
Satisfaction with major	Dissatisfied Satisfied	50 (12.0) 366 (88.0)
GPA (mean GPA 3.5)	Normal (<3.5) Good (≥3.5)	248 (59.6) 168 (40.4)
Interpersonal relationships	Bad Good	118 (28.4) 298 (71.6)
Pharmacy school location	Seoul Incheon/Gyeonggi province Gangwon province Chungcheong province Jeolla province Gyeongsang province	138 (33.2) 69 (16.6) 12 (2.9) 39 (9.4) 70 (16.8) 88 (21.2)

Abbreviation: GPA, grade point average.

relationships. Regarding pharmacy school location, the percentage of students in Seoul was the highest (33.2%), followed by Gyeongsang (21.2%), Jeolla (16.8%), Incheon/Gyeonggi (16.6%), Chungcheong (9.4%), and Gangwon (2.9%).

Construct Validity

Construct validity of the instrument was examined using an EFA (see Supplement Table). For critical thinking disposition, the calculated KMO had an optimal value (0.873), Bartlett's test of sphericity was statistically significant (p=0.000), and Eigenvalues of the factors were >1. All factor loadings were >0.4 except for one item each for challenge, prudence, and objectivity, and three for inquisitiveness, reducing the 35 items to 29. An additional PCA was performed on the remaining items, which confirmed the same eight factors as in the original study, explaining 63.1% of the total variance (Supplementary Table S1). For problem-solving ability, KMO presented an optimal value (0.873), Bartlett's test of sphericity was statistically significant (p=0.000), and the eigenvalues of the factors were >1. All factor loadings were >0.4 except for five problem-solving confidence items, 11 approach–avoidance style items, and 2 personal control items, reducing the 32 items to 14. PCA was performed on the remaining items, which revealed the same three factors as in the original study, explaining 57.5% of the total variance (Supplementary Table S2). For Personality, the KMO presented an optimal value (0.891), Bartlett's test of sphericity was statistically significant (p=0.000), and Eigenvalues of the factors were >1. All factor loadings were >0.4 except for six items on openness, four on conscientiousness, four on extroversion, and five on neuroticism. The agreeableness factor (12 items) was deleted because of its low factor loadings (ie, lower than 0.40) and high item cross-loadings. Ultimately, the 60 items were reduced to 29. A PCA was performed on the remaining items in this study produced a clear four-factor structure that accounted for 54.0% of the total variance. Although the original study identified five factors, this study found that four were sufficient to describe the data (Supplementary Table S3). Communication competence analysis revealed that one factor accounted for 31.5% of total variance. The KMO index of sampling adequacy presented an optimal value (0.867), and Bartlett's test of sphericity was statistically significant (p=0.000) (Supplementary Table S4). For leadership, the KMO presented an optimal value (0.899), Bartlett's test of sphericity was statistically significant (p=0.000), and Eigenvalues of the factors were >1. All

factor loadings were >0.4, except for five items on goal achievement, one on recreative ability, five on command, five on social relationship, and three on sense of purpose, reducing the 50 items to 31. Another PCA was performed on the remaining items, yielding the same five factors as in the original study, explaining 59.0% of the total variance (Supplementary Table S5).

Table 2 shows the mean scores and standard deviations of communication competence, critical thinking disposition, problem-solving ability, personality, and leadership, and all their subscales. Leadership, communication competence, critical thinking disposition, and problem-solving ability were assessed at moderate levels. Among the critical thinking subscales, "intellectual integrity" had the highest ranking, while four out of eight subscale presented below average scores, indicating potential weaknesses in these areas. In problem-solving ability, "problem-solving confidence" and "personal control" presented the highest and lowest means, respectively. For leadership, the subscale with the highest mean score was "command", whereas "recreative ability" was the lowest following by "goal achievement". Regarding personality as a control variable, pharmacy students scored highest in "conscientiousness" and lowest in "neuroticism".

Differences in communication competence, critical thinking disposition, problem-solving ability, and leadership based on the general characteristics of the participants were examined, and the results are shown in Table 3. Of the general characteristics, students who were satisfied with their major and those with good interpersonal relationships scored significantly higher in communication competence, critical thinking disposition, problem-solving ability, and leadership. Contrary to expectations, no significant differences were found in any of the variables among the participants based on their GPA. However, significant grade differences were observed for critical thinking disposition and leadership.

Table 2 Levels of Communication Competence, Critical Thinking Disposition, Problem-Solving Ability, Personality, and Leadership (n = 416)

Variables[a]	Categories	Mean±SD
Communication competence	Total	3.92±0.51
Critical thinking disposition	Intellectual integrity	4.04±0.59
	Creativity	3.36±0.91
	Challenge	3.31±0.79
	Open-mindedness	3.94±0.64
	Prudence	3.67±0.77
	Objectivity	3.35±0.77
	Truth-seeking	3.78±0.70
	Inquisitiveness	3.35±0.89
	Total	3.60±0.48
Problem-solving ability	Problem-solving confidence	4.55±0.77
	Approach–avoidance style	4.43±0.69
	Personal control	3.98±1.04
	Total	4.32±0.65
Personality	Extroversion	3.54±0.84
	Conscientiousness	3.82±0.65
	Neuroticism	2.46±0.81
	Openness	3.34±0.85
	Total	3.29±0.36
Leadership	Goal achievement	3.73±0.57
	Recreative ability	3.55±0.76
	Command	4.13±0.51
	Social relationships	3.96±0.52
	Sense of purpose	3.91±0.65
	Total	3.86±0.45

Notes: [a]All scores ranged from 1 to 5, except for problem-solving ability, which ranged from 1 to 6.

Table 3 Difference Between Communication Competence, Critical Thinking Disposition, Problem-Solving Ability, and Leadership by Participants' Characteristics (n = 416)

Characteristics	Categories	N	Communication Competence		Critical Thinking Disposition		Problem-Solving Ability		Leadership	
			M±SD	t(p)	M±SD	t(p)	M±SD	t(p)	M±SD	t(p)
Gender	Male	188	3.94±0.53	0.557(0.578)	3.75±0.49	6.015(<0.001)	4.40±0.67	4.895(0.027)	3.88±0.50	1.10(0.271)
	Female	228	3.91±0.50		3.48±0.43		4.25±0.64		3.83±0.42	
Grade	Junior	219	3.95±0.50	1.298(0.195)	3.65±0.44	2.201(0.028)	4.33±0.64	0.530(0.596)	3.92±0.41	3.130(0.002)
	Senior	197	3.89±0.53		3.54±0.51		4.30±0.67		3.78±0.49	
Satisfaction with major	Dissatisfied	50	3.70±0.61	−3.335(0.001)	3.45±0.49	−2.431(0.015)	4.00±0.71	−3.788(<0.001)	3.58±0.47	−4.669(<0.001)
	Satisfied	366	3.95±0.49		3.62±0.47		4.36±0.63		3.89±0.44	
GPA	Normal	248	3.92±0.50	0.087(0.931)	3.60±0.49	−0.152(0.879)	4.29±0.67	−1.022(0.307)	3.86±0.44	0.192(0.848)
	Good	168	3.92±0.53		3.60±0.47		4.36±0.63		3.85±0.47	
Interpersonal relationships	Bad	118	3.59±0.57	−7.919(<0.001)	3.45±0.53	−4.169(<0.001)	4.02±0.73	−5.436(<0.001)	3.58±0.48	−8.303(<0.001)
	Good	298	4.05±0.43		3.66±0.44		4.44±0.58		3.96±0.40	

Abbreviations: M, Mean; SD, Standard deviation.

Leadership was significantly positively correlated with all components except neuroticism. Communication competence had the strongest significant correlation with leadership. Neuroticism was negatively correlated with all assessed variables (Table 4).

The first model included only three main independent variables—communication competence, critical thinking disposition, and problem-solving ability—resulting in R^2 of 0.654 (p < 0.001). After adding control variables to the second model, communication competence, critical thinking disposition, problem-solving ability, grade, satisfaction with major, and personality subscales—extroversion, conscientiousness, and openness—remained significant predictors of leadership, with an R^2 of 0.756 (F = 104.124, p < 0.001). Finally, in Model 2, communication competence was the variable that explained leadership the most (β = 0.319) (Table 5).

Discussion

Leadership, an essential skill in the IR 4.0 era, is critical in business and health organizations. Thus, this study aimed to measure the level of communication competence, critical thinking disposition, problem-solving ability, and leadership in pharmacy students, as well as the factors affecting their leadership.

The present study found that pharmacy students exhibited moderate levels of leadership, consistent with the findings of a previous study on premedical students.[33] However, leadership scores from studies on nursing students[34,35] were

Table 4 Correlations Among Personality, Communication Competence, Critical Thinking Disposition, Problem-Solving Ability, and Leadership (n = 416)

Variables	1	2	3	4	5	6	7	8
	r(p)	r(p)	r(p)	r(p)	r(p)	r(p)	r(p)	r(p)
1. Extroversion	1							
2. Conscientiousness	0.377**	1						
3. Neuroticism	−0.439**	−0.480**	1					
4. Openness	0.135**	0.198**	−0.024(0.628)	1				
5. Communication competence	0.594**	0.548**	−0.388**	0.240**	1			
6. Critical thinking disposition	0.270**	0.565**	−0.346**	0.421**	0.421**	1		
7. Problem-solving ability	0.327**	0.629**	−0.515**	0.252**	0.461**	0.688**	1	
8. Leadership	0.644**	0.653**	−0.418**	0.327**	0.724**	0.615**	0.599**	1

Notes: ** p<0.001.

Table 5 Factors Influencing Leadership (n = 416)

Variables	Model 1				Model 2			
	B	**SE**	**β**	**t(p)**	**B**	**SE**	**β**	**t(p)**
(Constant)	0.574	0.119		4.810(<0.001)	0.297	0.188		1.583(0.114)
Communication competence	0.470	0.029	0.532	16.084(<0.001)	0.281	0.030	0.319	9.410(<0.001)
Critical thinking disposition	0.265	0.038	0.279	6.904(<0.001)	0.172	0.036	0.182	4.831(<0.001)
Problem-solving ability	0.112	0.029	0.161	3.898(<0.001)	0.065	0.028	0.093	2.317(0.021)
Personality								
Extroversion					0.158	0.018	0.292	8.807(<0.001)
Conscientiousness					0.157	0.025	0.226	6.334(<0.001)
Neuroticism					0.030	0.018	0.054	1.645(0.101)
Openness					0.041	0.015	0.076	2.768(0.006)
Age					0.006	0.005	0.036	1.367(0.172)
Grade (senior)[a]					−0.075	0.024	−0.083	−3.126(0.002)
GPA (good)[a]					−0.015	0.024	−0.016	−0.627(0.531)
Satisfaction with major (satisfied)[a]					0.076	0.036	0.054	2.092(0.037)
Interpersonal relationships (good)[a]					0.004	0.030	0.004	0.129(0.898)
R^2	0.654				0.756			
adj.R^2	0.651				0.749			
F(p)	259.550(<0.001)				104.124(<0.001)			

Notes: adj R^2, adjusted R^2. [a]Dummy variable; the reference groups were grade (junior), GPA (normal), satisfaction with major (dissatisfied), and interpersonal relationships (bad).

lower than those in this study. This finding implies that curricular weaknesses may exist during the development of this trait. Additionally, the minor score variations observed among pharmacy, medical, and nursing students are likely the result of differences in student characteristics, such as academic year, and the education/training (learning methods and assessments) they have received.

Specifically, in this study, the lowest subscale mean score was for recreative ability, which is inconsistent with a previous study with higher and above-average scores for nursing students.[36] For effective leaders, recreative ability involves the capacity to create new paradigms, encompassing self-reflection on one's own experiences, ability to learn from past and present experiences, and willingness to learn from others.[23] This is a crucial factor that pharmacy students must possess for desirable changes in their pharmacy roles. Therefore, the development of a program aimed at enhancing this ability, which is a fundamental leadership trait, is necessary.

Previous studies have noted that leadership-related competencies, including students' knowledge, skills, and abilities, can be improved through education and training.[14,20,37] A study by Lisevick et al reported that medical students' knowledge, attitudes, and skills in three major leadership domains: self, teams, and systems (which include, for example, self-regulation, communication skills, relationship management, negotiation, and conflict resolution skills) were developed through a relationship-centered leadership curriculum.[37] Furthermore, Janke et al mentioned that the course's later placement in the curriculum limits opportunities for effectively integrating leadership skill development, as it could reduce the time that students have to practice and apply these skills in real-world scenarios.[21] Therefore, leadership education should be offered at the appropriate timing and integrated both vertically across years and courses and horizontally across disciplines and activities, including practical courses and co-curricular activities.

Interestingly, leadership skills differed significantly by grade, satisfaction with the major, and interpersonal relationships, consistent with findings from other studies.[38,39] These studies have reported significant differences in self-leadership according to general characteristics, such as grade, academic performance, interpersonal relationships, major satisfaction, and leadership program experience. Although it is difficult to directly compare owing to the lack of prior studies examining the leadership of pharmacy students, the findings of this study suggest that college programs should be designed to incorporate elements that create a conducive learning environment and actively seek ways to

maintain students' interest in their majors. These should aim to enhance academic enthusiasm and satisfaction with the pharmacy major as well as enhance leadership skills by prioritizing the development of character education and harmonious interpersonal relationships.

This study's findings indicate a significant difference between academic year and leadership. Leadership scores were higher among junior students than among senior students, consistent with previous studies on leadership among nursing students.[34,40] However, this finding was inconsistent with that of Yun and Kim,[41] who found that college student leadership scores increased as the grade level increased. Lower leadership scores observed in senior pharmacy students in this study could be attributed to a decreased tendency to participate in various activities and the time spent on them owing to the pressure experienced by advanced-level studies. Furthermore, the transition from classroom settings to clinical environments in pharmacies or hospitals poses challenges in adapting to new surroundings and communicating with diverse individuals, unlike senior students in non-health professionals. Hence, this study recommends supporting leadership activities tailored to students' needs, while considering the academic year. Additional findings revealed no significant differences between GPA, gender, and leadership, supporting a previous study's findings of no significant differences in medical leadership competences based on gender and GPA among medical students.[42] However, previous studies have yielded varying results; thus, further research is required for greater clarity and insight.

As Hackman and Johnson noted, leadership is a "special form of communication", which means that leaders must communicate effectively with others.[43] Communication can be regarded as the most frequently cited characteristic among successful leaders and has also been indicated as a fundamental element in pharmacists' professionalism.[17] Therefore, various competency frameworks and accreditation standards have included communication competence[44–46] because enhanced confidence in communication can foster effective relationships with other healthcare professionals, ultimately influencing the quality of pharmacy services and patient satisfaction.[47,48] This study found that pharmacy students' communication competence scores were moderate. This result is consistent with that of a study in which fourth-year nursing students achieved the same score[49] and surpassed the lower scores of first-year medical students reported in another study.[50] This may be because students in this study included all four grades in all 35 pharmacy schools nationwide, whereas other studies targeted students from a single grade or from only a few cities.

Previous studies have observed communication apprehension and anxiety among pharmacy students,[51,52] which may have a significantly negative impact on their future pharmacy professions, including patient care. Therefore, the recently reformed curriculum in Korean pharmacy schools should focus on developing an effective communication curriculum for pharmacy students. This should include practical and systematic education across subjects, enabling them to acquire effective relationships with patients and other healthcare professionals and contribute to the enhancement of patient health outcomes.

Moreover, the results of this study demonstrated moderate levels of critical thinking disposition, aligning with Sharples et al's findings,[53] in which medical students exhibited an average level of critical thinking disposition, whereas another study with pharmacy students reported a higher average score.[54] This study also found that the subscale mean scores for intellectual integrity, open-mindedness, and truth seeking were higher, whereas the score for challenge was the lowest. This explains why the results indicated a moderate score for the traditional pharmacy education system, which appears to be ineffective in fostering critical thinking among pharmacy students. For instance, in many pharmacy schools in Korea, lectures still dominate the teaching methodology, with a limited emphasis on active teaching methods. In addition, cultural differences are a contributing factor[55] as there may be a lack of early-age training or educational background in systematic thinking. In this context, Western countries (eg, the US and Canada) emphasize individualism, while East Asian countries (eg, China, Japan, and South Korea) prioritize collectivism, valuing group harmony and relationships. Consequently, students from Eastern cultures tend to avoid contradictions[56] and may hesitate when questioning teachers, participating in debates, or engaging in arguments. Critical thinking is regarded as one of the most fundamental learning outcomes in higher education[57] and an essential characteristic of evidence-based practice and professionalism. Therefore, the quality of teaching methodologies, such as active methods, should be considered in conjunction with other components of the pharmacy curriculum.

The results of this study showed that the students had moderate problem-solving skills, higher than those observed by Chaung who investigated problem-solving ability among nursing students.[58] The variance in problem-solving ability

between pharmacy and nursing students may stem from disparities in their curricula. In this study, the problem-solving confidence subscale received the highest score, whereas the personal control subscale yielded the lowest, consistent with Chaung's findings.[58] However, the present results are inconsistent with those of Yang, who reported that the approach–avoidance style subscale scored the highest and the personal control subscale scored the lowest.[59]

Problem-solving proficiency is a complex cognitive skill that cannot be quickly acquired.[6] Traditional education methods based on rote memorization fall short in developing practical skills, leaving students underprepared for the challenges of the clinical field. Therefore, in a rapidly evolving health system, it is imperative to develop a comprehensive array of teaching and learning strategies, along with curricula tailored to enhance problem-solving skills and thereby equip pharmacists with the competences needed to become adept problem solvers capable of delivering professional and safe patient care. Hache et al highlighted the effectiveness of various educational strategies, such as real patient involvement, role-play and simulation, and feedback and self-assessment in pharmacy education,[60] which could also be applied to enhance problem-solving competencies.

Communication competence, critical thinking disposition, problem-solving ability, and leadership among pharmacy students showed a statistically significant positive correlation. For pharmacy students, higher communication competence, stronger critical thinking disposition, and enhanced problem-solving ability indicated higher leadership level.

In this study, the factors that influenced pharmacy students' leadership skills included communication competence, critical thinking disposition, problem-solving ability, grade, personality, and satisfaction with the major. Among these, communication competence was the most influential. Healthcare professionals are expected to excel in various areas, including communication, critical thinking, problem-solving ability, ethical behavior, and professionalism.[61] Previous studies have demonstrated that among college students, these skills can be improved through learning or training using various learning strategies, including experiential education or active learning, hands-on training using standardized patients and team- and case-based learning.[62–65] Leadership is not defined by position or title; therefore, educators and students should acknowledge that all students have the potential to make a difference in their environment. Moreover, it is crucial to carefully consider and continually implement educational approaches that focus on improving the leadership abilities of future pharmacy students.

This study has certain limitations. First, a cross-sectional design was selected; therefore, further longitudinal studies should be conducted to investigate effective approaches to enhance communication competence, critical thinking, problem-solving ability, and leadership among undergraduate pharmacy students. Second, the data were collected using self-reporting methods, which could have affected the accuracy of the results owing to social desirability biases. Third, multiple studies have suggested that leadership can be differentiated based on personality traits.[66,67] Therefore, additional studies are required to clarify the role of personality traits in pharmacy students' leadership. Finally, students' leadership seems to be influenced by various factors including parental characteristics, birth order, and self-esteem. Future research should incorporate a broader range of variables to identify additional factors associated with leadership.

To the best of our knowledge, this is the first study to examine Korean pharmacy students' degrees of communication competence, critical thinking disposition, problem-solving ability, leadership, and factors affecting leadership, which are required to align with the needs of professional practice. The results of this study support the need to pay attention to the abilities and provide an overview of the extent of these skills among students. We believe that this study contributes to learning not only among pharmacy students in South Korea, where the study was conducted, but also in other countries to address the needs of patients, society, and pharmaceutical health. In addition, the present findings can be applied not only to Western pharmaceutical schools, where leadership education has not yet been widely adopted or standardized, but also to pharmacy schools in Asian cultural regions like Korea. In particular, by considering appropriate adjustments and integrating it with local educational values in these Asian contexts, students' leadership outcomes could be enhanced.

Conclusions

This study investigated the factors influencing leadership among pharmacy students and confirmed that communicative competence had the most significant impact. To increase the leadership skills of pharmacy students, it is suggested that a program be developed that includes the promotion of communication skills, critical thinking, and problem-solving abilities and integrates them into pharmacy school curricula using a variety of advanced teaching strategies and methods.

We believe that these findings provide insights into areas of pharmacy education in both South Korea and other countries with similar environments that are currently largely unexplored. This could help adapt to the demands of IR 4.0.

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