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Frontiers of **Nursing**

Role of academic self-efficacy in the relationship between self-directed learning readiness and problem-solving ability among nursing students

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Abstract: **Objective:** Problem-solving should be a fundamental component of nursing education because it is a core ability for professional nurses. For more effective learning, nursing students must understand the relationship between self-directed learning readiness and problem-solving ability. The aim of this study was to investigate the relationships among self-directed learning readiness, problem-solving ability, and academic self-efficacy among undergraduate nursing students.
Methods: From November to December 2016, research was conducted among 500 nursing undergraduate students in Tianjin, China, using a self-directed learning readiness scale, an academic self-efficacy scale, a questionnaire related to problem-solving, and self-designed demographics. The response rate was 85.8%.
Results: For Chinese nursing students, self-directed learning readiness and academic self-efficacy reached a medium-to-high level, while problem-solving abilities were at a low level. There were significant positive correlations among the students' self-directed learning readiness, academic self-efficacy, and problem-solving ability. Furthermore, academic self-efficacy demonstrated a mediating effect on the relationship between the students' self-directed learning readiness and problem-solving ability.
Conclusions: To enhance students' problem-solving ability, nursing educators should pay more attention to the positive impact of self-directed learning readiness and self-efficacy in nursing students' education.

Keywords: *self-directed learning readiness • problem-solving ability • academic self-efficacy • nursing undergraduates • nursing students • cross-sectional survey*

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1. Introduction

Problem-solving is a core ability for students to develop professional nursing skills and perform quality care. By improving problem-solving abilities, nursing students can discover and solve patient problems using cognitive, effective, and behavioral processes.[1] Today, problem-solving is believed to be an evaluation index of a student's high-level thinking ability, and since it can help nurses design and implement effective interventions, problem-solving is a core competency of nursing students.[2] Furthermore, as the economy develops, individuals are paying more attention to health care and seeking holistic care, requiring nurses to be good at solving problems. To improve nursing students' problem-solving abilities, educators must develop pertinent teaching methods and curricula. However, researchers have previously found that nursing students in different countries had low problem-solving abilities.[3,4] Therefore, to help nursing students confront the challenges they

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face in clinical settings, their abilities to solve problems must be improved.

According to the Organization for Economic Cooperation and Development,[5] problem-solving is a process that leads an individual to recognize, formulate, and solve problems. This skill helps individuals solve problems effectively and guide the implementation of solutions. Psychologists[6] believe that the ultimate goal of education is to train students to solve problems, including those related to life, society, and the environment. China's Ministry of Health and Education (2001) stressed the need for higher medical educators to cultivate medical students' learning ability, which can help them assess the entirety of their patients' needs and determine timely countermeasures to solve clinical problems. In the nursing profession, problem-solving abilities affect job performance, quality of nursing care, and prognosis intervention for patients.[7] Although the need for nurses who make appropriate decisions and possess strong problem-solving skills is always increasing,[8] China's traditional model for nurse education, which affects the cultivation of the students' practical and problem-solving abilities, is not of high quality.[9] Therefore, to achieve a better learning effect, educators must cultivate their students' problem-solving abilities.

In self-directed learning (SDL), with or without the help of others, learners display great initiative to judge their own learning needs, formulate goals, evaluate learning resources, engage appropriate learning methods, and evaluate education results.[10] Anyone can become a self-directed learner; however, the outcome of SDL depends on several factors, including motivation and learning attitude, self-confidence, experience, and individual characteristics,[11,12] which comprise self-directed learning readiness (SDLR). To help students convert from dependent to active learners and then become self-directed lifelong learners, the Accreditation Council for Pharmacy Education[13] encouraged colleges to combine teaching and learning methods. According to previous research, nursing students' SDLR was significantly correlated with their problem-solving ability, and problem-solving ability could be facilitated by improving the students' SDLR.[9,14] Research by Struyf et al.[15] and Williams[16] showed that cultivating students' problem-solving abilities could improve their self-learning abilities. Therefore, SDL and problem-solving ability are mutually influential and stimulated. In summary, nursing educators should cultivate nursing students' SDLR and problem-solving ability, which will help nurses effectively cope with complex working environments.[17]

Academic self-efficacy, which relates to an individual's perception of his or her own capabilities,[18] is an internal factor that influences a student's SDLR ability.

Additionally, it is a key factor that affects students' learning behaviors, such as problem-solving ability and thinking.[19,20] According to an individual study, self-efficacy has a positive psychological effect on an individual's problem-solving process, which was conducive to solving problems.[21]

In conclusion, the ability to solve problems is a professional skill that enables nursing students to enact nursing interventions when they step into clinical work. Further, SDLR is a key factor for improving problem-solving abilities. To enhance nursing students' problem-solving abilities, educators are making many efforts to develop appropriate teaching methods, such as problem-based learning (PBL). For nurses who face a new environment and the stressful occupation of clinical work, self-confidence and self-evaluation can play an important role in their problem-solving efficacy. Nursing students should be confident when confronting various clinical problems and unpredictable situations. Therefore, academic self-efficacy can have a positive effect on nursing students' abilities to solve problems. Today, most research investigates the relationship between problem-solving ability and SDLR or the relationship between problem-solving ability and academic self-efficacy, but researchers ignore the relationship among the three skills. This study identified the role academic self-efficacy plays in the relationship between SDLR and problem-solving ability in nursing students. From the perspective of positive psychology, this study suggests that SDLR can improve students' abilities to solve problems by improving their academic self-efficacy. If this hypothesis is valid, nursing educators can improve their students' SDLR and problem-solving abilities by improving their academic self-efficacy and learning enthusiasm.

2. Methods

2.1 Design and study sample

A cross-sectional design was used to identify the mediating effect of academic self-efficacy in the relationship between nursing students' SDLR and problem-solving ability. Convenience sampling was used to select participants from a nursing school in Tianjin, China. With a total of 500 respondents, undergraduate nursing students in all grades participated in this survey.

2.2 Instruments

A demographic questionnaire was designed to collect a range of information, including age, gender, grade, and national origin, as well as whether the participant was

an only child. Students were asked five questions: did they have experience working in a part-time job; did they choose nursing as their first profession; did they enjoy nursing; did they feel satisfied with their learning; and did they have difficulty learning.

The Self-Directed Learning Readiness Scale (SDLRS) for nursing students was used to measure the level of SDLR. This instrument was developed by Fisher et al.[22] and translated into Chinese by Wang.[9] It consisted of 40 items in three subscales: self-management (13 items), the desire to learn (12 items), and self-control (15 items). This was a five-point Likert scale, ranging from 5 (strongly agree) to 1 (strongly disagree), with a higher score representing a higher level of SDLR. The total Cronbach's α coefficient of the SDLRS was 0.932, which indicated good reliability.

The Chinese version of the Social Problem-Solving Inventory (C-SPSI), which was translated by Wang,[9] was used to evaluate the problem-solving ability of nursing students. This scale consisted of 25 items in five subscales: rational problem-solving (RPS), positive problem orientation (PPO), negative problem orientation (NPO), avoidance style (AS), and impulsivity/carelessness style (ICS). A five-point Likert scale was used to measure responses. Prior research concluded that the C-SPSI could measure the level of problem-solving ability in nursing students. For example, Huang and Li[23] and Li and Xu[20] found that Cronbach's α coefficients for the C-SPSI were 0.840 and 0.871, respectively. In this study, the total Cronbach's α coefficient for the C-SPSI was 0.774.

The final component of this study was academic self-efficacy. Using a questionnaire designed by Liang,[24] the nursing students' level of academic self-efficacy was tested. The questionnaire included 22 items in two subscales. The sum of the two dimensions was the total score of the respondent's academic self-efficacy, with a higher score indicating a higher level of academic self-efficacy. This method has high reliability and validity and has been widely used in the evaluation of college students' academic self-efficacy. For example, using an academic self-efficacy questionnaire, Guo et al.[25] analyzed college students' academic self-efficacy and its influencing factors. Additionally, researchers used an academic self-efficacy questionnaire[26] to test the level of academic self-efficacy among nursing students. In this study, Cronbach's α coefficient was 0.815.

2.3 Data collection

From November to December 2016, we collected data among nursing students in Tianjin. With an 85.8% response rate, 429 questionnaires were returned, all of which were adapted for analysis.

2.4 Ethical considerations

This study was approved by Tianjin University of Traditional Chinese Medicine's Research Ethics Committee. Students who voluntarily participated were informed about the purpose of the study. Researchers also ensured that respondents' school records were unaffected, and they experienced no negative consequences for their participation in the study.

2.5 Data analysis

SPSS version 21.0 (IBM Corporation, Armonk, NY, USA) was used to analyze the data. Demographic characteristics of the study participants were summarized using descriptive statistics. Correlations among SDLR, academic self-efficacy, and problem-solving ability were analyzed by Pearson's correlation coefficient. The linear regression method was used to analyze the mediating effect of academic self-efficacy on the relationship between SDLR and problem-solving ability. To establish a valid mediation model, three requirements must be satisfied in three steps: the mediator (academic self-efficacy) must predict the independent variable (SDLR) in Step 1; the independent variable (SDLR) must be a predictor of the dependent variable (problem-solving ability) in Step 2; and the dependent variable (problem-solving ability) must predict the mediator (academic self-efficacy) in Step 3. Partial mediation will be considered if there is a significant relationship between the independent and dependent variables in Step 3.[27]

3. Results

3.1 Participant demographic characteristics

Participants' ages were between 17 and 25 years (mean: 21.3 years). Nursing student participants included 379 females (88.3%) and 50 males (11.7%). Five hundred students from different grades participated: 105 freshmen (24.5%), 105 sophomores (24.5%), 132 juniors (30.8%), and 87 seniors (20.3%). Most students (65.7%) were satisfied with their school's teaching methods. More than half of the students (67.1%) had no difficulty with learning and reported that they were satisfied with their major (53.14%). Most participants came from the village (48.5%), and the remainder were from the town (27.5%) and city (24%). The results are shown in Table 1.

Characteristics	n (%)
Gender	
Male	50 (11.7)
Female	379 (88.3)
Grade	
1	105 (24.5)
2	105 (24.5)
3	132 (30.8)
4	87 (20.3)
Living location	
City	103 (24)
Town	118 (27.5)
Village	208 (48.5)
Satisfaction with major	
Very much	19 (4.4)
Prefer	202 (47.0)
No feeling	185 (43.1)
Hate	23 (5.4)
Satisfaction with teaching methods	
Satisfied	17 (3.9)
Relatively satisfied	265 (61.8)
Uncertain	80 (18.6)
Less satisfied	59 (13.8)
Very dissatisfied	8 (1.9)
Learning difficulties	
No difficulties	288 (67.1)
Have little	130 (30.3)
Have more	11 (2.6)

Table 1. Demographic characteristics of the participants (*n*=429)

3.2 Scores of and correlations among variables

The total scores for SDLR and academic self-efficacy were 149.98 (standard deviation [SD] = 15.73) and 76.26 (SD=8.16), respectively, which were at the medium-to-high level. Further, problem-solving ability was at a low level, with a score of 85.14 (SD=10.08).

SDLR was remarkable when correlated with academic self-efficacy and problem-solving ability. Academic self-efficacy was significantly correlated with problem-solving ability. The four dimensions of problem-solving ability were related to the other variables, except ICS (Table 2).
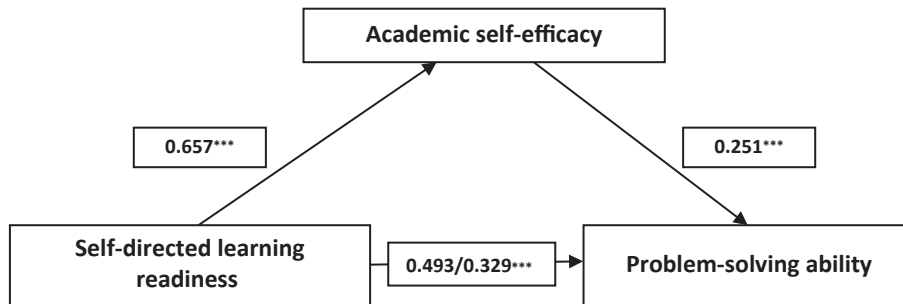
3.3 Mediating effect of academic self-efficacy on the relationship between SDLR and problem-solving ability

The results of the mediating effect of academic self-efficacy on the relationship between SDLR and problem-solving ability are shown in Table 3 and Figure 1. In Step 1, SDLR had a significant effect on academic self-efficacy (F=323.634, P=0.000). In Step 2, academic self-efficacy had a significant effect on problem-solving ability (F=118.84, P=0.000). In Step 3, when adding academic self-efficacy to the regression model in Step 2, the standardized coefficient decreased from 0.493 to 0.251, and the variance of SDLR explained by problem-solving increased from 24.3% to 27.9%. Academic self-efficacy predicted problem-solving ability. Moreover, the

Order	Item	1	2	3	4	5	6	7	8	9	10	11	12	13
1	SM	1												
2	DL	0.537*	1											
3	SC	0.616*	0.673*	1										
4	Total SDLR	0.849*	0.838*	0.890*	1									
5	NPO	0.210*	0.163*	0.219*	0.232*	1								
6	RPS	0.285*	0.393*	0.413*	0.420*	−0.37	1							
7	PPO	0.365*	0.502*	0.528*	0.537*	0.118*	−0.58*	1						
8	AS	0.294*	0.313*	−0.28*	0.346*	0.53*	0.125*	0.266*	1					
9	ICS	0.00	0.063	−0.024	0.012	0.270*	0.004	0.01	0.379*	1				
10	Total PSA	0.376*	0.452*	0.451*	0.493*	0.660*	0.481*	0.592*	0.808*	0.520*	1			
11	ASE	0.507*	0.431*	0.540*	0.576*	0.201*	0.353*	0.422*	0.173*	−0.067	0.339*	1		
12	BSE	0.557*	0.490*	0.509*	0.606*	0.291*	0.308*	0.432*	0.379*	0.134*	0.499*	0.621*	1	
13	Total academic self-efficacy	0.591*	0.512*	0.582*	0.657*	0.274*	0.366*	0.474*	0.308*	0.039	0.467*	0.898*	0.903*	1

Table 2. Pearson correlation coefficients of the variables (N = 429)

Notes: SM: self-management; DL: the desire to learn; SC: self-control; SDLR: self-directed learning readiness; NPO: negative problem orientation; RPS: rational problem-solving; PPO: positive problem orientation; AS: avoidance style; ICS: impulsivity/carelessness style; PSA: problem-solving ability; ASE: ability self-efficacy; BSE: behavioral self-efficacy.
*P<0.001.

Dependent variable	Independent variable	t	ß	R²	Adjusted R²
Academic self-efficacy	Self-directed learning readiness	17.99***	0.657	0.431	0.430
Problem-solving ability	Academic self-efficacy	10.90***	0.467	0.218	0.216
Problem-solving ability	Self-directed learning readiness	11.72***	0.493	0.243	0.242
Problem-solving ability	Self-directed learning readiness	6.027***	0.329	0.279	0.276
	Academic self-efficacy	4.598***	0.251		

Table 3. Mediating effect of academic self-efficacy on the relationship between self-directed learning readiness and problem-solving ability (N = 429)

Note: ***$P<0.001$.

Figure 1. Mediating effect of academic self-efficacy on the relationship between self-directed learning readiness and problem-solving ability.

Note: ***$P<0.01$.

Sobel test indicated a partial mediating effect of academic self-efficacy on the relationship between SDLR and problem-solving ability.

4. Discussion

The results of our research were consistent with the results from other studies and showed that SDLR was significantly positively correlated with problem-solving ability, indicating that higher levels of SDLR in nursing students leads to better problem-solving ability.[9,17] Further, academic self-efficacy had a remarkable positive correlation with SDLR and problem-solving ability. In their research, Wang et al.[28] and Zhang and Liu[29] showed that when the level of a student's academic self-efficacy increased, the level of the student's SDLR and the ability to solve problems also increased. This study suggested that academic self-efficacy was a partial mediator in the relationship between SDLR and problem-solving ability among nursing students.

SDLR is a major priority for the development of professional health education. Medical schools should not hesitate to cultivate nursing professionals' SDL ability, such that students' knowledge and skills can exceed beyond graduation, and they can form the habit of observation, thinking, and solving problems in study and life. To encourage students to engage in the process of SDL, Alotaibi[30] recommended that nursing educators pay attention to students' independence, especially during times of knowledge exploration and the evolution of technology. In turn, this ability will enhance their problem-solving abilities and academic performance.

However, in China, the majority of teaching strategies are teacher-centered, which provides students with little opportunity to discover, explore, or solve problems in continuing education programs.[31] This study demonstrated that Chinese nursing students' SDLR was at a medium-to-high level, but their problem-solving ability was at a low level, which was consistent with previous findings.[4,9,32] The ability to solve problems is particularly important for nursing students, especially in their clinical work, when they must plan and implement appropriate nursing interventions for their patients. Therefore, it is imperative for nursing educators to pay more attention to improving nursing students' problem-solving abilities.

In addition, previous research[33,34] showed that the impact of academic self-efficacy on individual development varied, and it was related to the individual's perception of their capabilities, such as thinking, goal-setting, and the ability to cope with difficulties, all of which can improve students' SDLR and problem-solving ability. With increased academic self-efficacy, students will have confidence in themselves. They learn how to set goals, solve problems, and bring a positive attitude to their studies.

Therefore, nursing educators face a common challenge of determining how to improve academic self-efficacy by increasing student confidence and how to foster the students' capabilities to be successful in school.

Academic self-efficacy partly mediates SDLR and problem-solving ability. This finding shows that nursing students with SDLR are likely to have a higher ability to solve problems. Furthermore, positive psychological effects, such as self-confidence, were conducive to solving problems.

Convenience sampling was used to extract the samples. We recruited students only from Tianjin, China, which may not be representative of all nursing students. Further research will be needed to expand the study sample and recruit students from different regions. Another limitation was that we used a Likert scale to conduct a quantitative analysis of nursing students' responses. Without a qualitative analysis, the effect of the evaluation was limited.

5. Conclusions

Problem-solving is considered an evaluation index of high-level thinking ability, and it is a core competency of nursing students.[35] Problem-solving can also influence nurses when making decisions related to their patients' outcomes in the clinic. Therefore, to achieve a better learning effect, educators must cultivate nursing students' problem-solving ability.

The findings of this study suggest that academic self-efficacy partly mediates SDLR and problem-solving ability. From the perspective of psychological cognition, nursing educators can enhance students' SDLR and problem-solving ability by improving their learning confidence and attitude. This study provides a basic understanding of the role of academic self-efficacy in the relationship between SDLR and problem-solving ability among nursing students.

Acknowledgments

Conflicts of interest

All contributing authors declare no conflicts of interest.

References

1. D'Zurilla TJ, Maydeu-Olivares A, Gallardo-Pujol D. Predicting social problem solving using personality traits. *Pers Indiv Differ*. 2011;50:142-147.
2. Lau Y. Factors affecting the social problem-solving ability of baccalaureate nursing students. *Nurse Educ Today*. 2014;34:121.
3. Yang SA. Critical thinking disposition and problem solving ability in nursing students. *Speech*. 2010;16:389-398.
4. Li Y, Yuan J. Relationship between self-directed learning ability and problem-solving ability of nursing undergraduates. *J Nurs*. 2015;22:44-47. (in Chinese).
5. Organization for Economic Cooperation and Development. http://www.oecdchina.org/. Accessed January 18, 2017.
6. Gagné RM. Domains of learning. *Interchange*. 1972;3:1-8.
7. Stayt LC, Merriman C. A descriptive survey investigating pre-registration student nurses' perceptions of clinical skill development in clinical placements. *Nurse Educ Today*. 2013;33:425-430.
8. Bayindir Çevik A, Olgun N. Do problem-solving skills affect success in nursing process applications? An application among Turkish nursing students. *Int J Nurs Knowl*. 2015;26:90-95.
9. Wang W. *Investigation of Nursing Students' Self-Directed Learning Ability and Problem-Solving Ability*. Shanghai: Fudan University; 2010. (in Chinese).
10. Knowles MS, Holton EF III, Swanson RA. *The Adult Learner: the Definitive Classic on Adult Education and Human Resource Development*. 8th ed. New York: Routledge; 2015.
11. Cazan AM, Schiopca BA. Self-directed learning, personality traits and academic achievement. *Soc Behav Sci*. 2014;27:640-644.
12. Zheng ZH, Chen JX, Zheng LW, Deng LJ. Study on students quo of self-directed learning readiness in undergraduate nursing factors. *Chin Nurs Res*. 2016;30:1945-1949. (in Chinese).
13. Accreditation Standards and Guidelines, ACPE – Accreditation Council for Pharmacy Education, ACPE – Accreditation Council for Pharmacy Education. http://www.acpe-accredit.org/standards/default.asp. Accessed January 25, 2017.
14. Choi E, Lindquist R, Song Y. Effects of problem-based learning vs. traditional lecture on Korean nursing students' critical thinking, problem-solving, and self-directed learning. *Nurse Educ Today*. 2014;34:52-56.

15. Struyf E, Beullens J, Van Damme B, Janssen P, Jaspaert H. A new methodology for teaching clinical reasoning skills: problem solving clinical seminars. *Med Teach*. 2005;27:364-368.

16. Williams B. Self direction in a problem based learning program. *Nurse Educ Today*. 2004;24:277-285.

17. Malekian M, Ghiyasvandian S, Cheraghi MA, Hassanzadeh A. Iranian clinical nurses' readiness for self-directed learning. *Glob J Health Sci*. 2015;8:157-164.

18. Cassidy S. Resilience building in students: the role of academic self-efficacy. *Front Psychol*. 2015;6:1781.

19. Zhang DQ. *Study on the Relationship Between Self-Regulated Learning Perceived Self-Efficacy and Academic Emotion of Medical Students-Taking the Management Majors' in A Medical University as an Example*. Taiyuan: Shanxi Medical University; 2016. (in Chinese).

20. Li BB, Xu JF. The influence of achievement goal orientation on English self-directed learning ability and the mediating effect of self efficacy. *Foreign Lang China*. 2014;3:59-68. (in Chinese).

21. Xiong L. *The Characteristics of Undergraduates' Social Problem Solving Ability and its Relationship with Self-Efficacy and Social Adaption*. Nanchang: Jiangxi Normal University; 2012. (in Chinese).

22. Fisher M, King J, Tague G. Development of a self-directed learning readiness scale for nursing education. *Nurse Educ Today*. 2001;21:516-525.

23. Huang HL, LI CY. Relationship between the problem solving abilities and clinical practice performances among undergraduate nursing students. *Mod Preventive Med*. 2015;42:1727-1729. (in Chinese).

24. Liang YS. *A Study on the Achievement Goal, Attribution and Academic Self-Efficacy of College Students*. Wuhan: Central China Normal University; 2000. (in Chinese).

25. Guo XR, Liu BY, Wang JX, Dong WT, Zhang YL. An analysis of College Students' academic self-efficacy and its influencing factors. *Sci Soc Psych*. 2016;31:21-24. (in Chinese).

26. Yuan QH, Lei XL, Gao JJ, Fan XZ. Relationships among academic self-efficacy, achievement motives and autonomous learning ability in nursing students. *J Nurs Sci*. 2008;2:48-51. (in Chinese).

27. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*. 1986;51:1173-1182.

28. Wang J, Zhang XL, Hao YL, Han RM, Sun PP. Influence of academic self-efficacy on self-directed learning ability in Nursing undergraduates. *J Chin Med Educ*. 2016;31:51-52. (in Chinese).

29. Zhang YM, Liu HY. An experimental study of the effect of curriculum-embedded performance assessment on the relationship of mathematical self-efficacy and mathematical problem solving ability. *J Educ Stud*. 2013;9:51-60. (in Chinese).

30. Alotaibi KN. The learning environment as a mediating variable between self-directed learning readiness and academic performance of a sample of Saudi nursing and medical emergency students. *Nurse Educ Today*. 2016;36:249-254.

31. Fang JB, Luo Y, Li YH, Huang WX. Social problem-solving in Chinese baccalaureate nursing students. *J Evid Based Med*. 2016;9:181-187.

32. Zhao L, Shen J, Tan M, Lei R. Study on the current situation and strategies of the academic self-efficacy of undergraduate nursing students. *China Med Herald.* 2012;9:143-145. (in Chinese).

33. Chen CM, Liu ZJ, Fan WJ, Li CH, Jiang LQ. Mediating effect of self-efficacy in relationship between self care and quality of life of colostomy patients. *Chin Nurs Res*. 2015;29:2024-2026. (in Chinese).

34. Cassidy S. Resilience building in students: the role of academic self-efficacy. *Front Psychol*. 2015;6:1781.

35. Jun WH, Lee G. The role of ego-resiliency in the relationship between social anxiety and problem solving ability among South Korean nursing students. *Nurse Educ Today*. 2017;49:17-21.