

# The correlation of metacognitive ability, self-directed learning ability and critical thinking in nursing students: A cross-sectional study

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## Abstract

**Aim:** To understand the status quo of metacognitive ability (MA), Self-directed learning (SDL) ability and critical thinking (CT) ability of five-year higher vocational nursing students as well as the correlation among them.

**Background:** MA, SDL ability and CT are the core abilities that nursing students must have and they are the important factors to improve students' nursing service quality and lifelong learning ability.

**Design:** A quantitative and cross-sectional descriptive study.

**Method:** The survey collected data from 3,047 five-year vocational nursing students with questionnaires April–May in 2020.

**Results:** The total score of MA was 81.18 (*SD* 13.51), SDL ability score was 220.28 (*SD* 35.09), and CT ability score was 271.96 (*SD* 26.08). The positive correlations were found between those three ( $p < .01$ ).

**Conclusions:** The overall metacognitive ability of nursing students was not high, SDL ability and CT ability were both at a medium level. Health educators need pay attention to cultivation and development of the core competencies.

## KEYWORDS

critical thinking, metacognitive ability, nursing students, self-directed learning

## 1 | INTRODUCTION

With the rapid change of medical knowledge and the continuous updating of practice guidelines, the nursing field is increasingly emphasizing that nurses need to undertake lifelong learning to develop professional knowledge and practical skills. The Institute of Medicine stressed in its report that nurses need to be prepared and able to lead change, promote health and participate in lifelong learning (Fitzpatrick, 2010). Bindon (2017) and Liu (2011) consider that philosophy of lifelong learning and competency are mainstays of

nursing practice. And the cultivation of nurses' lifelong learning can promote nursing career to be a more top profession (Steelman, 2014). Generally speaking, lifelong learning has been established as an essential component of nursing culture, yet there continues to be substantial obstacles to implementing lifelong learning into nursing practice (Bennion, 2015). Neglect to guide nursing students to use effective learning strategies is one of the obstacles. There are some core competencies that are thought to improve nursing students' learning strategies, enhance learning efficiency and promote the formation of lifelong learning skills, including Metacognitive ability

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(Basford, 2002; Hsu & Hsieh, 2014), Self-directed learning ability (SDL) (Song & Kim, 2015) and Critical Thinking (CT) (Basford, 2002; Novotny et al., 2016).

### 1.1 | Metacognitive ability

Metacognition is a kind of reflective thinking, which is described by Flavell (1979) as a process where cognitive patients recognize, monitor, feedback and adjust many cognitive factors affecting their own psychological states, task objectives and learning strategies. At the structural level, metacognition consists of metacognitive knowledge, metacognitive experience and metacognitive regulation. Although many scholars (Kluwe, ; Schraw, 2001; Wang et al., 2002) hold different opinions on the definition or structure of metacognition, the concept expounded by Flavell reflects the essence of cognition best and is recognized by the academic community. Of course, this kind of definition is based on the scope of psychology, it is uniquely understood by the educational community as students' understanding and regulation of their learning process or knowledge and their thinking, feelings and values of themselves or others (Gonullu & Artar, 2014). Because of the basic characteristics of scientific, humanistic and practical nature of nursing education, the metacognition of nursing will focus on the ability to check whether there is possible deviation in the diagnostic thinking, whether to view the disease from the perspective of the patient, or to evaluate what treatment or nursing plans the patient needs to know (Quirk & Ebrary, 2006). Furthermore, metacognitive knowledge represents the nursing knowledge stored in the mind, metacognitive experience involves the process of applying nursing knowledge to practice and metacognitive regulation is the skill of constantly summarizing, reflecting and evaluating in the metacognitive experience to improve the practical ability.

Metacognition can help students understand, analyse and adjust their cognition in the process of learning. It has been proved that metacognition can improve nursing students' academic performance (Safari & Meskini, 2015), affect general self-efficacy (Chen et al., 2019) and critical thinking (Arslan, 2015) and enhance their clinical decision-making ability (Zhou et al., 2018) and professional values (Chen et al., 2018). Medina, Castleberry and Persky, (2017) reported that metacognitive ability can be used to monitor, regulate, reason and solve problems in health professional education; teachers can help students develop metacognitive skills in classroom and environmental experience through effective teaching methods and learning activities during teaching. Josephsen (2017) proved that simulation design lends itself to the use of metacognitive strategies; nursing students would benefit from these strategies being implemented throughout prebriefing, simulation and debriefing. Other methods such as problem-based learning (PBL) (Mohammad et al., 2016; Yu et al., 2015) and the use of examination wrappers (Poorman & Mastorovich, 2016; Schuler & Chung, 2019; Williams, 2019) can also help nursing students develop good learning habits and significantly improve their metacognitive level. Current studies have shown that

nursing students have poor or moderate levels of metacognitive abilities (Liu et al., 2017; Wei et al., 2019; Ye et al., 2018), but the survey data of nursing students in five-year Higher Vocational Technical School of Health are still lacking. Therefore, one of the purposes of this study is to show the five-year higher vocational nursing students' metacognitive ability level.

### 1.2 | Self-directed learning

SDL is described as the process where the learner actively judges his learning needs with or without the help from others, formulates learning objectives, determines human and material resources for learning, selects and implements appropriate learning strategies and evaluates learning outcomes (Van Lankveld et al., 2019). SDL is a kind of self-teaching where learners make learning plans and conduct learning activities. It has the necessary personal attributes such as goal orientation, autonomy, self-management and motivation (Behar-Horenstein et al., 2018). Markant et al. (2014) reported that SDL involves a series of decision-making and control process; the improvements to memory following self-directed encoding are related to the learner's current learning state or ability to coordinate attention. After the learning information in the environment is connected to the internal needs of learning, SDL can build learning content according to individual needs to regulate the learning process to improve academic performance. Some studies have shown that there is no obvious gender difference in the SDL scores of nursing students (Jafari Sani et al., 2013; Veskarami et al., 2012). However, Li et al. (2016) suggested that there were no differences in nursing students' SDL scores across gender. The grade of the nursing students proved to be one of the factors affecting the level of SDL, the higher the grade, the stronger the self-directed learning ability (Chen et al., 2016; Tao, 2014). But Tang et al.'s (2015) research showed that grade is significantly negatively correlated with SDL ability. In addition, factors such as learning motivation (Samarasooriya et al., 2019), self-directed learning experience (Shen et al., 2012), personality type (Slater et al., 2017) and group learning (Arpaichiraratana & Attharos, 2015) all have a certain degree of influence on the SDL ability of nursing students. It has been proved that the PBL teaching method can stimulate the motivation of nursing students to learn actively, increase students' self-confidence in learning and have a significant effect on improving the SDL ability of nursing students (Gabr & Mohamed, 2011; Liu, 2018). However, studies have shown that the SDL ability of nursing students is still at a low level (Smedley, 2016; Liao & Ni, 2017). Therefore, the methods used to improve the SDL ability of nursing students require more attention.

### 1.3 | Critical thinking

CT is expressed as a purposeful, self-supervised judgment process and reflects the thinking process of interpretation, reasoning, analysis and evaluation (Hajrezayi et al., 2015). And CT is considered an

essential component of nursing science (Jones & Brown, 1991), for it emphasizes the ability to accurately analyse, judge and collect information for logical reasoning and knowledge adaptation (Scheffer & Rubenfeld, 2000). Nursing students and nurses need to use critical thinking skills (CTS) to comprehensively analyse patient data and conditions and then make accurate judgments to effectively solve nursing problems during the nursing practice or when facing patients with complicated conditions. Tiwari et al. (2003) found that there was a significant difference in critical thinking disposition between nursing students in Hong Kong China and Australia; the reason could be attributed to institutional, educational, professional and cultural factors, with implications for education and practice alike. He proposed the environments where nurses learn and practise should model a critical culture that nurtures and support the disposition and skills of critical thinking. A cross-sectional study in South Korea (An & Yoo, 2008) showed that CT was positively correlated with the academic performance of nursing students, and there were significant grade differences in CT scores. However, Sun's (2011) longitudinal research showed that there was no significant difference in the CT scores of the same nursing students in different periods and different grades. Mary et al. (2016) reported that the use of reflective diary method and scenario simulation method can independently promote the development of CT for nursing students. The simulation method gives nursing students the opportunity to develop clinical practice and communication skills and can guide them to adopt the method of reflective diary to assist nursing professional learning. Furthermore, case analysis method (Poodineh Moghadam et al., 2015; Yoo & Park, 2015) can guide nursing students to evaluate and analyse clinical problems, reason and reflect and improve students' critical thinking ability. And conceptual mapping teaching (Burrell, 2014; Mohammadi et al., 2019; Odreman & Clyens, 2020) enhances the sense of learning experience by encouraging nursing students to understand and process information in a deeper level. It is a cognitive tool that can effectively improve nursing students' CTS.

## 2 | METHODS

### 2.1 | Study purpose

The purposes of this research were as follows: (a) to describe the current level of metacognitive ability, self-directed learning ability and CT of nursing students in five-year higher vocational colleges, (b) to compare the metacognitive ability, self-directed learning ability and CT between higher vocational nursing students in grades 1–4, and (c) to explore the relationship between nursing students' metacognitive ability, self-directed learning ability and CT.

### 2.2 | Study design and participants

A cross-sectional, correlational design was used in this study. A convenience sample of nursing students was chosen for participation;

inclusion criteria were five-year higher vocational nursing students in their first, second, third and fourth year at seven higher vocational technical schools of health in Jiangsu, China. Exclusion criteria were nursing students who were unwilling to cooperate with the investigation.

### 2.3 | Data collection

The Questionnaires were conducted through the online survey, including socio-demographic data such as age, gender and year of schooling and the Metacognitive Ability Scale (Kang & Zhang, 2005), Self-Rating Scale For Self-Directedness in Learning (SRSSDL, Shen & Hu, 2011) and Critical Thinking Disposition Inventory-Chinese Version (CTDI-CV, Peng et al., 2004). The survey based on the class was assisted by the class teacher. Students completed the questionnaires by clicking on the link posted in the class WeChat group from April–May in 2020. Of a total of 3,047 students, 3,000 responded and completed all the items in the questionnaires (response rate 98.46%). Instruments used in this study are described below.

#### 2.3.1 | Metacognitive ability scale

This scale was developed by Kang and Zhang (2005) to measure the metacognitive ability of Chinese college students. It has a total of 24 items including four dimensions: metacognitive planning (7 items), metacognitive monitoring (6 items), metacognitive regulating (6 items) and metacognitive evaluating (5 items). Those items are rated using a 5-point Likert-type scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often and 5 = always). And the total score ranges from 24–120, the higher the score, the stronger the metacognitive ability. The Cronbach's alpha of this scale has been reported to be 0.93, and the Cronbach's alpha values for metacognitive planning, metacognitive monitoring, metacognitive regulating and metacognitive evaluating are 0.87, 0.83, 0.85 and 0.79, respectively. The content validity and construct validity of the scale have been reported to be acceptable.

#### 2.3.2 | SRSSDL

The original SRSSDL was compiled by Williamson (2007). The SRSSDL used in this study was adapted to the Chinese language and culture by Shen and Hu (2011). And it is divided into five dimensions of learning awareness, learning strategy, learning behaviour, learning evaluation and interpersonal skills, with 12 items in each dimension, a total of 60 items. The response alternatives are on a five-point Likert scale, scoring of the items is as follows: 1 = never, 2 = rarely, 3 = sometimes, 4 = often and 5 = always. All entries are scored positively; the total score ranges from 60–300, higher scores indicating better SDL ability. The Cronbach's alpha

of this scale has been reported to be 0.966, and its retest reliability is 0.855.

### 2.3.3 | CTDI-CV

This scale was adapted to the Chinese language by Peng et al. (2004) from Facione et al.'s (1994) California Critical Thinking Disposition Inventory (CCTDI), and it is composed of 7 dimensions: truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness and maturity. Each dimension has 10 items, a total of 70 items. The Cronbach's alpha of seven dimensions are from 0.54–0.77, the Cronbach's alpha of this scale has been reported to be 0.90 and its content validity is 0.89. The response alternatives are on a six-point Likert scale (6 = strongly agree, 5 = agree, 4 = basically agree, 3 = not very agree, 2 = disagree and 1 = strongly disagree), and 40 of them are reverse scoring. A score of  $\leq 30$  in each dimension indicates that the CT ability in this aspect is negative; 31–39 indicates the medium CT ability and  $\geq 40$  indicates the positive CT ability. The total score of 70 items is the total score, the total score  $\leq 210$ , representing the negative CT ability, 211–279, representing the medium CT ability and  $\geq 280$ , representing the positive CT ability.

## 2.4 | Data analysis

The data were coded and analysed using IBM SPSS Statistics 22.0. The measurement data were expressed by mean (M), standard deviation (SD), minimums (MIN) and maximums (MAX). The categorical data were described by frequency and percentage. The correlation between two variables was explored using Pearson's correlation coefficient. ANOVA was used for comparison of means between multiple groups; the least significant difference method (LSD) or Games–Howell method was used for pairwise comparisons; mean test between two groups was performed using two independent sample *t* tests. All analysis adopts the inspection level  $\alpha = 0.05$ .

## 2.5 | Ethical considerations

Written permission from the nursing faculty. Prior to recruitment, the nursing students received information about the study, including the purpose of the research and the specific process and the anonymity was guaranteed. The students were further informed that participation would be voluntary. No individually identifiable data were requested from the participants, and the anonymity of all data was ensured. If someone completed and submitted the questionnaire, it was considered informed consent to participate in the study.

## 3 | RESULTS

### 3.1 | Participants and characteristics

Most nursing students were female ( $N = 2,779$ , 92.63%), and 7.37% were male ( $N = 221$ ). The participants' average age was 17.6 years ( $SD$  1.44), ranging from 14–22 years. Among all the participants in the survey, the number of students in the fourth grade was the largest ( $N = 937$ , 31.23%) and the second grade had the smallest number ( $N = 638$ , 21.27%). There were 697 people in the first grade, accounting for 23.23%. The number of the third grade accounted for 24.27% ( $N = 728$ ). Approximately 90% of the students ( $N = 2,691$ ) believed they had clear learning objectives, while 10.30% ( $N = 309$ ) thought their learning goals were not clear. Only 29.14% ( $N = 882$ ) of students often participated in group study. 81.47% ( $N = 2,444$ ) of the students thought they had interested in nursing. 83.73% ( $N = 2,512$ ) planned to work as nurses after graduation, while 1.47% ( $N = 44$ ) determined to change profession. Detailed data of the characteristics were presented as frequency and percentage in Table 1.

**TABLE 1** Background characteristics of the nursing students ( $N = 3,000$ )

Characteristics	<i>n</i>	%
Gender		
Male	221	7.37
Female	2,779	92.63
Grade		
1	697	23.23
2	638	21.27
3	728	24.27
4	937	31.23
Clear learning objectives		
Yes	2,691	89.70
No	309	10.30
Study in groups		
Often	882	29.14
Average	1,791	59.70
Occasionally	246	8.20
Never	81	2.70
Interested in nursing		
Yes	2,444	81.47
No	556	18.53
Career preference		
Engaged in nursing	2,512	83.73
Likely to change profession	444	14.80
Determine to change profession	44	1.47

### 3.2 | Metacognitive ability

Adopt scoring rate (SR) to compare the scores of metacognitive ability scale' each dimension for they have different number of items. And  $SR (\%) = \text{actual score} / \text{theoretical maximum score} \times 100\%$ . The nursing students' total score of metacognitive ability (MA-TS) was 81.18 (*SD* 13.51, *SR* = 67.65%), metacognitive evaluating score was 17.23 (*SD* 3.05, *SR* = 68.92%), metacognitive monitoring score was 20.53 (*SD* 3.43, *SR* = 68.43%), metacognitive planning score was 23.40 (*SD* 4.24, *SR* = 66.86%), and metacognitive regulating score was 20.01 (*SD* 3.63, *SR* = 66.70%). It was shown that metacognitive evaluating got the highest SR, yet metacognitive regulating got the lowest one.

### 3.3 | SDL ability

The five-year higher vocational nursing students had the medium SDL ability for the SDL ability total score (SDL-TS) was 220.28 (*SD*

35.09, *SR* = 73.43%); the scores of five dimensions from the highest to the lowest were as follow:

interpersonal skills (mean = 44.76, *SD* 7.62), learning awareness (mean = 44.65, *SD* 7.27), learning strategies (mean = 44.07, *SD* 7.55), learning evaluation (mean = 43.73, *SD* 7.70) and learning activities (mean = 43.08, *SD* 7.43).

### 3.4 | CT ability

CT ability total score (CT-TS, mean = 271.96, *SD* 26.08, *SR* = 64.75%) represented that those nursing students had the medium CT ability. Inquisitiveness dimension got the highest score (mean = 42.18, *SD* 26.08), then the analyticity (mean = 40.94, *SD* 5.67), open-mindedness (mean = 40.19, *SD* 5.15) and maturity (mean = 40.02, *SD* 6.76). And the scores of the above four dimensions were all over 40, which means that students had positive CT skills in these dimensions. The other three dimensions as systematicity (mean = 38.06, *SD* 5.27), truth-seeking (mean = 36.51, *SD* 6.50) and self-confidence

**TABLE 2** Comparison of metacognitive ability, SDL and CT ability scores of nursing students with different background characteristics (N = 3,000)

Characteristic	Metacognitive	Ability	SDL	Ability	CT	Ability
	M (SD)	t/F	M (SD)	t/F	M (SD)	t/F
Gender		-0.072		-0.483		-1.453
Male	81.10(16.40)		219.01 (40.90)		269.00 (31.89)	
Female	81.18(13.26)		220.38 (34.59)		270.20 (25.55)	
Grade		9.808 <sup>*</sup>		8.17 <sup>*</sup>		38.028 <sup>*</sup>
1	81.08(14.04)		220.29 (36.20)		268.99 (25.44)	
2	79.13(13.11)		215.80 (36.28)		266.53 (25.96)	
3	80.90(13.49)		218.91 (34.83)		270.38 (25.31)	
4	82.84(13.20)		224.39 (33.18)		279.12 (25.73)	
Clear learning objectives		18.433 <sup>*</sup>		17.205 <sup>*</sup>		12.840 <sup>*</sup>
Yes	82.45(13.19)		223.62 (33.97)		273.62 (26.18)	
No	70.05(10.95)		191.19 (31.06)		257.56 (20.12)	
Study in groups		203.564 <sup>*</sup>		198.049 <sup>*</sup>		53.985 <sup>*</sup>
Often	89.33(14.91)		241.39 (34.46)		280.65 (28.50)	
Average	78.63(10.65)		213.44 (30.47)		269.27 (23.53)	
Occasionally	74.20(12.06)		204.02 (31.96)		264.03 (26.61)	
Never	69.88(15.77)		191.05 (39.13)		261.06 (26.26)	
Interested in nursing		13.246 <sup>*</sup>		11.732 <sup>*</sup>		9.896 <sup>*</sup>
Yes	82.71(13.07)		223.78 (33.89)		274.00 (26.32)	
No	74.43(13.35)		204.87 (36.13)		263.01 (22.99)	
Career preference		35.311 <sup>*</sup>		31.014 <sup>*</sup>		13.597 <sup>*</sup>
Engaged in nursing	82.08(13.26)		222.43 (34.10)		273.04 (25.94)	
Likely to change profession	76.63(13.50)		210.00 (36.99)		266.69 (26.31)	
Determine to change profession	75.59(17.36)		201.05 (46.02)		263.64 (24.34)	

\**p* < .05.

(mean = 34.09, SD 5.25) showed that the students got the medium CT ability in these areas.

### 3.5 | Comparison of metacognitive ability, SDL and CT ability scores of nursing students with different general information

Except for gender, there were statistically significant differences in the scores of the three abilities of five-year higher vocational nursing students with other factors ( $p < .05$ ) (Table 2). Nursing students who had clear learning goals, often participated in group studies, who were interested in nursing and willing to engage in nursing work in the future had significantly higher scores on the three abilities than others. Games-Howell analysis results illustrated the SDL ability scores of the fourth-grade nursing students were higher than the second and third grade ( $p < .05$ ), LSD showed the metacognitive ability and CT ability scores of the fourth grade were significantly higher than other grades, the scores of these two abilities of the third-grade nursing students were significantly higher than that of the second grade ( $p < .05$ ).

### 3.6 | Relationships between metacognitive ability, SDL ability and CT ability

The results showed positive and significant relationships between the nursing students' metacognitive ability and SDL ability ( $r = 0.663$ ,  $p < .01$ ), metacognitive ability and CT ability ( $r = 0.461$ ,  $p < .01$ ), SDL and CT ( $r = 0.466$ ,  $p < .01$ ). Furthermore, positive relationships were found between the subscales of MA and SDL ability ( $r$  ranging from 0.540–0.616), subscales of MA and CT ability ( $r$  ranging from 0.109–0.433), and subscales of SDL and CT ability ( $r$  ranging from 0.146–0.436). Pearson's correlations among their subscales were reported in Tables 3 and 4.

**TABLE 4** Correlation coefficients between nursing students' SDL ability and CT ability

Variables	SDL1	SDL2	SDL3	SDL4	SDL5	SDL-TS
CT-TS	0.444*	0.417*	0.409*	0.435*	0.473*	<b>0.466*</b>
CT1	0.175*	0.146*	0.162*	0.160*	0.192*	0.179*
CT2	0.197*	0.196*	0.169*	0.204*	0.246*	0.217*
CT3	0.312*	0.292*	0.263*	0.297*	0.332*	0.320*
CT4	0.421*	0.372*	0.389*	0.399*	0.394*	0.423*
CT5	0.372*	0.369*	0.381*	0.373*	0.377*	0.401*
CT6	0.402*	0.403*	0.380*	0.408*	0.436*	0.435*
CT7	0.174*	0.155*	0.149*	0.171*	0.205*	0.183*

\* $p < .01$ .

Abbreviations: CT1, truth-seeking; CT2, open-mindedness; CT3, analyticity; CT4, systematicity; CT5, self-confidence; CT6, inquisitiveness; CT7, maturity; SDL1, learning awareness; SDL2, learning strategy; SDL3, learning behaviour; SDL4, learning evaluation; SDL5, interpersonal skills.

**TABLE 3** Correlation coefficients between nursing students' metacognitive ability, SDL ability and CT ability

Variables	M1	M2	M3	M4	MA-TS
SDL-TS	0.633*	0.618*	0.625*	0.617*	<b>0.663*</b>
SDL1	0.616*	0.603*	0.612*	0.600*	0.646*
SDL2	0.575*	0.561*	0.567*	0.564*	0.603*
SDL3	0.606*	0.586*	0.597*	0.574*	0.629*
SDL4	0.603*	0.586*	0.604*	0.598*	0.636*
SDL5	0.555*	0.554*	0.540*	0.544*	0.583*
CT-TS	0.435*	0.444*	0.417*	0.441*	<b>0.461*</b>
CT1	0.119*	0.118*	0.109*	0.116*	0.123*
CT2	0.172*	0.199*	0.172*	0.206*	0.197*
CT3	0.338*	0.364*	0.322*	0.347*	0.364*
CT4	0.433*	0.421*	0.419*	0.416*	0.449*
CT5	0.431*	0.423*	0.399*	0.397*	0.439*
CT6	0.415*	0.418*	0.396*	0.428*	0.439*
CT7	0.126*	0.136*	0.133*	0.148*	0.143*

\* $p < .01$ .

Abbreviations: CT1, truth-seeking; CT2, open-mindedness; CT3, analyticity; CT4, systematicity; CT5, self-confidence; CT6, inquisitiveness; CT7, maturity; M1, metacognitive planning; M2, metacognitive monitoring; M3, metacognitive regulating; M4, metacognitive evaluating; SDL1, learning awareness; SDL2, learning strategy; SDL3, learning behaviour; SDL4, learning evaluation; SDL5, interpersonal skills.

## 4 | DISCUSSION

This study revealed that five-year higher vocational nursing students' metacognitive ability was not high, and they had the moderate levels of SDL ability and CT ability. The five-year higher vocational nursing students' metacognitive ability was like some studies (He et al., 2007; Xing et al., 2017; Zhang, 2012). But it was slightly lower than Lu and Yin's (2015) research on undergraduate nursing students and this cued metacognitive ability may be related



to nursing students' own cultural quality or the degree of academic qualifications. Furthermore, five-year higher vocational nursing students had the highest score rate in the metacognitive evaluation dimension and the lowest score rate in the metacognitive regulating, consistent with Ye et al.'s (2018) research. On one hand, these results showed that nursing students' ability to think independently had been improved. During the learning process, they can be aware of the learning strategies they have adopted and pay attention to evaluating the learning effects. By analysing the deficiencies in learning, they constantly adjust the learning strategies and improve their self-reflection ability in improvement. On the other hand, they may failure to accurately master the skills to adjust their learning strategies in time. In general, there was still much room for improvement in the metacognitive ability of five-year higher vocational nursing students. Moreover, the metacognitive ability of fourth-grade nursing students was significantly higher than that of other grades, but Tang and Chen's research (2013) showed that there is no grade difference in the metacognitive ability of nursing students. The survey data of Zhang et al. (2014) showed that metacognitive scores of nursing students who were interested in nursing are significantly higher than those not. The findings of this study were consistent with this conclusion.

The research's result about the students' SDL ability was like some other studies (Chen et al., 2016; Lin, 2019; Su et al., 2015). However, its' scoring rate was much lower than that of undergraduate nursing students in Italian (mean = 160.79, SR = 80.40%, Cadarin et al., 2016). It illustrated that there was a certain SDL ability difference between vocational nursing students and foreign nursing students. This may be related to the educational environment, teaching concept, cultural background and students' thinking characteristics. In addition, the ranking of scores in SDL' s each dimension in this study which showed that five-year higher vocational nursing students were good at interpersonal skills, but poor at learning activities were the same as Shen et al.'s (2012). It can be seen that the nursing students pay attention to the interpersonal communication and interaction during the learning process. When they encounter problems, they can maintain information communication with others and effectively seek help. However, they were not good at thinking and summarizing the related questions raised by educators in the teaching process and the learning behaviour lacked initiative and scientificity. The SDL ability of fourth-grade nursing students was significantly higher than that of second grade and third grade. Although fourth-grade scores were higher than those of first grade, there was no significant difference in this gap ( $p > .05$ ). The possible reason was that the first-year students had just been exposed to professional knowledge learning, which was full of motivation for learning and exploration. And because of the pressure of internship and employment, the fourth-year students still maintained the initiative of learning.

CT ability was consistent with some other studies (Cai et al., 2018; Mao et al., 2015; Sun et al., 2012). The survey from Turkey (Atay & Karabacak, 2012) and the USA (Stewart & Dempsey, 2005) showed that nursing students have a moderate critical thinking tendency,

which was similar to the survey data of this study. Besides, it also showed that five-year higher vocational nursing students had the positive critical thinking tendency in inquisitiveness, analyticity, open-mindedness and maturity, while the moderate levels in the other three dimensions, which was similar to that reported by Li et al. (2007). This study showed that the five-year vocational nursing students have the positive thinking ability in inquisitiveness, which consistent with the results of a survey (Yeh, 2002) among undergraduate nursing students in Taiwan. At the same time, the research showed the vocational nursing students' self-confidence was the weakest, which meant the vocational educators should pay more attention to improve students' tendency to trust reflective thinking when solving problems. The critical thinking ability of the fourth grade was significantly higher than other grades, probably because the fourth-grade students were familiar with nursing professional knowledge and clinical nursing practice skills and had experienced more clinical practice exercises. The CT ability of the third-grade students is higher than that of the second grade. But Fu et al.'s (2010) longitudinal study in undergraduate nursing students drew the opposite conclusion. The educational method of training nursing students in schools may be a factor that affects the development of CT ability in nursing students. Another reason for this result may be due to the different research methods.

This study also found positive correlations between metacognitive ability, SDL ability and CT ability. Those outcomes supported Liu and Zhao's (2005) theory of CT ability training, Gonullu and Artar's (2014) analysis of metacognition in medical education and Yu et al.'s (2014) longitudinal study. The correlation coefficient between metacognitive ability and SDL ability was 0.663, which meant they had positive and significant relationships and Samarasooriya et al.'s (2019) research proved this point. Zhang et al.'s (2014) study showed that those students who were interested in nursing were better at using metacognitive strategies for learning. Nursing students who often joined group learning performed stronger SDL ability (Shen et al., 2012). Students who did not against the nursing profession or prefer to engage in nursing behaved higher level of CT (Tan et al., 2015). In this study, we found that five-year higher vocational nursing students, who were interested in nursing major, had clear learning goals, often participated in group study and were willing to engage in nursing career got the higher scores of those three core competencies than the others ( $p < .05$ ).

#### 4.1 | Limitations

The research used the design of cross-sectional survey, it can just represent the ability state of students at a certain point in time and it was impossible to draw the trend of those three abilities development, nor to determine the directions of causality. In addition, this study included only five-year vocational nursing students in and used the convenient sampling. The sample may not fully represent the status of these three core competencies of all five-year vocational nursing students in. Further research on more sample sizes in

more regions is awaited. The universality of these conclusions needs to be verified by the researches of more samples in more regions in the future.

## 4.2 | Conclusions

The overall metacognitive ability of the five-year vocational nursing students was not high, and the SDL ability and CT ability were both at a medium level. Furthermore, positive correlations were found between the three. In the future, more longitudinal studies and multi-centre large sample studies are still needed to validate and supplement this study. For the present, health vocational educators should pay attention to the cultivation and development of five-year vocational nursing students' core competencies by increasing students' self-confidence and interest in nursing major study, encouraging students to participate in the exchange and cooperation of the learning situation between the groups, improving professional recognition of nursing students.

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## CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

## AUTHOR CONTRIBUTIONS

Meijuan Jin: Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data. Cheng Ji: Involved in drafting the manuscript or revising it critically for important intellectual content, given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## DATA AVAILABILITY STATEMENT

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