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# The Development of Structural Equation Model of Critical Thinking among Nursing Students

**Kanjana SRISAWAD[1,*], Thanin RATANA-OLARN[2] and Krissana KIDDEE[2]**

*[1]Faculty of Nursing, Kasem Bundit University, Bangkok 10510, Thailand*
*[2]Department of Industrial Education, Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand*

**([*]Corresponding author's e-mail: naza_cmu@hotmail.com)**

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**Abstract**

These were to study the critical thinking of nursing students, and to develop and check the goodness of fit of the Structural Equation Model of critical thinking among nursing students, which was compared with an empirical data set. There were 549 first year nursing students. Multi-stage random sampling was used in this research, by cluster random sampling from 20 private higher education institutions that provide nursing courses, comprising 25 percent, and random sampling 5 private higher education institutions, in order to gain 549 samples for this study. These were critical thinking questionnaires and variable effects of critical thinking questionnaires. The data was analyzed by descriptive statistics and the Structural Equation Model. This research indicated that the goodness of fit test of the Structural Equation Model of critical thinking among nursing students was applicable. The results showed the following statistical values: Chi-square = 284.895, df = 248, p-value = 0.054, RMSEA = 0.016, RMR = 0.009, GFI = 0.968, CFI = 0.997 and $\chi^2$/df = 1.149; this indicated that the Structural Equation Model goodness of fit matched the empirical data quite well. The Self Efficiency, Emotional Intelligence, and Learning Style variables had positively direct effects on critical thinking ($b$ = 0.371, 0.370 and 0.376). The Internal Locus of Control had a negatively direct effect on critical thinking ($b$ = –0.120). In conclusion, in theoretical and practical teaching, nursing academies should promote critical thinking among nursing students by using the following variables: self-efficiency, emotional intelligence, learning style, and internal locus of control. This model should be used to develop complementary courses on critical thinking for nursing students.

**Keywords:** Structural equation model, critical thinking, nursing students

## Introduction

Critical thinking is important for professional nursing. Nursing is regarded as holistic care, requiring the application of both sciences and arts to patient treatment. As a result, critical thinking is important for nursing. For learning management in the 21st Century, it is important for learners to possess critical thinking [1]. The Nursing Council of Thailand defined critical thinking as a main competency of Thai nursing and midwifery [2]. Critical thinking for nursing is required because registered nurses must have unique knowledge in order to explain situations which are significant for nursing science and require reasonable thinking and deliberate consideration. Nursing practice is a professional practice, which must include technical and conceptual knowledge about nursing, and the ability to apply nursing science to other sciences for proper practice. Therefore, nursing students necessarily require critical thinking skills [3,4].

Facione and Facione [5] showed that critical thinking was a necessary skill for clinical decision competency. Critical thinking consists of 2 elements. The first element is critical thinking skill, which incorporates thinking skills from other experiences, such as interpretation, analysis, evaluation, inference, explanation, and meta-cognitive self-regulation skills. The second element is the disposition component of critical thinking, a personal characteristic which supports the intellectual development process. It consists of truth-seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and maturity. Previous studies found that most critical thinking of nursing students was at a medium level [6,7]. Studies on a comparison of critical thinking in nursing students found that the level of critical thinking in first year nursing students was lower than the second, third, and fourth year nursing students [6]. Schools should emphasize critical thinking of nursing students. If nursing students have critical thinking, nursing practice will be high-quality. Studies on effected variables which influence critical thinking in nursing students identified self-efficiency, consisting of vicarious experience, verbal persuasion, enactive attainment, and physiological and affective; internal locus of control, consisting of beliefs about the actions that are needed to share intelligence, beliefs about learning, and beliefs about the fate; emotional intelligence, consisting of self-awareness, motivation, self- regulation, social skills, and empathy, and learning style, consisting of avoidance, competitive, participant, collaborative, independence, and dependent [8-11], and these were used to develop a Structural Equation Model for critical thinking of nursing students. The analysis was done along structural equation model concepts in order to improve and examine the accord of Structural Equation Model development of critical thinking in nursing students in private higher education institutions. There were no previous studies on nursing students from private higher education institutions. This research was interested in studying first year students from private higher education institutions, as it could provide guidelines for critical thinking skill development for nursing students before they start their nursing professions. It was developed with empirical data in order to provide technical and practical models on critical thinking in nursing students.

## Materials and methods

### The sample

The sample of this study consisted of first year nursing students at private higher education in 2014. The sample size was determined based on criteria of Hair *et al*. [12]. The size of the sample and the number of observed variables in the confirmatory factor analysis should be in the ratio of 10 - 20 observations per observed variable. Multi-stage random sampling was used in this study, and the researcher gained a sample of 549 people by determining the sample size and random samples using statistical sampling methods. The multi-stage random sampling process is as follows:

1. Cluster random sampling from 20 private higher education institutions which provide nursing courses.

2. Using 25 percent from 20 private higher education institutions which provide nursing courses, and random sampling of 5 private higher education institutions: Siam University, Huachiew Chalermprakiet University, Vongchavalitkul University, Western University, and the College of Asian Scholars, in order to gain 549 samples.

### Research instruments and validity test:

1. Questionnaire on general information of nursing students.

2. Critical thinking questionnaire, consisting of a critical thinking skills test. The researcher improved it from the critical thinking test of Amonchai [13] and Yamsuda [14], which was translated and adapted from Facione and Facione, to be used with nursing students. There were 20 multiple choice questions of critical thinking skills test, 7 questions using a 5 rating scale of meta-cognition self-regulation test, and 39 questions using a 5 rating scale of disposition component critical thinking test, using content validity. The content validity was tested based on a determining consistency index. In this part, validity was calculated to be 0.86, difficulty index was from 0.47 to 0.60, and discrimination value was from 0.36 to 0.80. Reliability, tested with Kuder Richson – 20, was 0.90. The result of the meta-cognition self-regulation measure showed that the consistency index was 0.86. The reliability test of

internal consistency, based on Cronbach's alpha coefficient, was 0.87. Disposition component critical thinking validity value was 0.86, and reliability value was 0.87.

3. Measurement of critical thinking related variables. Such variables consisted of self-efficiency, internal locus of control, emotional intelligence, and learning style. Validity value was from 0.86 to 1.00, and reliability value was from 0.80 to 0.97.

**Data analysis**

Preliminary data of the samples were analyzed using frequency and percentage. Data on the critical thinking were analyzed by determining the mean and standard deviation, as well as using the analysis structural equation model.

Primary assumption checking was as follows:

1. The samples were random, from populations with normal distribution, and tested with skewness and kurtosis.

2. The variable correlation was examined by using Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity in order to check the information suitability.

3. KMO over 0.50 showed that the data was suitable and could be analyzed.

4. Bartlett's test of sphericity must be/with significance showed that the variables were relevant enough to be analyzed.

5. Checking the merging/compatibility of the Structural Equation Model of critical thinking in nursing students from private higher education institutions with empirical data using the AMOS program, considering chi-square statistics, Goodness of Fit (GFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Error of Approximation (RMSEA).

6. Goodness of fit measures were used to study the overall model, and if it fitted the empirical data. The researcher used the following statistic methods [15]:

6.1 Chi-square statistics were used to test the hypothesis that the compliance function was zero if Chi-square statistics was very low or close to zero, showing that the data were consistent with the empirical data.

6.2 Goodness of Fit Index was the ratio of the difference between compliance function from the previous model and the adjusted model to function. If the GFI was close to 1.00, it showed that the model was consistence to the empirical data.

6.3 Adjusted AGFI was used by adjusted GFI regardless of the size of variables and samples. The used value was the same as GFI; if the AGFI approached 1.00, it showed that the model was consistence to the empirical data.

6.4 RMSEA indicated the inconsistency of the created model with the model covariance matrix of the population. An acceptable value close to 0 showed that the created model was consistent with the model.

The researcher has developed criteria to determine the consistency between the hypothesis models with the empirical data, as shown in **Table 1**.

**Table 1** Criteria to determine consistency.

| Index | The acceptance level |
|---|---|
| 1. Chi-square statistics ($\chi^2$) | $\chi^2$ insignificant, or P-value higher than 0.05, shows consistency |
| 2. $\chi^2$/df Ratio | value should not exceed 2 |
| 3. Goodness of Fit Index | approach 1 |
| 4. Adjusted Goodness of Fit Index | approach 1 |
| 5. Tucker-Lewis Index | approach 1 |
| 6. Standardized Root Mean Square Residual | approach 0 |
| 7. Root Mean Square Error of Approximation | approach 0 |

**Results**

This study aimed to development the Structural Equation Model of critical thinking of nursing students in private higher education institutions. The results were as follows:

1. General information of the samples

Most of the samples were females (89.44 %); 1.56% were males. The samples were mostly aged less than 20 years old (69.58 %), aged 20 - 22 years old (21.12 %), and those aged more than 22 years old (9.30 %). Most of them were Buddhist (96.90 %); 3.10 % were Muslim.

2. The analysis of critical thinking indicated that the nursing students had a mean of 3.16 - 3.94. Based on the sample nursing students' responses about critical thinking variables, Open-mindedness had a mean of 4.15, with standard deviation of 0.593, followed by Maturity with a mean of 4.04, with standard deviation of 0.595. The lowest mean score was 3.16, with standard deviation of 1.550, as shown in **Table 2**.

**Table 2** Basic statistics of critical thinking (n = 549 person).

| Variables | Mean | Standard deviation |
|---|---|---|
| Critical thinking | | |
| 1. Critical thinking skill | | |
| 1.1 Interpretation | 3.35 | 1.27 |
| 1.2 Explanation | 3.27 | 1.50 |
| 1.3 Evaluation | 3.18 | 1.48 |
| 1.4 Inference | 3.94 | 1.17 |
| 1.5 Analysis | 3.16 | 1.55 |
| 1.6 Meta-cognitive self-regulation | 3.79 | 0.402 |
| 2. Disposition component of critical thinking | | |
| 2.1 Trust seeking | 3.96 | 0.599 |
| 2.2 Analyticity | 3.77 | 0.602 |
| 2.3 Open-mindedness | 4.15 | 0.593 |
| 2.4 Systematicity | 4.01 | 0.607 |
| 2.5 Critical thinking self confidence | 4.03 | 0.624 |
| 2.6 Inquisitiveness | 4.03 | 0.595 |
| 2.7 Maturity | 4.04 | 0.595 |

3. The goodness of fit test of the Structural Equation Model of critical thinking of nursing students found the following statistical values: Chi-square = 284.895, df = 248, p-value = 0.054, RMSEA = 0.016, RMR = 0.009, GFI = 0.968, CFI = 0.997, and $\chi^2$/df = 1.149; this indicated that the Structural Equation Model goodness of fit to the empirical data is quite good. The Self Efficiency (SE), Emotional Intelligence (EI), and Learning Style (LS) variables had a positively direct effect on critical thinking ($b$ = 0.371, 0.370 and 0.376). The Internal Locus of Control (ILC) variable had a negatively direct effect on critical thinking ($b$ = –0.120), as shown in **Table 3** and **Figure 1**.

**Table 3** Statistical analysis on internal effect of Structural Equation Model of critical thinking of nursing students.

| Dependence | $R^2$ | Effect | Independence | | | |
|---|---|---|---|---|---|---|
| | | | SE | ILC | EI | LS |
| LS | 0.564 | DE | 0.774 | 0.322 | - | - |
| | | IE | 0.180 | - | 0.879 | - |
| | | TE | 0.954 | 0.322 | 0.879 | - |
| SE | 0.741 | DE | - | - | 0.861 | - |
| | | IE | - | - | - | - |
| | | TE | - | - | 0.861 | - |
| ILC | 0.517 | DE | 0.558 | - | 0.180 | - |
| | | IE | - | - | 0.480 | - |
| | | TE | 0.558 | - | 0.660 | - |
| CT | 0.931 | DE | 0.371 | –0.120 | 0.370 | 0.376 |
| | | IE | 0.291 | 0.121 | 0.570 | - |
| | | TE | 0.662 | 0.001 | 0.940 | 0.376 |

Notes: DE = Direct Effect, IE = Indirect Effect, TE = Total Effect; Mark – = No line parameters based on hypothesis

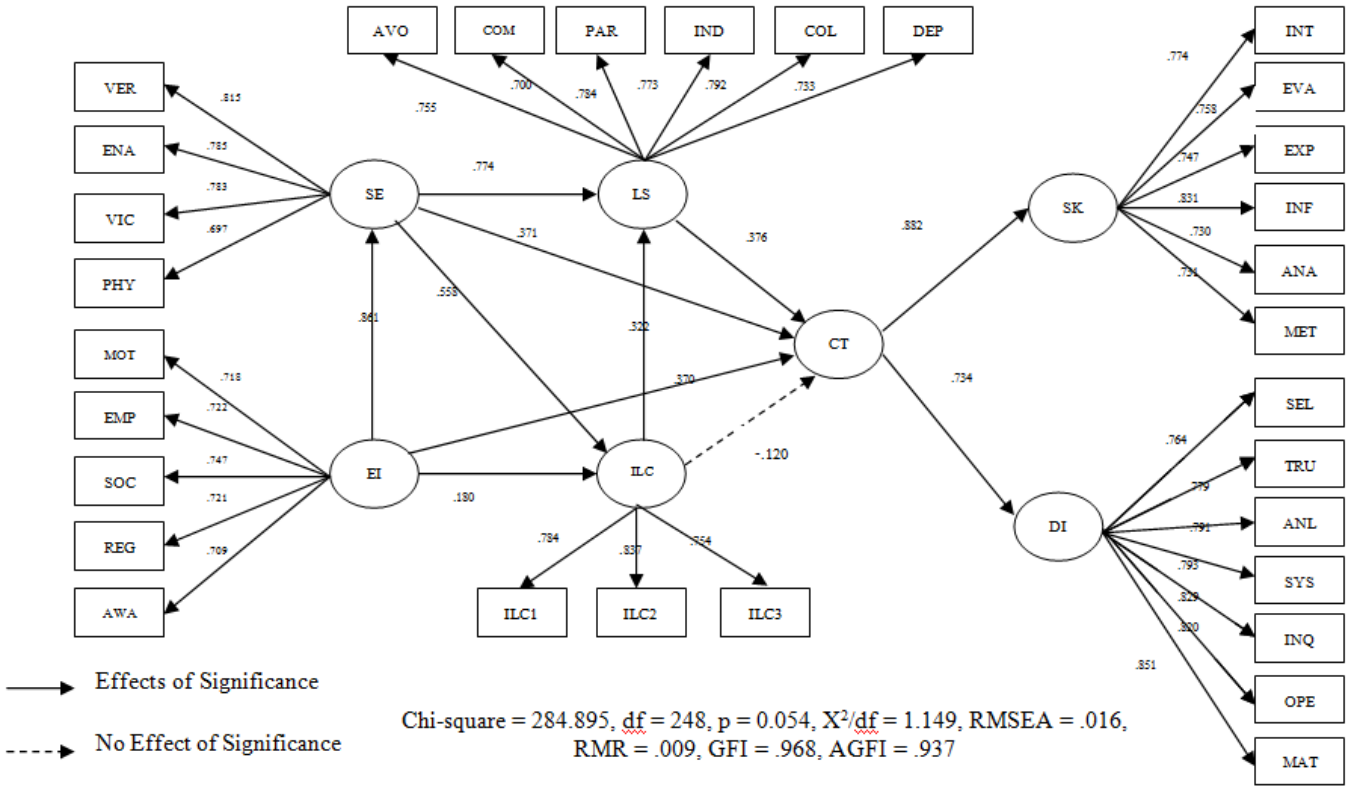


**Figure 1** Structural Equation Model of critical thinking of nursing students.

**Discussion**

The results indicated that the mean of the sampled nursing students for critical thinking was 3.16 - 3.94. The critical thinking of nursing students was shown by prudence thinking and reliable information selection in each situation, as shown in the concept of Facione and Facione [5]. The critical thinking consisted of two components. First, critical thinking skill related to other experiences; interpretation, analysis, evaluation, inference, explanation, and meta-cognitive self-regulation. The disposition component critical thinking supported the intellectual development process, which consisted of sub-skills. They are truth-seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and maturity. Critical thinking is necessary for nursing, because nurses require unique knowledge to explain situations which are significant for nursing science through reasonable thinking and deliberate consideration. Nursing practice is a professional practice which must involve technical and conceptual knowledge about nursing and the ability to apply nursing science to other sciences for proper practice. Private higher education institutions provided various teachings and supports nursing students to be critical thinkers, according to the Nursing Council of Thailand, and to meet the higher standard of education qualifications. Critical thinking is a brain process which can be improved by using technical and practical nursing experiences to create correct nursing decisions. Therefore, the moderate to high levels of critical thinking of the sampled nursing students were attributed them to be encouraged in practical teaching and rote learning. Moreover, because the freshmen have not previously had real experiences in the hospital, this might have affected the development of the critical thinking of nursing students.

To develop and check goodness of fit of the Structural Equation Model of critical thinking of nursing students, it was compared with the empirical data set, and the results showed that the Structural Equation Model of critical thinking of nursing students in private higher education institutions fit the empirical data quite well. The following discusses the results:

The emotional intelligence total effect at high level on critical thinking (TE = 0.940): Emotional intelligence was shown by the nursing students' ability of thinking, realization and sensing both their and others' emotions. It can affect attraction and give success to themselves, positive thinking, emotional adaptation and management, their actions would reasonably change, and making successful friendships. In other words, nursing students who have higher emotional intelligence in self-awareness, motivation, self- regulation, social skills, and empathy [16] tend to have higher levels of critical thinking. This result was consistent with Balsiri *et al.* [17], which stated that emotional intelligence highly affected critical thinking; if the nursing students had high emotional intelligence, they tend to have higher critical thinking levels. Nurses require both sciences and arts in order to take care of patients. Emotional intelligence is the emotional ability to create quality nursing practice and provide benefits for clients. Moreover, their study found that emotional intelligence had a positively indirect effect on critical thinking, via self-efficiency and internal locus of control of nursing students, at a statistical significance of 0.05. In the other words, the higher level of emotional intelligence resulted in higher self-efficiency and internal locus of control.

The self-efficiency total effect on critical thinking (TE = 0.662): The self-efficiency of nursing students indicated how well they could do something. The nursing students were self-determined and believed in self-achievement. Self-efficiency is important for nursing students from private and governmental higher education institutions. Nursing practices were on wards, taking care of patients, and making nursing decisions [4]. If the nursing students believed in their vicarious experience, verbal persuasion, enactive attainment, and physiological and affective [18] status had an impact on nursing practices and critical thinking. These results were consistent with Manalo *et al.* [19], which stated that the higher self-efficiency in students highly affected critical thinking. Moreover, the self-efficiency indirect effect on critical thinking via learning style and internal locus of control was at statistical significance of 0.05. In other words, higher levels of self-efficiency of nursing students highly affected internal locus of control.

The learning style total effect on critical thinking (TE = 0.376): The learning style was the behavior or characteristic for each nursing student's favored learning or knowledge seeking way in class. It included avoidance, competitive, participant, collaborative, independent and dependent [20]. These kinds

of study differently affect learning and thinking process of students. 21st century education and learning is student-oriented. Private higher education institutions support participant learning in corporate practices and creation, so various teaching techniques, collaborative learning, and participant learning are used. In terms of dependent learning, most nursing study emphasizes patient practices, where advisers can give suggestions and closely follow students in order to support practicing skills in nursing studies. In terms of independent learning, it might come from students; teenagers have characteristics which require freedom and self-confident. In terms of competitive learning, it might come from Thai social values that rank higher achieving students and the weaker ones, leading to competition among students. The avoidant learning style has a low level effect on critical thinking, because nursing students were young adults who were be able to take care of themselves and had to be responsible on something. The nursing profession is importance to human lives; therefore, learning realization might increase. These results were consistent with the study of Balsiri *et al*. [17], which stated that the learning style affected critical thinking.

The internal locus of control total effect at low level on critical thinking (TE = 0.001): The locus of control had a positively indirect effect through the learning style of nursing students at a statistical significance of 0.05. On the other hand, the higher level of internal locus of control influenced a higher learning style; this, in tern, increased critical thinking. These results were related to Rotter [21], which explained the quality of whom had internal locus of control was being active and ready for any situations which might provide knowledge or useful guidance for behavior. The internal locus of control was significant as to the quality of people's minds; it indicated self-efficiency and was awaken the desirable behavior. Things which happened to each person were the results from their abilities or actions; failure or success both came from one's own actions. If the nursing students in private higher education institutions had a higher internal locus of control, they could be active nurses and self-attempt realization, reasoning belief, and situation control; this affects nursing practices and patients. This can be related to Strickland [22] and Mara [23], which found that the students who had internal locus of control wanted to gain knowledge, believed in the internal locus of control, and had critical thinking.

This study found that the internal locus of control had a negatively direct effect on critical thinking (TE = –0.120). This was consistent with Balsiri *et al*. [17] which stated that the internal locus of control had a negative effect on critical thinking. The reason for this opposing theory might be that most of the samples in the research were of other major students, or they were in a government university.

## Conclusions

In theoretical and practical teaching, nursing academies should promote critical thinking among nursing students by using the following variables: self-efficiency, emotional intelligence, learning style, and internal locus, in order to improve critical thinking in nursing students.

## Recommendations

1. The study investigated components for critical thinking and for influencing variables in critical thinking. Both technical and practical studies should support critical thinking, and these variables for critical thinking, in nursing students.
2. Study on critical thinking levels of nursing students should be done for all courses, to be a model for technical and practical study development.
3. Promoting critical thinking among nursing students in private higher education institutions is recommended, by developing a complementary course on critical thinking for nursing students.
4. The affective variables on critical thinking were Emotional Intelligence, Self-Efficiency, Learning style, and Internal Locus of control. Those variables should be promoted for the development of an enriched curriculum on the critical thinking in nursing students.
5. An examination on unchanged critical thinking in nursing students in each year should be done, in both private and governmental higher education institutions, to be a model of critical thinking development.

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