The relationship between Self-Directed Learning and Clinical Reasoning among Nursing Students at Suez Canal University

Alaa Mohamed Salah El-Demerdash[1] & Esraa Mohammed Soltan[2]
[1] Lecturer of Nursing Administration in Faculty of Nursing, Suez Canal University, Egypt
[2] Lecturer of Nursing Administration in Faculty of Nursing, Suez Canal University, Egypt

Abstract
Background: Self-directed learning is more expected over the continuum of healthcare education globally. Clinical reasoning also is a basic competence for the nursing students. It is emphasized in nursing education. Both self-directed learning and clinical reasoning involve knowledge-cognition or reasoning integration; using of metacognition during the learning or reasoning process. **The aim of the study:** This research aims to examine the relationship between self-directed learning and clinical reasoning of nursing students at Faculty of Nursing in Suez Canal University. **Design:** is descriptive correlational design. **Setting:** Faculty of Nursing in Suez Canal University. **The sample of the study:** 356 students at the faculty of nursing in Suez Canal University. **Tools:** Two tools is utilized. **Tool (1)** is Self-Rating Scale of Self Directed Learning (SRSSDL). **Tool (2)** is Nurse Clinical Reasoning Scale (NCRS). **Results:** The mean score of self-directed learning readiness is 242.91± 35.9. The mean score of clinical reasoning is 58.96 ± 10.29. There is a moderate positive correlation between self-directed learning readiness and clinical reasoning (r=0.661, P value < 0.001). **Conclusion:** This study revealed that there is a moderate positive correlation between self-directed learning readiness and clinical reasoning. **Recommendations:** For enhancing both self-directed learning and clinical reasoning, the Faculty of Nursing in Suez Canal University should maintain and develop problem based learning strategy

Keywords: Clinical reasoning, Faculty of Nursing, Nursing students & Self-directed learning

Introduction
Healthcare and nursing practice rapidly and constantly advance through regulatory standards, health policy, evidence-based research and technological advances **(Coster et al., 2018 & George & Schocksnider, 2014).** As healthcare advances occur rapidly and continuously, nursing students must be lifelong students who are continuously learning during their career life. Nursing educators must help students in developing the ability to identify their learning needs and apply the best strategies to meet those needs. This is the essence of self-directed learning **(Arpin, 2021).**

Recently, attention has been given to the principles of andragogy, particularly, self-directed learning. Due to the increasing interest of higher education institutions in developing their students' lifelong learning skills, self-directed learning progressively gained wide popularity over the past few years **(Williamson & Seewoodhary, 2017).** Self-directed learning is known as the most suitable approach for adults in the continuing acquisition of professional skills and knowledge **(Williamson & Seewoodhary, 2017).** In addition to that, self-directed learning allows learners to obtain ownership and self-mastery of learning to regulate, direct and be accountable for their learning **(Wong & Kan, 2022).**

Self-directed learning is defined as a process in which the students take initiation with or without the teacher's help, identify their learning needs, formulate their learning goals with the implementation of the most appropriate learning strategies and evaluate their learning outcomes **(Kumar et al., 2021).** The students become increasingly self-directed as they mature. Self-directed learning readiness arises from life's issues, circumstances, and obligations **(Lollis, 2016).** It represents the extent of ability, talent, attitude and other personality features present in students for self-directed learning **(Clark, 2021 & Kumar et al., 2021).**

However, clinical reasoning is essential for nurses to deliver safe and high-quality patient care **(Cappelletti et al., 2014).** It enables them to provide timely person-centered care which is very crucial for patient safety **(Gonzalez, 2018)**. It also enables them to make independent clinical decisions during their clinical practice **(Mohammadi-Shahboulaghi et al., 2021).** They must be equipped with clinical reasoning competencies before entering the clinical field **(Hong et al., 2021).**

Also, it is a very important qualification required for achieving the expected outcomes in clinical and professional nursing education **(Mohammadi-Shahboulaghi et al., 2021).** Nursing education that focuses on clinical reasoning; improves

the coping ability with unstable and complex situations when dealing with patients **(Hong et al, 2021).** Clinical reasoning improves nursing students' problem-solving skills in increasingly complex clinical situations **(Alfaro-Lefevre, 2016).**

Clinical reasoning is neither linear nor temporary but a cyclical process within the limits of nurses' knowledge and experience and patients' circumstances **(Hong et al., 2021).** It is the process of applying experience and knowledge to a clinical situation to develop an appropriate solution **(Jung & Roh, 2022).** In care practice, the thinking process that results in clinical reasoning should occur in all stages of the nursing process **(Campos de CarvalhoI et al., 2017).**

This occurs through recognizing evidence/cues about the situation (considering the idea); recognizing differences between the investigated situation and a similar one (elaborating their judgment); and concluding thinking based on related judgments previously known (reasoning). The nurse is responsible for the accurate interpretation of the human responses to select the most appropriate interventions and evaluate the achieved outcomes **(Campos de CarvalhoI et al., 2017).**

Both self-directed learning and clinical reasoning involve knowledge-cognition or reasoning integration; using metacognition during the learning or reasoning process, to critique, manage and monitor cognition; the goal and outcome of decision-making for responsible action; the outcome of, need for, ongoing knowledge base development and important collaboration with others affected by, or participating in, the decision making/action process **(Paterson et al., 2002).**

Traditional nursing pedagogies pose inadequacy for developing self-directedness, while problem-based learning is utilized as a strategy to self-directed learning, analytical reasoning and enhancing problem-solving skills **(Lollis, 2016).** Also, Recent educational programs that aim to enhance clinical reasoning, use diverse strategies, such as problem-based learning **(Hong et al, 2021).**

Significance of the study

Problem-based learning is described as an educational strategy that enhances clinical reasoning skills. It is designed as a learning method for adults to encourage their active participation. The learners perceive the goal of learning and accept responsibility for learning and progress toward their own goals. Problem-based learning utilizes actual situations and significant contextualized to drive learning **(Scaffa & Wooster, 2004)**. Faculty of Nursing at Suez Canal University adopts problem-based learning as a learning strategy. It was very important to study the relationship between the student's practice of self-directed learning during their study and their ability to make clinical reasoning in the clinical areas.

Aim of this study

This research aims to examine the relationship between self-directed learning and clinical reasoning of nursing students at Faculty of Nursing in Suez Canal University

Objectives of study

1. Assess self-directed learning of nursing students at Faculty of Nursing in Suez Canal University
2. Assess clinical reasoning among nursing students at Faculty of Nursing in Suez Canal University
3. Find out the relationship between self-directed learning and clinical reasoning of nursing students at Faculty of Nursing in Suez Canal University

The research question

Is there a relationship between self-directed learning and clinical reasoning of nursing students at Faculty of Nursing in Suez Canal University?

Subjects and Method

The methods of this study were portrayed under the following designs:
1. Technical design
2. Operational design
3. Statistical design

Technical design:

Consisted of the research design, the study setting, study subjects, and tools of data collection

Research design:

Descriptive correlational design was utilized to conduct this study

Study setting:

The study was conducted at the Faculty of Nursing in Suez Canal University. The Faculty of Nursing in Suez Canal University is located in Ismailia. It consisted of 2 buildings which are educational building and administrative building. It was established in 2006. It was accredited for the first time in 19/7/2017, then it was reaccredited in 21/6/2023.

It adopts the problem based learning strategy. It provides the baccalaureate degree of nursing science. This academic program includes 55 courses that are classified as follow: (13theoretical nursing courses, 13 practical nursing courses, 25 supporting course and 4 university requirement courses). It also provides the accelerated baccalaureate degree of nursing science. These two program are for the undergraduate study. In the field of postgraduate study, it provides six academic master programs, six academic doctorate programs, two professional diploma programs and one professional master program.

Study Subjects:

Target population:

▪ All 2nd , 3rd and 4th level students in the Faculty of Nursing, Suez Canal University for the academic year 2023/2024 which are 1689 students

▪ 1st year students were excluded because they train in the hospitals in the second semester for 2 months so their clinical reasoning abilities don't be developed

Sampling technique: Simple random sample technique

Sample size:

▪ The G- power analysis for correlation was utilized with a moderate effect size, and a probability of 0.80 **(Anthony, 2022).** The sample size was **356 student.**

▪ The number of students in each level was according to the ratio of the sample to the target population which is **(356 / 1689)**

▪ The sample from the second level = number of students in second year $\times$ (356 / 1689) = 683 $\times$ (356 / 1689) = 143.96 = **144 student**

▪ The sample from the third level = number of students in third year$\times$ (356 / 1689) = 540$\times$ (356 / 1689) = 113.82 = **114 student**

▪ The sample from the forth level = number of students in forth year$\times$ (356 / 1689) = 466 $\times$ (356 / 1689) = 98.22 = **98 student**

The data collection tools:

Two tools were utilized:

The first tool: It is divided in to two parts:

Part 1 Demographic data sheet:

It was developed by the researchers. It consists of questions about academic level, age, gender (sex), GPA, residence and study before faculty admission.

Part 2: Self-Rating Scale of Self-Directed Learning (SRSDL):

This scale was developed by **(Williamson, 2007).** It consists of 60 items that are classified under five broad domains of self-directed learning:

▪ **Awareness:** 12 items related to the learners' understanding of the factors that are contributing to being self-directed learners.

▪ **Learning strategies:** 12 items explaining the various strategies that should be adopted by self-directed learners to be self-directed in their learning process.

▪ **Learning activities:** 12 items identifying the requisite learning activities that the learners should actively engage to become self-directed in the learning process.

▪ **Evaluation:** 12 items revealing learners' specific attributes that help in monitoring their learning activities.

▪ **Interpersonal skills:** 12 items relating to learners' skills in interpersonal relationships that are pre-requisite to becoming self-directed learners.

▪ **Scoring system:** All the items on the scale were positively stated. Responses of each item are rated by using a five-point Likert scale: 5 means always, 4 means often, 3 means sometimes, 2 means seldom and 1 means never. Thus, the maximum possible score is 300 and the minimum possible score is 60 **(Williamson, 2007).**

Williamson, (2007) developed the following scoring system:

▪ A low level of self-directing learning readiness range from 60 to 140 means guidance is needed from the educators. Any specific changes necessary for development should be identified and a possible re-structuring of the learning methods identified.

▪ Moderate level of self-directing learning readiness range from 141 to 220 refers to halfway to being a self-directed learner. Areas for development should be identified and evaluated, and a strategy adopted with educators' guidance when necessary.

▪ High level of self-directing learning readiness range from 221 to 300 refers to effective self-directed learning. The aim is to maintain progress by identifying strength areas and methods for improving the students' effective self-directed learning

The second tool (Nurse Clinical Reasoning Scale (NCRS):

It was developed by **(Liou et al., 2016)** to assess clinical entry-level and pre-graduate nurses' perceptions of their clinical reasoning abilities. It consists of 15 items

Scoring system:

All the items are positively stated. Responses of each item are rated on a five-point Likert scale where 1 means strongly disagree, and 5 means strongly agree. The total score for this scale ranges from 15-75. The higher score refers to a higher level of clinical reasoning abilities **(Liou et al, 2016).**

Tools validity:

Both tools are valid. The content validity of the SRSSDL items was established after the review of the related literatures and through the appraisal of the panel of experts who participated in the Delphi technique **(Williamson, 2007).** According to the validity of NCRS, the item content validity index is 1.0, which refers to confirmation of content adequacy **(Liou et al, 2016).** Both tools were translated into Arabic language and then back-translated to the English language to apply the content validity of Arabic versions.

Tools reliability:

Both tools were reliable. The Cronbach's alpha coefficient for all five dimensions of SRSSDL was more than 0.7 **(Williamson, 2007).** The Cronbach's alpha coefficient for total SRSSDL was 0.92 **(Cadorin et al., 2013).** The Cronbach's alpha coefficient for all items of NCRS was more than 0.7.

The Cronbach's alpha coefficient for total NCRS was 0.9 **(Liou et al, 2016).** Also, the reliability was tested by the researcher in this study by utilizing Cronbach's alpha coefficient. Cronbach's alpha coefficient for both tools was more than 0.7, so both tools were reliable. The following table shows the reliability of tools in this study:

The reliability of the study's tools

Tool	Cronbach's alpha
SRSSDL	0.87
NCRS	0.94

Operational design:
Pilot study:
It was carried out on 36 students (10%) from the target population and out of the study sample before starting the data collection. It was performed to test the clarity, applicability and feasibility of the tool and to identify the obstacles and problems that may be encountered. It was to estimate the time needed for collecting data.

Procedure:
The researchers reviewed local and international related literature review about the various aspects of the research problem. Then, the data was be collected from participants online by using Google form in the second semester of the academic year 2023/2024 and for one month. The students were collected in Whats app group with the researchers. The researchers provided a brief explanation about the study and its aim. The researchers sent the links of the electronic informed consent and the questionnaires to the students and were in contact with them to clarify any ambiguous issues.

Ethical considerations:
The study was approved first by the Research Ethical Committee (RCE) at the Faculty of Nursing in Suez Canal University. Ethical considerations regarding data confidentiality was taken by the researcher and an electronic written informed consents were taken from the students before commencing the study. The participants were informed that the answers to the questionnaires will be used only for the purpose of research. Also, these answers weren't shared with anyone outside the study team. Additionally, the ethical and legal principles were applied in the current study through maintaining justice, autonomy for participants of the study. Furthermore, the subjects of this study were full autonomy of withdrawing from the study in any time. The anonymity of participants was considered

Statistical design:
The statistical analysis was done by SPSS system files (SPSS package version 23). The normality of variables were checked with Kolmogorov Smirnov test at 0.05 level, accordingly both variables were significant (P<0.001) and the data were nonparametric. Descriptive statistics including mean score, median, standard deviation and frequency distribution were used to describe the characteristics of variables. Spearman correlation test was used to test the correlation between variables. Significance level values considered at p<0.05.

Results

Table (1): Distribution of demographic data of study group (n=356)

Age				
Mean			**Standard deviation**	
20.99			1.26	
Sex (gender)				
Male			**Female**	
121 (34%)			235 (66%)	
Residence				
Family house		**Independent house**		**University housing**
265 (74.4%)		64 (18%)		27 (7.6%)
Study before faculty admission				
Secondary high school			**Nursing institute**	
232 (65.2%)			124 (34.8%)	
Academic level				
2nd level		**3rd level**		**4th level**
144 (40.5%)		114 (32%)		98 (27.5%)
Academic grade				
Fail	**Poor**	**Good**	**Very good**	**Excellent**
24 (6.7%)	55 (15.4%)	92 (25.8%)	116 (32.6%)	69 (19.4%)

Table (2): Mean ±SD distribution of self-directed learning dimensions among studied group (n=356)

Dimension	Mean	Standard deviations
Awareness	50.37	6.65
Learning strategy	47.89	7.86
Learning activities	47.57	8.21
Evaluation	48.96	8.48
Interpersonal skills	48.12	8.24
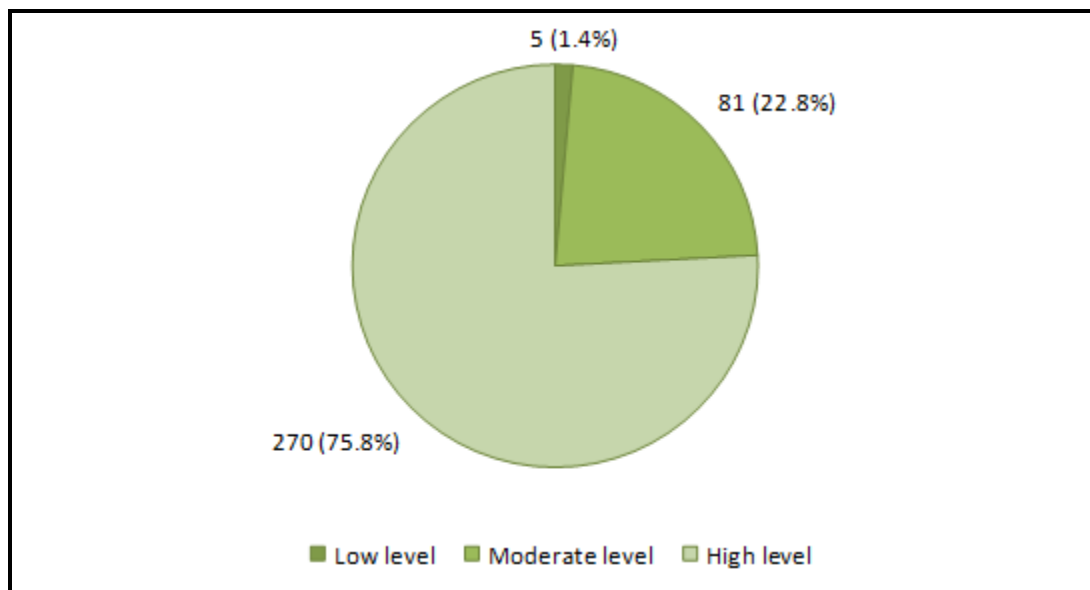
**Figure (1): Level of self-directed learning among study sample (n=356)**

Table (3): Mean ±SD distribution of clinical reasoning items among studied group (n=356)

Item	Mean	Standard deviation
I know how to collect an admitted patient's health information quickly.	3.94	0.86
I can apply proper assessment skills to collect a patient's current health information	3.94	0.87
I can identify abnormalities from the collected patient information.	4.01	0.85
I can identify a patient's health problems from the abnormal information collected.	3.86	0.94
I can recognize possible early signs or symptoms when a patient's health deteriorates.	3.9	0.87
I can explain the mechanism and development associated with the early signs or symptoms when a patient's health deteriorates.	3.81	0.9
I can accurately prioritize and manage any identifiable patient problems.	3.87	0.87
I can correctly explain the mechanism behind a patient's problems	3.83	0.84
I can set nursing goals properly for the identified patient problems.	3.97	0.83
I can provide appropriate nursing intervention for the identified patient problems.	3.98	0.86
I am knowledgeable of each nursing intervention provided	3.82	0.9
I can identify and communicate vital information clearly to the doctors based on the patient's current condition.	4.08	0.86
I can anticipate the prescription ordered by the doctor according to the patient information provided.	3.95	0.89
I can accurately evaluate and identify whether a patient's condition is improved.	3.4	0.89
I know the follow-up steps to take if the patient's condition does not improve.	4	0.86

Table (4): Distribution of the study variables (n = 356)

Study variables	Mean	Standard deviation	Median	Minimum	Maximum
Self-directed learning	242.91	35.9	246	67	300
Clinical reasoning	58.96	10.29	60	15	75

rho= 0.661   **P=**   **Clinical reasoning**   **rho by spearman test**
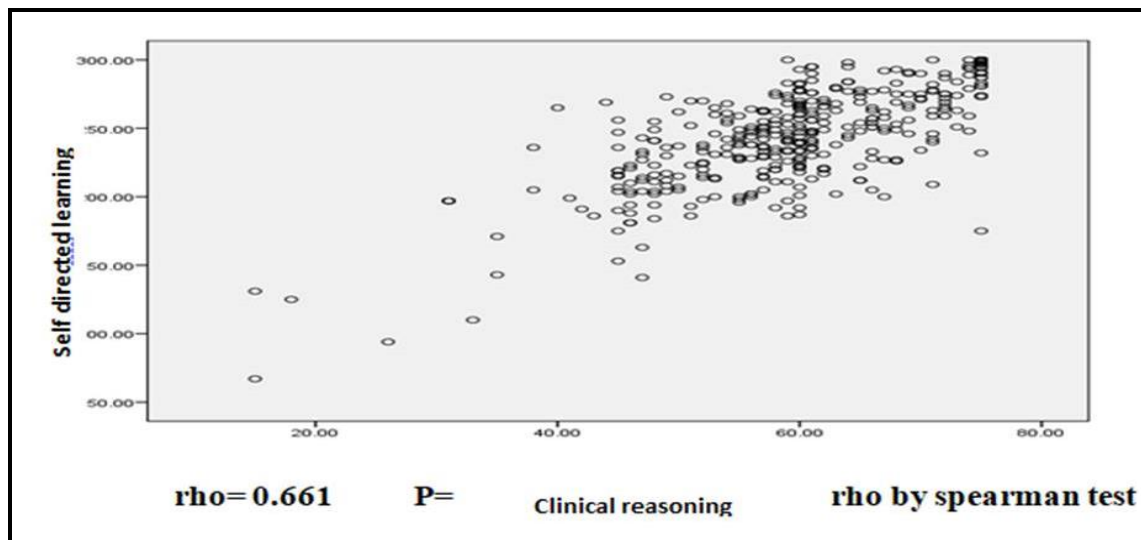
Figure (2): Correlation between self-directed learning and clinical reasoning (n=356)

Table (1): Indicates that the mean age of the study sample was 20.99. About two-thirds of the study sample (66%) were female. Three-quarters of the study sample (74.4%) live with their family in the family house. Two-thirds of the study sample studied in the high secondary school before their admission to the faculty. One-third of the study sample (32.6%) got very good grades in their academic study and one-quarter (25.8%) got good grades in their academic study

Table (2): Indicates that the mean score of the sample response on all dimensions of self-directed learning exceeds half. The mean score of their response on the awareness dimension was the highest (50.37). The mean score of their response on evaluation and interpersonal skills dimensions comes in the second degree. They were 48.96 and 48.12 respectively. The mean score of their response on learning strategies and learning activities dimensions comes in the third degree. They were 47.89 – 47.57 respectively.

Figure (1): Shows that three-quarters of the study sample (75.8%) scored a high level of self-directed learning and about one-quarter of the sample (22.8%) scored a moderate level of self-directed learning.

Only 1.4% of the study sample scored low level of self-directed learning.

Table (3): Shows that the mean score of study sample answers on all items of clinical reasoning exceed 3. The mean score of the study sample answer on "Knowing the follow-up step to be taken if the patient's condition does not improve"; "Identifying the abnormalities from the collected data"; "Identifying and communicating important data clearly to the doctors based on the patient's current condition" were the highest. They were 4, 4.01, 4.08 respectively.

Table (4): Shows that the mean score of total self-directed learning of the study sample is high (242.91). The mean score of the study sample response on total clinical reasoning exceeds half (58.96).

Figure (2): Shows a moderate positive correlation between self-directed learning and clinical reasoning. P = 0.001, rho= 0.661

Discussion

Self-directed learning is increasingly expected in the field of healthcare education globally (**Visiers-Jiménez et al, 2022**). It is indicated to develop

individual attitudes, qualities and abilities that provide continuous learning skills to nursing students and help them to acquire the necessary professional competencies **(Kaulback, 2020).** Also, clinical reasoning is a basic competency for nursing students. It is necessary to solve problems that occur in complicated clinical situations. It is emphasized in nursing education **(Hong et al, 2021).**

Therefore, our study aimed to examine the relationship between self-directed learning and clinical reasoning of nursing students at the Faculty of Nursing in Suez Canal University. Three objectives were set to achieve this aim. These objectives were: a) Assess self-directed learning of nursing students at Faculty of Nursing in Suez Canal University. b) Assess clinical reasoning among nursing students at Faculty of Nursing in Suez Canal University. c) Find out the relationship between self-directed learning and clinical reasoning of nursing students at the Faculty of Nursing in Suez Canal University

Regarding the first objective, the results showed that the mean score of self-directed learning reflected a high level of self-directed learning among the study group. Three-quarters of the study sample had a high level of self-directed learning. About one quarter of the study sample had a moderate level of self-directed learning. Only 1.4% of the study group had a low level of self-directed learning.

The level of self-directed learning readiness of our students was identical to the results of many studies. One of these studies was done by **Visiers-Jiménez et al, (2022)** who assessed nursing students' self-directed learning abilities in six European nations (Spain, Czech Republic, Slovakia, Italy, Portugal, and Finland) at graduation. This study was conducted on 737 students who studied to become graduated nurses in general care and who were in the last academic semester to graduate after completing the ongoing final clinical practicum. The graduated nursing students' overall self-directed learning abilities were high in all six European countries

In the same line as our study, **Zhou et al, (2022)** reported that the mean score of self-directed learning readiness of 511 Chinese nursing students from five universities across the breadth of China commutated high levels of self-directed learning readiness. Also, the mean score of self-directed learning readiness of 353 undergraduate students from one nursing school in China reflected a high level (slightly above moderate) of self-directed learning readiness **(Li et al, 2021)**

Other similar results were the results of the study conducted on 103 newly graduated registered nurses who were hired in an 864-bed non-profit community hospital in central Florida. The mean score of self-directed learning for those nurses reflects a high level of self-directed learning. Almost three-quarters of them (70.87%) had a high level of self-directed learning. One-fifth of these newly graduated nurses scored moderate levels of self-directed learning. Only 9.7% scored a low level of self-directed learning **(Hain, 2020).**

Another study was conducted on 63 students enrolled in the Fall and Summer 2019 academic semesters at a higher education private institute in the southeast United States. The result of this study was conforming with our results. The mean score of self-directed learning readiness for those student reflected a high level of self-directed learning readiness **(Stephen, 2020).** Also, the study conducted on 872 pharmacy students revealed that their mean score of self-directed learning reflected that they have high levels of self-directed learning behaviors **(Behar-Horenstein & Beck, 2018).**

Lollis, (2016) examined self-directing learning among 383 associate degree nursing students in the U.S.A. The results of this study were similar to our results. The mean score of self-directed learning of those American students indicated a high level of self-directed learning. Also, **Avdal, (2013)** reached similar results of our study. This study was conducted on 220 nursing students at a nursing school at Dokuz Eylul University in Turkey. The results of this study reflected that the mean score of self-directed learning of those Turkish students indicated a high level of self-directed learning

Another study goes along with our results was the cross-sectional descriptive study. This study conducted to examine self-directed learning readiness among 275 Saudi nursing students at Al Jouf University in Saudi Arabia. The total self-directed learning readiness score for those Saudi nursing students was high, and about 77% of them exemplified high levels of self-directed learning readiness **(El-Gilany & El Sayed Abusaad, 2013).**

In contrast, many studies were opposite in their results to the results of our study. **Jin & Ji, (2021)** assessed the self-directed learning readiness of 3000 five-year higher vocational nursing students at seven higher technical vocational schools of health in Jiangsu, China. The mean score of self-directing learning readiness reflected that those students scored a medium level of self-directing learning ability.

Also, **Abou Shousha & El Sherbini, (2014) reported** opposite results to our results. Their study was conducted on 200 undergraduate students enrolled in the Community Health Nursing Course during the second semester of the academic year 2013-2014 from Damanhur Faculty of Nursing and Alexandria Faculty of Nursing. This study revealed that the mean score of self-directed learning readiness

of students in both faculties reflected that the students don't have self-directed learning readiness.

Regarding the dimensions of self-directed learning, our results revealed that the awareness scored highest mean. The mean score of learning strategy and learning activities came in the second degree. The mean score of evaluation and interpersonal skills came in the third degree. The mean scores of the five dimensions of our students were greater than the mean scores of the five dimensions of 3000 five-year higher vocational nursing students at seven higher technical vocational schools of health in Jiangsu, China **(Jin & Ji, 2021)**.

The mean score for those Chinese students from the lowest to the highest were learning activities, evaluation, learning strategies, awareness and interpersonal skills **(Jin & Ji, 2021)**. The score of 353 undergraduate students from one nursing school in China regarding the dimensions of self-directed learning reflected that the score of interpersonal skills was higher than others; the learning strategy and awareness came in the second degree; and learning activities were the lowest **(Li et al, 2021)**.

The researcher attributed that the students at the faculty of nursing in Suez Canal University scored this high level of self-directed learning readiness due to three main causes. The first cause was that the faculty of nursing at Suez Canal University adopted problem-based learning strategy. It was proved that the problem-based learning method has a significant effect on improving the self-directed learning activities and ability of nursing students **(Liu, 2018)**. Also, **Abou Shousha & El Sherbini, (2014)** reported that the student's readiness to become self-directed is facilitated by problem-based learning.

In problem based learning, tutors or educators act as facilitators, mentors, or guides. Students solve the problems through self-directed learning activities. Before any type of preparation, firstly, the students encounter the problem in their learning process. Secondly, they are presented with the problem just as they would professionally encounter it. Thirdly, they work the problem appropriately to their learning level using knowledge application and reasoning. The students identify weaknesses and strengths in their learning process guided by the tutors and their self-directed study. Lastly, the applicable knowledge and skills are applied to the associated problems and evaluated by the learning effectiveness **(Lollis, 2016)**. The second cause from the researcher's point of view was that engaging the students in blended learning led to this high level of self-directed learning readiness. For some students, blended learning is better suited to their self-directedness **(Gagnon et al., 2013)**. Self-directed learning is an essential factor in face-to-face and online students' achievements **(Khiat, 2015)**.

Student development of self-direction are necessary for persistence in online classes. Computer and information literacy is basic learning activities that the student must engage in to be more self-directed. Computer-based interaction is an interpersonal skill that is necessary for self-directed learning **(Stephen, 2020)**. Web-based course positively affects self-directed learning **(Li et al, 2021)**.

Lastly, the researchers thought that the high level of self-directed learning readiness of the students at faculty of nursing in Suez Canal University is because of that the teaching strategy at the faculty of nursing, Suez Canal University is active. The student's role is active. They are engaging in many active learning activities such as preparing scientific presentations and posters. Many authors noted that students' readiness to become self-directed is motivated by introducing appropriate learning activities **(Abou Shousha & El Sherbini, 2014)**. Traditional pedagogies for nursing students pose inadequacy for self-directedness **(Lollis, 2016)**. Self-directed students must take an active role in their learning **(Stephen, 2020)**.

Regarding the study's results in dimensions of self-directed learning, the researchers thought that the student's awareness was the highest because their practice of problem-based learning continually and for a long time (at least three semesters) made them very aware of all factors that help them to be self-directed such as commitment, study habits and time management. The researchers also thought that the evaluation came in the last degree because of that the students at this young age usually are biased toward themselves and aren't able to apply accurate self-monitoring.

Interpersonal skills also came in the last degree. The researchers viewed that life experience and communication with people from different backgrounds, cultures and educational levels affect interpersonal skills. Students have limited relations and communications with people from different backgrounds, cultures and educational levels during the study year so the score in interpersonal skills was the lowest

Regarding the second objective of assessing clinical reasoning among nursing students at the Faculty of Nursing, Suez Canal University, our study revealed that the mean score of total clinical reasoning was 58.96. This mean exceeds three-quarters of the total score. **Kojabadi et al, (2023)** reported similar results to the results of our study. Their study was conducted on 180 emergency nurses in 10 hospitals affiliated to the Tabriz University of Medical Sciences in the East Azerbaijan Province of Iran. The mean score of those nurses regarding clinical reasoning was 60.91. Also, the mean of clinical reasoning for 88 senior nursing

students at the final clinical course of medical-surgical in the American National School for Nursing Program was asymptotic to the results of our study (59.58) **(Anthony, 2022)**

Many studies reported results less than our results. The Chinese research that was conducted on 508 undergraduate nursing students, reported mean score less than the mean score of our students. This Chinese study was conducted in a tertiary private professional training institute that offers both sub-baccalaureate and baccalaureate nursing programs. The mean score of these Chinese students regarding clinical reasoning was 50.83 **(Chan, 2024)**

Also, the clinical reasoning mean score of 223 undergraduate senior nursing students belonging to four nursing schools in South Korea was 50.9 **(Hong et al, 2021).** Another Chinese study reported results lower than our results. This Chinese study was conducted on 172 third-year nursing students enrolled in the course of emergency and intensive care nursing at Wuhan University in 2016, 2017 and 2018 spring. The mean scores of those students regarding clinical reasoning were 47.03, 48.38, and 47.48 respectively **(Hu et al, 2021).**

Forty one academic observers assessed the clinical reasoning of 233 second-year undergraduate Bachelor Nursing students at a large university in Brisbane, Queensland, Australia. The median of clinical reasoning of those Australian students was (51) less than the median of clinical reasoning in our study (60) **(Johnston et al, 2021)**. Also, the pilot study that was conducted at the University of Milan, reported mean of clinical reasoning less than the mean in our study. This pilot study assessed the clinical reasoning abilities of 10 second-year baccalaureate nursing students . The assessment reflected that the clinical reasoning mean for those students was less than the mean score of our study (50.8) **(Marcomini et al, 2021).**

Regarding the items of clinical reasoning, the mean of all clinical reasoning items in this study was less than four except three items which are "knowing the follow-up steps that must be taken if the patients don't improve"; "identifying and communicating important data clearly to the doctors based on the patient's current condition." and "identifying abnormalities from the collected data.". The mean score of these three items is equal to or more than score four but less than score five

The framework of **Anthony, (2022)** study depended on the theory of Benner's from novice to expert. Findings from Anthony's study supported Benner's theory. Interpretation of her results was determined by identifying score four (agree with the items) as an advanced beginner in Benner's theory. The score of 4 on an item refers to that students have the capability

in a specific area, and can perform clinical reasoning skills with a suitable level of confidence that is aligned with the advanced beginner in the Benner theory. A clinical reasoning score of five (strongly agree with the item) reflects a higher level of clinical reasoning skills that equal to competence in Benner's theory.

When reflecting the theoretical framework and scoring of **Anthony, (2022)** on our study, the students at the faculty of nursing in Suez Canal University are advanced beginners in only three previously mentioned items that exceed score four and less than score five. In contrast, **Anthony, (2022)** reported that 88 senior students in the last clinical course of medical-surgical in the American National School of Nursing Program are advanced beginner in nine items of clinical reasoning

These items are "applying appropriate assessment skills to collecting a patient's current health data"; "identifying the abnormalities from the collected patient's data"; "recognizing the possible early symptoms or signs when the patient's health worsens."; "prioritizing and managing any identifiable patient problems accurately."; "setting the goals appropriately for the patient problems"; "providing suitable intervention for the identified problems"; "being knowledgeable of all nursing intervention provided"; "identifying and communicating the vital information clearly to the physicians depending on the patient's current condition." and "accurate evaluation and identification whether a patient's condition is improved" **(Anthony, 2022)**

On another hand, **Hu et al, (2021)** reported that the mean scores of third-year nursing students (172) enrolled in the course of emergency and intensive care nursing at Wuhan University during 2016, 2017 and 2018 spring, are less than 4 in the all clinical reasoning items. **Liou et al., (2015)** conducted their study on 251 nurses in southern Taiwan hospitals and nursing pre-graduates in their final semester in a university in southern Taiwan. They reported that the mean scores of all clinical reasoning items don't exceed score of four. According to **Anthony, (2022)** theoretical framework and scoring, the participants in both studies were never competent nor advanced beginners in any area of clinical reasoning.

The researchers identified three causes of this high clinical reasoning mean score (exceeds three-quarters of the total score) of nursing students in Suez Canal University. These causes are the adoption of problem-based learning strategy by the faculty of nursing in Suez Canal University; pre-clinical training in laboratories; and clinical training of students in different healthcare organizations. Regarding the adoption and application of a problem based learning

strategy; one of the most obvious learning outcomes of problem based learning is the acquisition of problem-solving skills **(Moallem et al, 2019).**

There is a positive relationship between clinical reasoning competence and problem-solving ability **(Kang et al, 2018).** Clinical reasoning is a method of thinking that focuses on outcomes. It is based on scientific problem-solving methods **(Liou et al., 2015).** It is rooted in problem-solving **(Kojabadi et al, 2023)**. Recent studies report that problem-solving abilities provide applicable answers in complex difficult clinical situations. It is considered a factor that affects nursing students' clinical reasoning competency **(Hong et al, 2021)**. Problem-based learning, including reflective practices, plays a basic role in developing clinical judgment **(Anthony, 2022)**. Modern educational programs aim to improve clinical reasoning competency by using many methods, such as problem-based learning **(Zhao & Cong, 2019).**

Regarding the pre-clinical training on the campus that occurred before clinical training in health care organizations. Practical training in the faculty of nursing, Suez Canal University is divided into two parts which are clinical training on campus and clinical training in different healthcare organizations. The students are trained on different practical skills and many clinical situations on campus before they are trained in health care organizations. Different educational methods are utilized to train the students on campus such as demonstration and return demonstration, case study and simulation.

Adequate training time in the university laboratories allows nursing students to gain and apply different practical skills, which in turn reduce theory–practice gap. There is a positive relation between the clinical reasoning score and attending pre-clinical training **(Chan, 2024).** Active educational strategies such as case studies enable students to have sufficient clinical reasoning skills **(Englund, 2020).** Modern educational programs aim to enhance clinical reasoning competency by utilizing different methods, such as simulation-based learning and case-based learning **(Watari et al., 2020; Zhao & Cong, 2019).**

The use of simulation is known as well-suited for developing nursing students' clinical reasoning **(Hege et al., 2017).** Clinical simulation is utilized to improve nursing clinical reasoning abilities in wound assessment and treatments **(Maurício et al, 2022).** Nursing curriculums that include simulations and provide real situations, help the learners to improve their clinical judgment **(Levett-Jones et al, 2019; Yang; 2019).** Simulated practicum classes strengthen students' clinical reasoning in a harmless environment **(Hong et al, 2021).** During simulations, the learners have enough opportunities to practice

clinical reasoning in a harmless environment without any risks to patients **(Hu et al, 2021).**

The third cause of this high mean score of clinical reasoning in our study was the clinical training of students in different healthcare organizations. The students of faculty of nursing, Suez Canal University train in two major health care organizations (Suez Canal University Hospitals and Ismailia Medical Complex). These two healthcare organizations include all medical departments. The students also train in the 30th June centre for Urology and many primary health care centers. Training in different healthcare setting, exposes the students to different medical conditions which in turn enhance their clinical experience and develop their clinical reasoning.

Clinical experience is very important for developing clinical reasoning **(De Menezes et al, 2015).** Supportive and adequate clinical placement is a continuous requirement to help in applying theoretical knowledge into practice **(Van Wyngaarden et al., 2019).** Organising of clinical rotations helps students to be members of specific practical communities for short periods **(Coakley & Bennett, 2020)**. Each practical community entails specific clinical reasoning skills **(Boshuizen et al., 2020).** Clinical reasoning skills are improved by seeing a variety of patients with different and similar diagnoses **(Steven et al., 2014).** The higher mean score of nursing clinical reasoning is a result of training in many different clinical places **(Chan, 2024).**

Three clinical reasoning items are considered areas of advanced beginners for nursing students in Suez Canal University. Those items are "knowing the follow-up steps that must be taken if the patient's condition worsen"; "identifying and communicating important data to the physicians depending on the patient's current condition." and "identifying abnormalities from the collected patient data.". Those items are mostly related to theoretical knowledge more than clinical experience. This is a normal result because of students during their academic study have more theoretical knowledge and less clinical experience.

The third objective of our study was that finding out the relationship between self-directed learning and clinical reasoning of nursing students at Faculty of Nursing in Suez Canal University. The results revealed a positive correlation between self-directed learning and clinical reasoning. In accordance with our results, **Heinerichs et al., (2013)** reported that clinical reasoning techniques can be efficient and effective by shifting the focus of the educational encounter from the instructors to the learners.

In the learner-centered paradigm, the students become more autonomous within the interaction, and learning

becomes the responsibility of both learner and instructor. The learner-centered techniques of summarizing the findings and history, narrowing the differentials, analyzing the differentials, probing the instructors about uncertainties, planning management, and selecting issues for self-directed study (SNAPPS). The SNAPPS technique which includes self-directed components, is effective for expressing clinical reasoning in a timely efficient manner. It removes the responsibility of the teachable moments from the instructors and places it on the learners while helping the students articulate concise thinking **(Heinerichs et al., 2013)**.

In the same context, the educational culture that has a large power distance, the students appear more dependent on authorities in the framework of the higher education system and education is a more traditional teacher-cantered process. This dependence leads to the potential to hinder students' abilities in diagnostic scripts and constructing their knowledge which are very important for learning clinical reasoning skills **(Findyartini et al, 2016).**

Self-directed learning facilitates nursing students' adaptation to and preparation for clinical practice and thereafter enhances the creativity and quality of clinical competencies **(Tohidi et al., 2019; Ma et al., 2018).** In self-directed learning, the students plan their learning and formulate their learning goals (**Lollis, 2016**). The students' strategic planning and setting goals during the forethought before a clinical reasoning task have a positive on the outcomes of these tasks (**Lockwood, 2017).** The research that studied the association between student's perception of their clinical reasoning abilities and their background of clinical experiences, recommended nursing faculties consider strategies to reinforce caring attitudes and self-directed learning at an early stage in the program **(Chan, 2024)**

In contrast, **Steven et al., (2014)** reported that clinical reasoning skills are improved by working with peers and supervisors**. Pérez-Perdomo & Zabalegui, (2023)** reported that students need to discuss clinical cases with supervisors and colleagues, and explain their reasoning to each other to develop clinical reasoning skills. **(Mauricio et al, 2022)** reported that one-time self-instruction guidance is ineffective in affecting diagnostic accuracy in solving studied cases. **Pinnock & Welch, (2014)** reported that acquiring any skill requires coaching. The students in Midwestern University School of Nursing reported that clinical educators are the most important factor that influences learning in the clinical setting. Students cited that the clinical educators' engagement in and commitment to, their educational and professional improvement have a direct impact on their learning of clinical reasoning **(Cefo, 2019)**.

The researchers rationalized the positive correlation between self-directed learning and clinical reasoning to that the students play active roles and have a high degree of independence and responsibility in self-directed learning which in turn help them in applying knowledge to practice, analysing clinical situations and reason clinically. Self-directed learning is a self-initiated process that includes identifying learning needs, developing learning goals, identifying learning resources, selecting and implementing appropriate learning strategies and evaluating learning outcomes **(Yeh et al., 2022).**

Clinical reasoning encompasses four aspects which are recognition of clinical cues, identification of clinical problems, taking actions and evaluation/reflection on the appropriateness of the nursing interventions provided **(Huang et al., 2018)**. There is a similarity between the two process in some steps. Both processes include identification of problems/needs, implementation of actions/learning strategies and evaluation interventions/learning outcomes.

The limitation of the study

There are two limitations of this study. The first limitation was that the results of this study only applied to the Faculty of Nursing, Suez Canal University. The second limitation was that the data were collected electronically, so there may be miscommunication between researchers and participants and misinterpretation of the questionnaires by the participants

Conclusion

The study showed that about three quarters of the students in faculty of nursing, Suez Canal University have high level of self-directed learning readiness and about only one quarter of the students in faculty of nursing, Suez Canal University have moderate level of self-directed readiness. This study also revealed that the mean score of clinical reasoning among the students in faculty of nursing, Suez Canal University exceed the three quarters of total score of clinical reasoning. Finally, the study reflected that there is a moderate positive relation between self-directed learning readiness and clinical reasoning.

Recommendations

The researchers suggest the following recommendation to enhance the self-directed learning readiness of students in the faculty of nursing, Suez Canal University:

- Providing students with all necessary tools for scientific search such as books, electronic libraries and access to different international scientific data bases to increase student's independency in

- collecting scientific resources to facilitate their self-directed learning readiness
- Informing the students with the educational objectives of program and courses at the beginning of each academic year to help them in developing their learning objectives and plans which in turn enhance their self-directed learning abilities
- Adopting learner centered learning techniques and stressing on the active role of students in all courses because by increasing student role in learning process, he/she become self-directed learner

The researchers suggest the following recommendations to enhance the clinical reasoning skills of students in the faculty of nursing, Suez Canal university:

- Paying more attention to clinical training in hospitals and including it in the summer semester to increase clinical exposure and experience of students so their clinical reasoning abilities increase
- Increasing the application of simulation in practical training of all practical courses because simulation help students to practice clinical reasoning in different situations and safe environment
- Linking theoretical courses with practical courses and clinical training because clinical reasoning process depends on the application of scientific knowledge in clinical field

Finally for enhancing both self-directed learning and clinical reasoning, the faculty of nursing in Suez Canal University should maintain and develop problem based learning strategy because it was recommended in many studies as teaching strategy to develop self-directed learning and clinical reasoning abilities

Conflict of interest

The researchers declared that there isn't any conflict of interest

Reference

- **Abou Shousha, A.A. & El Sherbini, H.H. (2014):** Students' Readiness for Self Directed Learning and its Relation to their Perception of Learning Context in Alexandria and Damanhour Nursing Faculties, Assiut Scientific Nursing Journal, 16(2), Pp 73-88
- **Alfaro-Lefevre, R. (2016):** Critical thinking, clinical reasoning and clinical judgment: A practical approach, 6th edition, chapter 4, Florida: ELsevier Health Sciences
- **Anthony, J.P. (2022):** Nurse Clinical Reasoning: Comparing Graduate Nurse Perceptions with Faculty Assessments Across Three Nursing Preparation Program Types, Doctoral thesis, North central University.
- **Arpin, C.L. (2021):** Does Self-Directed Learning Readiness Differ Between Pre-Licensure Nursing Students In Associate Degree, Baccalaureate, And Accelerated Programs?, Doctorate thesis, Southern Connecticut State University.
- **Avdal, E. (2013):** The effect of self-directed learning abilities of student nurses on success in Turkey, Nurse Education Today, 33, Pp838-841.
- **Behar-Horenstein, S.L. & Beck, D.E. (2018):** An Initial Validation Study of the Self-Rating Scale of Self-Directed Learning for Pharmacy Education, American Journal of Pharmaceutical Education, 82(3), 6251.
- **Boshuizen H.P.A., Gruber, H., & Strasser, J. (2020):** Knowledge restructuring through case processing: The key to generalise expertise development theory across domains?, Educational Research Review, 29, 100310
- **Cadorin, L., Bortoluzzi, G., & Palese A. (2013):** The Self-Rating Scale of Self-Directed Learning (SRSSDL): a factor analysis of the Italian version, Nurse Education Today, 33, Pp 1511–1516.
- **Cadorin, L., Suter, N., Dante, A., Williamson, S. N., Devetti, A. & Palses, A. (2012):** Self-directed learning competence assessment within different healthcare professionals and amongst students in Italy, Nurse Education in Practice, 12, Pp153-158.
- **Cadorin, L., Suter, N., Saiani, L., Williamson, S. & Palese, A. (2010):** Self-Rating Scale of Self Directed Learning (SRSSDL): preliminary results from the Italian validation process, Journal of Research in Nursing, 16(4), Pp 363–373
- **Campos de CarvalhoI, E., Oliveira-KumakuraII, R. & Morais, S. (2017):** Clinical reasoning in nursing: teaching strategies and assessment tools, Revista Brasileira de Enfermagem, 70(3), Pp 662-668.
- **Cappellettei, A., Engel, J. & Prentice, D. (2014):** Systematic Review of Clinical Judgment and Reasoning in Nursing, Journal of Nursing Education, 53(8), Pp 453–458.
- **Cefo, L. M. (2019):** Qualitative Study Exploring The Development Of Clinical Reasoning In Nursing's Clinical Education Settings, Doctoral thesis, Cleveland State University
- **Chan, A. (2024):** The association between nursing students' perceptions of their clinical reasoning ability and their background of clinical experience: A cross-sectional correlation study, Journal of Nursing Education and Practice, 14(2), Pp5-14
- **Clark, C. (2021):** Examining Self-directed Learning Readiness and Performance of Business Students, E-Journal of Business Education & Scholarship of Teaching, 15(3), Pp 25-35.
- **Coakley, N. & Bennett D. (2020):** Boundary learning environments in landscapes of practice, Medical Education, 54(6), Pp495–497

▪ **Coster, S., Watkins, M., & Norman, I. (2018):** What is the impact of professional nursing on patients' outcomes globally? An overview of research evidence, International Journal of Nurse Studies, 78, Pp 76-83.

▪ **De Menezes, S., Corrêa, C., Silva, R., De Almeida,D. & Da Cruz, M. (2015):** Clinical reasoning in undergraduate nursing education: a scoping review. Journal of School of Nursing, 49(6), Pp1032-1039

▪ **El-Gilany, A. & El Sayed, F. (2013):** Self-directed learning readiness and learning styles among Saudi undergraduate nursing students, Nurse Education Today, 33, Pp1040-1044.

▪ **Englund, H. (2020):** Using unfolding case studies to develop critical thinking skills in baccalaureate nursing students: A pilot study.Nurse Education Today, 93, 104542.

▪ **Findyartini, A., Hawthorne, L., McColl, G. & Chiavaroli, N. (2016):** How clinical reasoning is taught and learned: Cultural perspectives from the University of Melbourne and Universitas Indonesia, BMC Medical Education, 16, Pp 1-10.

▪ **Gagnon, M., Gagnon, J., Demartis, M. & Njoya, M. (2013):** The impact of blended teaching on knowledge, satisfaction, and self-directed learning in nursing undergraduates: A randomized, controlled trial, Nursing Education Perspectives, 34(6), Pp 377-382

▪ **George V. M., & Schocksnider J. (2014):** Leaders: Are you ready for change? The clinical nurse as care coordinator in the new health care system, Nursing Administration Quarterly, 38(1), Pp 78-85.

▪ **Gonzale, L. (2018):** Teaching Clinical Reasoning Piece by Piece: A Clinical Reasoning Concept-Based Learning Method, Journal of Nursing Education, 57(12), Pp 727–735

▪ **Hain, D. (2020):** Analysis of the Self-Directed Learning Readiness of New Graduate Registered Nurses, Doctoral thesis, University of South Florida.

▪ **Hege, I., Kononowicz, A. A. & Adler, M. (2017):** A clinical reasoning tool for virtual patients: design-based research study. JMIR Medical Education, 3(2), e21

▪ **Heinerichs, S., Vela, L. I. & Drouin, J. M. (2013):** A Learner-Centered Technique and Clinical Reasoning, Reflection, and Case Presentation Attributes in Athletic T raining Students. Journal of Athletic Training, 48(3), Pp 362-371.

▪ **Hong, S., Lee, J., Jang, Y. & Lee, Y. (2021):** A Cross-Sectional Study: What Contributes to Nursing Students' Clinical Reasoning Competence, International Journal of Environmental Research and Public Health, 18, 6833.

▪ **Hong, S., Lee, J., Jang, Y. & Lee, Y. (2021):** A cross-sectional study: What contributes to nursing students' clinical reasoning competence?, International journal of environmental research and public health, 18(13), 6833.

▪ **Hong, S., Lee, J., Jang, Y. & Lee, Y.(2021):** A Cross-Sectional Study: What Contributes to Nursing Students' Clinical Reasoning Competence?, International Journal of Environmental Research and Public Health, 18(13), 6833.

▪ **Hu, F., Yang, J., Yang, B.X., Zhang, F., Yu. S., Liu, Q., Wang, A., Luo, D., Zhu, X. & Chen, J. (2021):** The impact of simulation-based triage education on nursing students' self-reported clinical reasoning ability: A quasi-experimental study, Nurse Education in Practice, 50, 102949

▪ **Huang, H.M., Huang, C.Y., Lee-Hsieh, J. & Cheng, S.F. (2018):** Establishing the competences of clinical reasoning for nursing students in Taiwan: from the nurse educators' perspectives. Nurse Education Today, 66, Pp 110–116.

▪ **Jin, M. & Ji, C. (2021):** The correlation of metacognitive ability, self-directed learning ability and critical thinking in nursing students: A cross-sectional study, Nursing Open, 8(2), Pp 936–945

▪ **Johnston, S., Tutticci, N., Theobald, K. & Ramsbotham J. (2021):** Comparison of simulation observer tools on engagement and maximising learning: a pilot study, International Journal of Nursing Education Scholarship, 18(1), 201901101-8.

▪ **Jung, M. & Roh, Y. (2022):** Mediating Effects of Cognitive Load on the Relationship Between Learning Flow and Clinical Reasoning Skills in Virtual Simulation Learning, Clinical Simulation in Nursing, 64, Pp 16-23.

▪ **Kang, H.S., Kim, Y.Y. & Lee, H.S. (2018):** Predictive factors influencing clinical competence in nursing students, Journal of the Korea Academia-Industrial cooperation Society, 19(3), Pp 389–398

▪ **Kaulback, M. K. (2020):** Correlating self-directed learning abilities to lifelong learning orientation in Baccalaureate nursing students, Nurse Educator, 45(6), Pp 347–351.

▪ **Khiat, H. (2015):** Measuring self-directed learning: A diagnostic tool for adult learners, Journal of university teaching & learning practice, 12(2), 2.

▪ **Kojabadi, A., Asghari, E., Jabbarzadeh Tabrizi, F. & Sarbakhsh, P. (2023):** Translation and Validation of the Persian Version of the Nurses Clinical Reasoning Scale (NCRS): A Psychometric Analysis, The Open Nursing Journal, 17(1). 1

- **Kumar, A., Omprakash, A., Mani, P. Swaminathan, N., Maheshkumar, K., Maruthy, K.N., Sathiyasekaran, B., Vijayaraghavan, P.V. & Padmavathi, R. (2021):** Validation of Internal structure of Self-Directed Learning Readiness Scale among Indian Medical Students using factor analysis and the Structural equation Modelling Approach, BMC nursing, 21, Pp 614-628.
- **Levett-Jones, T., Cant, R. & Lapkin, S. (2019):** A systematic review of the effectiveness of empathy education for undergraduate nursing students. Nurse Education Today, 75, Pp 80–94.
- **Li, S., Gong, H., Pan, J. & Wu, X. (2021):** Relationship Between Undergraduate Nursing Students' Self-directed Learning and Training Demands for Nursing Information Systems: A Cross-sectional Study, CIN: Computers, Informatics, Nursing, 39(12), Pp 908-915.
- **Li, S., Gong, H., Pan, J., & Wu, X. (2021):** Relationship between Undergraduate Nursing Students' Self-directed Learning and Training Demands for Nursing Information Systems: A Cross-sectional Study, CIN: Computers, Informatics, Nursing, 39(12), Pp908-915.
- **Liou, S., Liu, H., Tsai, H., Tsai, Y., Lin, Y., Chang, C. & Cheng, C. (2015):** The development and psychometric testing of a theory-based instrument to evaluate nurses' perception of clinical reasoning competence, Journal of Advanced Nursing, 72(3), Pp 707–717.
- **Liou, S.R., Liu, H.C., Tsai, H.M., Tsai, Y.H., Lin, Y.C., Chang, C.H. & Cheng, C.Y. (2016):** The development and psychometric testing of a theory-based instrument to evaluate nurses' perception of clinical reasoning competence, Journal of Advanced Nursing, 72, Pp 707–717.
- **Liu, L. (2018):** PBL teaching method applied in anatomy teaching of nursing specialty, Medical Equipment, 31(5), Pp 67–68.
- **Lockwood, P. (2017):** Teaching Clinical Reasoning Skills to Undergraduate Medical Students: An action research study, Doctoral Thesis, University of Liverpool.
- **Lollis, M. (2016):** Self-Directed Learning Readiness, Student Satisfaction, Self-Confidence, And Persistence In Associate Degree Nursing Students, Doctorate thesis, Capella University.
- **Lucia Cadorin1, L., Cheng, S. & Palese, A. (2016):** Concurrent validity of self-rating scale of self-directed learning and self-directed learning instrument among Italian nursing students, BMC nursing, 15, Pp 20-31.
- **Ma, X., Yang, Y.Y., Wang, X. & Zang, Y. (2018):** An integrative review: developing and measuring creativity in nursing, Nurse Education Today, 62, Pp1–8.
- **Marcomini, I.,Terzoni, S. & Destrebecq, A. (2021):** Fostering nursing students' clinical reasoning: a QSEN-based teaching strategy. Teaching and Learning in Nursing , 16, 338-341
- **Maurício, A., Cruz, E., Barros, A., Tesoro, M., Lopes, C., Simmons, A. & Guandalini, L. (2022):** Effect of a guide for clinical reasoning on nursing students' diagnostic accuracy: A clinical trial, Revista Latino-Americana de Enfermagem, 30, e3515.
- **Moallem, M., Hung, W. & Dabbagh, N. (2019):** The Wiley Handbook of Problem-Based Learning, 1st edition, Chapter 5, Pondicherry: John Wiley & Sons, Inc.
- **Mohammadi-Shahboulaghi, F., Khankeh, H. &Zadeh, T. (2021):** Clinical reasoning in nursing students: A concept analysis, Nursing Forum, 56(4), Pp 1008-1014.
- **Paterson, M., Higgs, J., Wilcox, S. & Villeneuve, M. (2002):** Clinical reasoning and self-directed learning: Key dimensions in professional education and professional socialization, Focus on Health Professional Education, 4(2), Pp 5-21.
- **Pérez-Perdomo, A., & Zabalegui, A. (2023):** Teaching Strategies for Developing Clinical Reasoning Skills in Nursing Students: A Systematic Review of Randomised Controlled Trials, In Healthcare, (12)1, Pp. 90.
- **Pinnock, R. & Welch, P. (2014):** Learning clinical reasoning, Journal of Paediatrics and child health, 50(4), Pp 253-257.
- **Scaffa, M. & Wooster, D. (2007):** Effects of Problem-Based Learning on Clinical Reasoning in Occupational Therapy, American Journal of Occupational Therapy, 58(3), Pp 333-336.
- **Silva, J.L.G., de Souza Oliveira Kumakura, A.R.. Zanchetta, F.C.. Coutinho, V.R.D. & Lima, M.H.M. (2020):** Clinical Simulation for Teaching of Wound Evaluation and Treatment, Clinical Simulation Nursing, 38, Pp 5–13
- **Stephen, J.S. (2020):** Examining A High-Impact, First-Semester Seminar Class on Online Undergraduate Student Self-Regulation, Self-Direction, Online Learning Self-Efficacy, and Persistence, Doctoral thesis, The University of Memphis.
- **Steven, K., Wenger, E., Boshuizen, H., Scherpbier, A. & Dornan T. (2014):** How clerkship students learn from real patients in practice settings, Academic Medicine, 89(3), Pp 469-476.
- **Tohidi, S., KarimiMoonaghi, H., Shayan, A. & Ahmadinia, H. (2019):** The effect of self-learning module on nursing students' clinical competency: a pilot study, Iranian Journal of Nursing and Midwifery Research, 24(2), Pp 91–95.

- **Van Wyngaarden, A., Leech, R. & Coetzee, I. (2019):** Challenges nurse educators experience with development of student nurses' clinical reasoning skills, Nurse education in practice, 40, 102623.

- **Visiers-Jiménez, L., Palese, A., Brugnolli,A., Cadorin, L., Salminen, L., Leino-Kilpi, H., Löyttyniemi, E., Nemcová, J., Simão de Oliveira, C., Rua, M., Zeleníková, R. & Kajander-Unkuri, S. (2022):** Nursing students' self-directed learning abilities and related factors at graduation: A multi-country cross-sectional study, Nursing Open, 9, Pp.1688–1699.

- **Watari, T., Tokuda, Y., Owada, M. & Onigata, K. (2020):** The utility of virtual patient simulations for clinical reasoning education, International Journal Environment Research and Public Health, 17, 5325.

- **Williamson, S. & Seewoodhary R. (2017):** Student evaluation of the usefulness of the self-rating scale of self-directed learning tool in the FdSc in health and social care course, Journal of Healthcare Communications, 2(4), Pp 48-61.

- **Williamson, S. (2007):** Development of a self-rating scale of self-directed learning, NURSERESEARCHER, 14(2), Pp 66-83.

- **Wong, F. & Kan, C. (2022):** Online Problem-Based Learning Intervention on Self-Directed Learning and Problem-Solving through Group Work: A Waitlist Controlled Trial, International Journal of Environmental Research and Public Health, 19, Pp 720-737.

- **Yang, F., Wang, Y., Yang, C., Zhou, M.H., Shu, J., Fu, B. & Hu, H. (2019):** Improving clinical judgment by simulation: A randomized trial and validation of the lasater clinical judgment rubric in Chinese. BMC Medical Education, 19, Pp 1-6.

- **Yeh, C., Huang, H., Kuo, C., Huang, C. & Cheng, S. (2022):** Effectiveness of e-STORY App in clinical reasoning competency and self-directed learning among students in associate nursing program: A quasi experimental study, Nurse Education in Practice, 64, 103456

- **Yuan, H., Williams, B., Fang, J. & Pang, D. (2012):** Chinese baccalaureate nursing students' readiness for self-directed learning, Nurse Education Today, 32, 427-431.

- **Zhao, X. & Cong, L. (2019):** Effect of problem and scripting-based learning combining wearable technology on orthopaedic operating room nurses' learning outcomes, Nurse Education Today, 73, Pp13–16.

- **Zhou, H., Wang, Y. & Cheng, L. (2022):** The mediating effect of self-directed learning in the relationship between caring and resilience among Chinese nursing students: A multi-center cross-sectional study, Nurse Education Today, 119, 105598