The effectiveness of different teaching methods on medical or nursing students

Protocol for a systematic review and network meta-analysis

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Abstract

Background: One of the major challenges in nursing and medical education is to foster the critical thinking ability and autonomous learning ability for students. But the effect of different teaching methods on these abilities of nursing or medical students has not been conclusive, and few studies have directly compared the differences in the effects of different teaching methods. As a result, it is necessary for students to evaluate the impact of different teaching methods on critical thinking ability and autonomous learning ability.

Methods: A systematic search will be performed using Chinese National Knowledge Infrastructure, Wanfang Data (Chinese database), VIP Information (Chinese database), Chinese Biomedical Literature, and English language databases, including PubMed and Embase, Web of Science, CINAHL Complete (EBSCCO), Cochrane library to identify relevant studies from inception to July 10, 2020. We will include random controlled trials that evaluated the different teaching methods. The Quality Assessment of Diagnostic Accuracy Studies 2 quality assessment tool will be used to assess the risk of bias in each study. Standard pairwise meta-analysis and network meta-analysis will be performed using STATA V.12.0, MetaDiSc 1.40, and R 3.4.1 software to compare the diagnostic efficacy of different hormonal biomarkers.

Results: The results of this study will be published in a peer-reviewed journal.

Conclusion: This study will summarize the direct and indirect evidence to determine the effectiveness of different teaching methods for medical or nursing students and attempt to find the most effective teaching method.

Ethics and dissemination: Ethics approval and patient consent are not required, because this study is a meta-analysis based on published studies.

INPLASY registration number: INPLASY202070017

Abbreviation: NMA = network meta-analysis.

Keywords: teaching method, the critical thinking ability, autonomous learning ability

1. Introduction

The ability of critical thinking is to be deliberate about thinking and actively assess and regulate one’s cognition,\textsuperscript{[1,2]} which is vital for nursing students and medical students which prepare them for clinical practice,\textsuperscript{[3]} because critical thinking makes them respond quickly to patients’ urgent problems, make a best clinical decision, and provide safe and quality care.\textsuperscript{[4]} And then, students with clinical thinking skills have capabilities such as information seeking, data analysis, decision making, and feedback.\textsuperscript{[5]} However, Absent critical thinking,\textsuperscript{1} typically relies on heuristics, a quick method or shortcut for problem-solving, and can fall victim to cognitive biases.\textsuperscript{[6]} Cognitive biases can lead to diagnostic errors, which result in increased patient morbidity and mortality, and the adverse event of nursing.\textsuperscript{[7]} Therefore, critical thinking and experience with technology have been noted as important qualities for graduates transitioning into professional roles.\textsuperscript{[8]}

The representative of Social Cognitive School, American psychologist Bandura\textsuperscript{[9]} believes that autonomous learning is that learners constantly monitor and adjust their cognitive and emotional states, observe and apply various learning strategies, adjust learning behaviors, and strive to create and use the process of using material and social resources that contribute to learning.
Autonomous learning is defined as a process where the learner is motivationally, behaviourally and meta-cognitively proactive in the learning process.[10] Besides, in the clinical environment, autonomous learning has been linked with academic achievement,[11-13] success in clinical skills,[14] and emotional health.[15] However, 1 of the major challenges in nursing and medical education is to develop an effective teaching method to foster critical thinking and autonomous learning ability for students.

In medical education, different teaching methods have different effects on nursing or medical students' critical thinking and autonomous learning ability. In addition, more and more medical educators have recognized the shortcomings of traditional teaching methods, so they try to use a variety of teaching methods to enhance students' critical thinking and autonomous learning ability, for example, case-based learning, problem-based learning, simulation-based learning. Compared with traditional teaching methods, these teaching methods reflect their own advantages. At present, the effect of different teaching methods on the critical thinking and autonomous learning ability of nursing or medical students has not been conclusive, and few studies have directly compared the differences in the effects of different teaching methods. Consequently, it is necessary and practical to evaluate the impact of different teaching methods on the critical thinking ability and autonomous learning ability of nursing or medical students.

2. Methods

A network meta-analysis (NMA) will be conducted to test the differences of different teaching methods. We have registered the protocol on the International Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY),[16] and the registration number was INPLASY202070017. We will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statements[17] to report our NMA.

2.1. Eligibility criteria

2.1.1. Types of patients. Medical students or nursing students will be included. There will also be no restrictions based on other conditions, such as age, educational attainment, gender, different courses.

2.1.2. Types of studies. We will consider only randomized controlled trials (RCTs) of teaching methods for medical or nursing students. We will exclude non-RCTs, quasi-RCTs, uncontrolled trials, and reviews.

2.1.3. Types of interventions. Studies that evaluated any kind of teaching method (case-based learning, problem-based learning, simulation-based learning) will be included. We will exclude trials that teaching methods are not used as a major therapy. The control interventions will include traditional teaching.

2.1.4. Types of outcome measures

2.1.4.1. Primary outcomes. The primary outcomes are critical thinking (CT), autonomous learning ability. And CT was evaluated by the California Critical Thinking Disposition Inventory (CCTDI),[18] and autonomous learning ability was evaluated by the Self-Directed Learning Instrument (SDLI) for Nursing Students.[19]

2.1.4.2. Secondary outcomes. The secondary outcome measures will include:

1. student satisfaction; Undergraduate Nursing Student Academic Satisfaction Scale[20]
2. score: Self-made scale based on different research content

2.2. Search methods and the identification of studies

2.2.1. Electronic searches. We searched Chinese National Knowledge Infrastructure, Wanfang Data (Chinese database), VIP Information (Chinese database), Chinese Biomedical Literature, and English language databases, including PubMed and Embase, Web of Science, CINAHL Complete (EBSCO), Cochrane library to July 10, 2020, for different teaching methods. The search term will include 3 parts: that is teaching methods (Training Technique; Training Technique; Problem Based Learning; Problem-Based Curriculum; Problem Based Curriculum; Problem Based Curricula; Problem Based Curricula; Experiential Learning; Active Learning; Self Directed Learning as Topic; Simulation Training; Interactive Learning; Interactive Learning), critical thinking or autonomous learning ability (Thinking Skill*, Thought*, Critical Thinking, Independent learning capability, autonomous learning ability, Self-learning ability, Learner Autonomy, Self-regulated ability), and medical students or nursing students (Medical Student* OR Pupil Nurse* OR Nursing Student*). The equivalent search entries will be used while searching in Chinese databases. The fully reproducible

| Search number | Search strategy used in the PubMed database | Search term |
|---------------|---------------------------------------------|-------------|
| 5             | 3 AND 4                                     | (Training Technique [Title/Abstract]) OR (Training Technique [Title/Abstract]) OR (Pedagog* [Title/Abstract]) OR (Teaching Method [Title/Abstract]) OR (Academic Training [Title/Abstract]) OR (Training Activ* [Title/Abstract]) OR (Educational Technique [Title/Abstract]) OR (Educational Technic [Title/Abstract]) OR (Problem Based Learning [Title/Abstract]) OR (Problem Based Learning [Title/Abstract]) OR (Problem Based Curriculum [Title/Abstract]) OR (Problem Based Curriculum [Title/Abstract]) OR (Problem Based Curricula [Title/Abstract]) OR (Problem Based Curricula [Title/Abstract]) OR (Problem-Based Learning [Title/Abstract]) OR (Problem-Based Curriculum [Title/Abstract]) OR (Problem-Based Curriculum [Title/Abstract]) OR (Self Directed Learning [Title/Abstract]) OR (Self Directed Learning [Title/Abstract]) OR (Simulation Training [Title/Abstract]) OR (Simulation Training [Title/Abstract]) OR (Interactive Learning [Title/Abstract]) |
| 4             | 1 AND 2                                     | (Thinking Skill [Title/Abstract]) OR (Thought [Title/Abstract]) OR (Critical Thinking [Title/Abstract]) OR (Independent learning capability [Title/Abstract]) OR (autonomous learning ability [Title/Abstract]) OR (Self-learning ability [Title/Abstract]) OR (Learner Autonomy [Title/Abstract]) OR (Self-regulated ability [Title/Abstract]) |
| 3             |                                             | (Medical Student [Title/Abstract]) OR (Pupil Nurse [Title/Abstract]) OR (Nursing Student [Title/Abstract]) |
search strategy provided in Table 1 is for PubMed. This will be appropriately adapted for search in the other databases. And the flow chart of searching and screening studies is showed at Fig. 1

2.2.2. Searching other resources. In addition, we will also search for dissertations and grey literature to identify systematic reviews or clinical trials related to teaching methods. Besides, related journals and conference processes will be manually searched.

2.3. Data collection and analysis

2.3.1. Selection of studies and data extraction. Initial search records will be imported into ENDNOTE X9 literature management software, then the titles and abstracts of records will be screened to identify potential trials according to eligibility criteria. Next, full-text versions of all potentially relevant trials will be obtained and reviewed to ensure eligibility.

A standard data extraction form will be created using Microsoft Excel 2013 to collect data of interest. Which include eligible studies characteristics (eg, name of the first author, year of publication, the country in which the study was conducted), intervention characteristics (eg, the name of teaching methods, intervention time, time of duration), population characteristics (eg, gender, mean age, sample) and outcome (eg, CT, autonomous learning ability, student satisfaction, score)

Study selection and data extraction will be performed by 1 reviewer (YB), and will be checked by other reviewers (CYT, SQ). Any conflicts will be resolved by discussion.

2.3.2. Assessment of risk of bias. Two reviewers (Y.B. and C. YT.) will independently assess the risk of bias for each study as low, moderate, or high using the Quality Assessment of Diagnostic Accuracy Studies. And conflicts will be also resolved by discussion.

2.3.3. Geometry of the network. Using R software V.3.4.1, a network plot will be drawn. In network plots, the size of the nodes is proportional to the number of studies evaluating a test, and the thickness of the lines between the nodes is proportional to the number of direct comparisons between tests. The network is connected because there exists at least 1 study evaluating a given test together with at least 1 of the other remaining tests. A loop connecting 3 tests indicates that there is at least 1 study comparing the 3 targeted tests simultaneously.

2.3.4. NMA

2.3.4.1. Pairwise meta-analyses. We will construct forest plots showing estimates of sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, diagnostic odds ratio, and their corresponding 95% confidence intervals for each index test using STATA V.12.0 (Stata) and MetaDiSc 1.40. Q value and the inconsistency index (I2 test) will estimate the heterogeneity of each study. If the I2 is ≤50%, it means that statistical heterogeneity could be negligible, and the fixed effects model will be used. If the I2 is >50%, we will explore sources of heterogeneity by subgroup analysis and meta-regression. If there is no clinical heterogeneity, the random-effects model will be used to perform the meta-analysis. In addition, we will also plot sensitivities and specificities in the summary receiver operating characteristic space, using different symbols for different hormonal biomarkers. Besides, we will use STATA V.12.0 (Stata) and Review Manager 5.30 (RevMan) analysis software to build the hierarchical summary receiver operating characteristic graphics for each index test.

2.3.4.2. Indirect comparisons between competing diagnostic tests. We could use STATA V.12.0 (Stata) software to calculate relative diagnostic outcomes between index tests, including
relative sensitivity, relative specificity, relative diagnostic odds ratio, relative positive likelihood ratio, and relative negative likelihood ratio, and then we could use these outcomes to conduct indirect comparisons.

2.3.4.3. Subgroup analysis. If sufficient studies are available, we will explore meta-regression or subgroup analysis based on the age, intervention time, and duration of intervention; the country in which the study was conducted, and the risk factors of teaching methods.

3. Discussion
To the best of our knowledge, this is the first NMA protocol comparing different teaching methods for nursing or medical students to foster the critical thinking ability and autonomous learning ability with RCTs. The study will provide a ranking of mesh fixation for teaching methods and we hope the result will provide recommendations for education managers to foster students’ ability. This protocol is designed in adherence to guidelines for NMA protocols and will be conducted and reported strictly according to the PRISMA extension statement for NMA.[12,23]

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Author contributions
Bei Yun, Yi-Tong Cai, and Qian Su: plan and design the research. Bei Yun, Yi-Tong Cai, Qian Su, and Lin Han tested the feasibility of the study. Yi-Tong Cai, Qian Su, Lian Chen, Chaoran Qu and Lin Han provided methodological advice, polished, and revised the manuscript. Bei Yun and Qian Su wrote the manuscript; all authors approved the final version of the manuscript.

Competing interests
None declared

Conceptualization: Lin Han.

Investigation: Lin Han.

Methodology: Bei Yun, Yi-Tong Cai, Qian Su, Lian Chen, Chaoran Qu and Lin Han

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