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The effect of integrating constructivist and evidence-based practice on baccalaureate nursing student's cognitive load and learning performance in a research course

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ABSTRACT

Background: Baccalaureate nursing students perceive research as unattractive, doubt the value of nursing research, and do not appreciate the link of research with practice. No studies have examined students' cognitive load during an evidence-based practice research course versus a traditional research course.
Objectives: To assess the effect of integrating constructivist theories and evidence-based practice on student cognitive load and learning performance in a research course.
Design: A true experimental study.
Settings: A Registered Nurse-to-Bachelor of Science in Nursing program.
Participants: Six classes of second-year students.
Methods: Students were randomly allocated to the control group (two classes) or the experimental group (two classes) using cluster randomization. The control group underwent "traditional research"; the experimental group experienced "integrating evidence-based practice into research." Instruments for outcome assessment include the Cognitive Load Scale, cognitive test, team critique paper, and qualitative feedback on course satisfaction. The between-subjects effects were compared by Analysis of Covariance.
Results: The experimental group had significantly higher mental load (8.74 vs. 7.27, $p < .001$), mental effort (11.07 vs. 10.07, $p = .009$), mental efficiency (0.33 vs. −0.31, $p < .001$), and research knowledge (70.61 vs. 44.92, $p < .001$) than the control group. The experimental group had better critique paper scores in introduction (92.80%), literature review (91.70%), and assignment requirement and writing (89.40%). Some experimental learners expressed satisfaction with learning evidence-based practice (17.78%) and critiquing a research article (7.78%).
Conclusions: Integrating evidence-based practice into a research course not only improved the research knowledge of baccalaureate nursing students, but also increased their mental load, mental effort, and mental efficiency. Additional studies may track learners' responses to different learning systems using the developed instrument to measure the three types of cognitive load. These findings may help educators design more effective and interesting curricula for integrating research and evidence-based practice into the studies of student nurses.

1. Introduction

A research course embedded into the curriculum of the bachelor degrees has long been a criterion of comprehensive education as defined by the National League for Nursing (NLN, 1977). With an increasing emphasis on patient safety, cost effectiveness, and quality of patient care, baccalaureate student nurses need education in evidence-based practice (EBP) and research utilization (American Association of Colleges of Nursing [AACN], 2015; Christie et al., 2012; Institute of Medicine, 2001). EBP is a core knowledge competency defined by the Institute of Medicine as a part of good professional education (Hickey et al., 2010). However, surveys show that American Registered Nurses (RNs) receive little or no education in information use and retrieval; neither do they understand or value research or EBP (Pravikoff et al., 2005); these results suggest that RN education should incorporate research use, EBP, and information literacy, to cultivate the knowledge and skills of EBP and an appreciation for research into new nurses. In addition, the U.K. Nursing and Midwifery Council (2010) requires that all undergraduate programs include education in research methods and the use

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of research evidence. Nurse educators must instill in baccalaureate nursing students an awareness of the research process and an appreciation of the worth of research.

EBP pedagogy studies show that nurse educators use diverse approaches to integrate EBP into the nursing curriculum (Moch et al., 2010; Moch and Cronje, 2010), thereby formulating long-lasting engagement to foster the ability of students to understand the research process, think analytically, and promote information literacy skills so as to discover evidence to apply to their own practice. However, integration of EBP into research does not always render a positive learning experience. Some baccalaureate nursing students report frustration, perceive research as unattractive, doubt the value of nursing research, believe teaching strategies are futile, and do not appreciate the relationship of research and practice (Kessler and Alverson, 2014; McCurry and Martins, 2010; Spatz, 2008). Likewise, Taiwanese student nurses perceive stress both before and after a learning research course (Tsai et al., 2014).

As nurse educators, we found that students in RN-to-BSN programs felt pressure and that learning research was a burden, because most did not study research in the 5-year associate degree in nursing program and they had difficulty understanding the abstract terms and concepts used in research. Compared to other nursing courses, learners in a research course need to put forth added effort to learn because of their lack of prior knowledge. Most creative, constructivist approaches to teaching research are called for so that students should graduate knowing that they can understand, critique, and use research to enhance their practice.

Learning EBP in a research course may affect students' cognitive load. Cognitive load theory (CLT) is the theory that learning involves mental effort or cognitive load. Under this theory, students most efficiently learn when they minimize the short-term memory load while enhancing the memory available for transferring knowledge from short-term to long-term memory (Behmake and Atwood, 2013). CLT builds upon an established model of learner memory that includes the subsystems of sensory, working, and long-term memory (Young et al., 2014). The process of learning research and EBP needs working memory for the learner to be actively engaged in understanding and processing the material. As a result, the learner can transfer the learned information into long-term memory. Irrelevant information increases the mental load, straining working memory and interfering with long-term memory (Vogel-Walcutt et al., 2011). In addition, when the cognitive load associated with a task exceeds the learner's work memory capacity, learning performance is impaired (Young et al., 2014). Naismith et al. (2015) use cognitive load theory for workshop design and evaluation for 59 clinical educators. Results suggest that instructional design optimized learning by managing intrinsic load, stimulating germane load, and minimizing extraneous load. No studies have assessed the cognitive load of learning research or EBP. In addition, there has been a dearth of research on the use of constructivist learning methods in nursing education (DeCoux Hampton, 2012). Therefore, the aim was to examine the effect of integrating constructivist and evidence-based practice on student cognitive load and learning performance in a research course.

2. Literature

Cognitive theories are used to study students' learning processes to understand how information is received, organized, stored, and retrieved by the mind (Ertmer and Newby, 2013). The goals of constructivism is to understand the skills used in critical thinking, collaboration, and personal query, skills crucial to nursing practice and to the application of EBP. Constructivism is based on the idea that newly-acquired knowledge is built upon and within the context of previous learning (Lincoln and Guba, 2000). In the constructivist model, instructors first present basic concepts, and then gradually add more complicated concepts, while learners familiarize themselves with the more basic concepts. Within a constructivist classroom, teachers must develop the skills students need to participate (Cooper, 2007). Lack of education means nurses lack the capacity to apply EBP; for this reason, AACN does not recommend that all of the five steps of the EBP process (ask, acquire, appraise, apply, and audit) be a standard part of the baccalaureate nursing curriculum. Rolloff (2010) demonstrates that constructivism can offer a framework for incorporating these steps into the entire nursing curriculum, from freshman year through senior year.

Teachers employ a variety of research and EBP pedagogy, from incorporating EBP into the whole baccalaureate curriculum, to integrating EBP into research using a variety of teaching strategies (Bloom et al., 2013; Odell and Barta, 2011). These strategies include a collaborative clinical project; cooperative learning groups; new knowledge discussion group; a research utilization project; critiqued research and made posters; journal club; the Web Resource Appraisal Process; the use of an internet tool for accessing and appraising evidence; teaching critical appraisal in classes; the use of the PICO questions, databases, and search strategy; education in locating and utilizing synopses journals; EBP reviews and presentations; use of clinical practice guidelines in teaching and in practice; using systematic reviews; use of EBP literature in teaching; discussion of an evidence-based research paper, a presentation, and participation in a faculty-sponsored research project; and the cookie experiment (Meeker et al., 2008; Thompson, 2006). The PICO questions include (P) patient, population or process of interest, (I) intervention or best practice to be assessed, (C) comparison group or unit, and (O) outcome or effect of interest (Hastings and Fisher, 2014).

Innovative approaches to teaching baccalaureate nursing research have better outcomes. For example, McCurry and Martins (2010) developed innovative strategies for teaching undergraduate nursing research and EBP; students' perceived effectiveness was greater with the use of innovative assignments than with traditional assignments ($t = 6.93$, $p < .0001$). Students also preferred active learning assignments, reading quizzes, clinical nurse researcher presentations, and collaboration with clinical course assignments. Liou et al. (2013) tested the effects on student research knowledge, classroom engagement, and eight core competencies in nursing of using innovative teaching strategies to teach research. Innovative teaching strategies were related to higher posttest outcomes of classroom engagement and nursing eight core competences, after controlling for pretest scores.

To ensure that future nurse educators are prepared to teach in an EBP curriculum, it is vital that they understand how do apply CLT to help nursing students learn EBP in nursing. CLT discriminates between three types of cognitive load: intrinsic, extraneous, and germane. Intrinsic cognitive load is determined by an interaction between the nature of the information being learned and the expertise of the learner and cannot be affected directly by instructional design. Extraneous cognitive load is the load arising from suboptimal instructional methods. Extreme extraneous load can generate split-attention and/or redundancy effect (Josephsen, 2015; Leppink et al., 2014). Germane cognitive load is "the load related to processes that contribute to the construction and automation of schemas" (Paas et al., 2003, p.65). Instructional design seeks to decrease extraneous cognitive load and enhance germane cognitive load (Brunken et al., 2003).

Schlairet et al. (2015) explored the impact of high-fidelity simulation on emotion and cognitive load in 40 first-semester BSN nursing students and found that simulation had a high mean cognitive load (6.27 ± 1.48) and non-significantly slight positive correlation with emotion. Fraser et al. (2012) examined the effect of simulation education on 84 medical students and found cognitive load was higher in active participants according to the level of their engagement. Chen and Wu (2015) investigated the influence of three types of video lectures on sustained attention, emotion, cognitive load, and learning performance of 37 undergraduate verbalizers and visualizers using a two factor experimental design. Lecture capture (using a digital video camera to record classroom lectures including a lecturer's voice, image, and instructional aids) and picture-in-picture types of lectures (displaying a lecturer's recorded image and voice, PowerPoint slides, subtitles, and