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ORIGINAL RESEARCH

The impact of deliberate reflection with WISE-MD™ modules on critical thinking of nurse practitioner students: A prospective, randomized controlled pilot study

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ABSTRACT

Objective: Nurse practitioner (NP) students at our graduate school of nursing use WISE-MDTM simulation modules in the curriculum. This prospective randomized controlled pilot study was undertaken to evaluate critical-thinking outcomes associated with adding metacognitive deliberate-reflection guidance to the learning strategy with WISE-MD™ simulation modules.

Methods: Of 33 NP students randomly assigned to intervention and control groups, 16 completed the study. The intervention group received WISE-MD™ learning modules with specific guidance or deliberate reflection. Controls used the modules with instructions for periodic free-thought reflections. Students' tape-recorded reflections were categorized according to author-developed critical-thinking categories. Data were analyzed using NVIVO™. Students' feedback was collected by post-intervention anonymous survey.

Results: Critical thinking outcomes (student responses to exercises after free-thinking or deliberate-reflection guidance) did not differ between groups. However, the intervention group demonstrated a higher level of critical thought after deliberate-reflection guidance. Post-intervention quantitative and qualitative feedback from both groups endorsed the value of the WISE-MD™ modules for NP education.

Conclusions: Despite no difference in unprompted outcomes between groups, the intervention group often verbalized more thoughtful clinical decision-making. We speculate that the deliberate-reflection guidance intervention utilized with students throughout only two modules was insufficient for them to internalize the critical-thinking process. We propose using free-thought reflections with one or two WISE-MD™ modules to identify struggling students' clinical decision-making process. These students' remediation plan could include recording their deliberate-reflection process while viewing WISE-MD™ modules. Students would be guided to verbalize and record their critical-thinking processes for faculty review until students sufficiently integrate the process into their clinical decision-making.

Key Words: WISE-MD™, Deliberate reflection, Self-reflection, Think aloud, Critical thinking, Nurse practitioner students, Advanced health assessment

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1. INTRODUCTION

Critical thinking in a clinical context has been defined as the ability to apply higher cognitive skills (*e.g.*, conceptualize, analyze, evaluate) to information from various sources (*e.g.*, medical history, physical assessment) to inform actions that precisely, consistently, logically and appropriately address clinical problems.^[1] However, the evidence for best methods of teaching, measuring and evaluating critical thinking is scarce.^[1-3] Contributing to this issue is a lack of consensus among medical educators on how to define critical thinking, *i.e.*, as an ability, a disposition to be deliberate about thinking, or both.^[1,3,4] In a systematic review of critical thinking in nursing, components of critical thinking included gathering and seeking information, questioning and investigating, analysis evaluation and inference, problem solving and application of theory.^[5] Other reviews have noted critical thinking to be logical thinking with the ability to predict and transform knowledge^[6] and high level cognitive abilities to integrate knowledge and solve complex problems.^[7]

To assess critical thinking skills of healthcare professionals at the novice, intermediate and master levels, the Millennium Conference 2011 proposed several milestones in knowledge, skills, and attitudes.^[1] Novice knowledge of critical thinking tends to emphasize content over process, whereas intermediate knowledge senses the limits of knowledge, with emerging knowledge of critical thinking skills. At the master level, clinicians show skill in modulating content, process, and context. They also have intricate knowledge of critical thinking skills. In terms of skills, the novice depends on prompting from faculty and relies on memory to solve problems, and the intermediate critical thinker slows down, sees limits of knowledge, and asks for help. At the master level, critical thinkers routinely use metacognition and can teach and articulate their thinking process. In terms of attitudes, the novice is not self-reflective, believes more facts are better, and relies on memorization, whereas intermediate critical thinkers are developing their self-reflection and awareness of their role in error. Master critical thinkers consider both sides of arguments and gray areas, understand the role of critical thinking in improving patient outcomes, see themselves as lifelong learners, and are intellectually humble.^[1]

One approach to helping novice students develop problem-solving ability in nursing care is for nursing faculty to externalize their own thinking processes in clinical settings by thinking aloud, thus modeling critical thinking for students.^[8] For the purposes of this study, critical thinking was defined as reflective, reasonable thinking focused upon the ability to make inferences and verbalize thought processes.^[9,10] To reinforce the notion that the reflective thinking process is an overt skill, complementing the skill set of deliberate practice,

one author (MQ) created the term deliberate reflection. Deliberate reflection is the metacognitive learning innovation that was tested in this study.

The process for deliberate reflection was introduced for several reasons: 1) deliberate reflection implies making the reflective process overt to enhance learning,^[11,12] 2) deliberate reflection, unlike the similar metacognitive strategy of self-explanation, is not restricted to inferences and clarifying, justifying or monitoring behavior,^[13,14] 3) deliberate reflection focuses on integrating previous experiences with current experience, applying strategic knowledge about self and learning (including awareness of affective components such as confidence),^[13,14] and, incorporating mental representation (selective encoding, combination and comparison),^[15-17] 4) deliberate reflection has important temporal features of reflection to consider before, during and after action, and 5) deliberate reflection uses a think-aloud or verbal-report strategy used in debriefing and other thought-process research strategies.^[7] The process of making reflective thinking overt (the first reason) is suggested by using cognitive forcing strategies to de-bias and prevent diagnostic errors.^[18,19] In this study, we explored whether deliberate reflection, as a learning strategy with specific instructions to guide students in applying the principles of reflective awareness, would enhance their learning outcomes and critical thinking about the content presented in WISE-MDTM modules.

WISE-MDTM

Web Initiative in Surgical Education (WISE-MDTM) is a set of case-based online teaching modules initially designed to support the core curriculum in surgical clerkships during medical school.^[20,21] For the remainder of this document, these modules will be referred to as WISE modules. Based on evidence-based multimedia design principles and designed for independent study, the modules combine visual, audio, and real-life content with animated graphics. The WISE modules, which are endorsed by the American College of Surgeons and the Association of Surgical Education, were designed to develop medical students' clinical reasoning in a consistently high quality learning environment to ensure clinical competence, a challenge appreciated by graduate nursing faculty as well.^[20,21]

Each module lasts approximately 1 hour, with its topic introduced by an instructor in a fundamentals section. The learner then follows a typical patient from initial presentation and history taking, physical examination, laboratory tests and radiological imaging, to preoperative preparation, surgery, and recovery. Most modules include videos of patient-physician interactions as well as graphic depictions of surgical processes alongside an overview of the actual surgical process.

While most nurses and nurse practitioners (NPs) may not be involved with the surgical component, however they will encounter these relatively common case presentations in both primary and acute care settings, where they are often the first to evaluate a patient's chief complaint. Exposing nurse learners to these modules could significantly enhance their clinical decision-making processes as they evaluate and consider referral of patients who present with signs and symptoms suggesting surgical intervention.^[20,21]

Although WISE modules have been used in medical schools since 1998 and are used by over 100 medical schools and a few nursing schools,^[20,21] few studies have reported on their use. One study found that medical students who viewed the WISE modules trended toward better knowledge and clinical reasoning than students who did not view the modules.^[22] The same group conducted a second (unpublished) multi-site research study on the learning impact of WISE modules for surgical clerkship students at six US medical schools, but at 10 months, short-, medium-, and long-term results did not differ among students in three research arms, so the trial was halted at 12 months.^[16]

Our interprofessional team of authors reviewed the literature to consider 1) how the modules might be enhanced to impact learning outcomes for our university's surgical clerkship students and 2) how the modules might be applicable to nursing students, particularly advanced practice nurses. Given that the value of learning through simulation lies in debriefing and reflection on the simulation experience,^[12] and that structured reflection improves learning outcomes,^[11,13,23-26] we reasoned that some of the educational value of the video-based simulation in the WISE modules might be lost without systematic instructions for learner reflection or self-debriefing. We further reasoned that the WISE module learning experience and outcomes related to working memory and critical thinking might be improved by a personalized, real time, self-debriefing/reflective component.

Therefore, this prospective randomized controlled pilot study was undertaken to evaluate critical-thinking outcomes associated with adding metacognitive deliberate-reflection guidance to the learning strategy with WISE-MD™ simulation modules. Controls were exposed to the WISE modules with instructions for periodic free-thought reflections. Outcomes on critical thinking came from three data sources: 1) intervention audiotapes, 2) student recordings of their thinking process and answers, and 3) students' self-report of self-efficacy and ability to verbalize thinking with the material. We hypothesized that NP students in the intervention group would show a significantly greater pre- to post-intervention

increase in critical thinking ability than students in the control group.

2. METHODS

2.1 Participants

Participants were recruited from 37 NP students enrolled in the Advanced Health Assessment course in spring and summer 2012 at the authors' university. During the first week of class, students were informed that all class members would have access to all the WISE modules, regardless of participation in the pilot study. The class was invited to participate in the study after being informed that participation: 1) was strictly voluntary with no likelihood of harm to participants, 2) anonymity was assured, and 3) they were free to drop out at any time. Students were also informed that they would 1) be enrolled in the study for one semester, 2) use a provided digital recorder to record their thoughts while viewing several pre-selected WISE modules, 3) view modules and complete assigned activities on their own time outside class, 4) not receive compensation for participation in the study, and 5) participation would not influence their grades. Additionally, students were informed that participation in the study and subsequent use of the WISE modules might be seen as an advantage in terms of their overall learning experience for the semester. The 33 students (89% participation) who volunteered to participate were randomly assigned into either the control (n = 16) or the intervention (n = 17) group.

2.2 Procedure

The procedure had four steps from pretest to posttest, as outlined in Figure 1.

Step 1/Pretest

Student participants filled out a brief demographic form. Both the intervention and control groups were divided into two subgroups as close to equal size as possible. One subgroup viewed the abdominal aortic aneurysm module and the other viewed the cholecystitis module. Each student was provided with a digital recorder and asked to record their thoughts freely while viewing each module. For this exercise, all students were provided with a "free-thought" guide (see Table 1).

Step 2

Both groups reviewed the thyroid nodule module, but the control group did so without using a digital recorder or instructions, and the intervention group used a digital recorder while answering questions from the guided deliberate reflection think-aloud instructions (see Table 2). For guided deliberate reflection when viewing the thyroid and appendicitis modules, participants were given general instructions and asked to complete "think-aloud" exercises at specific time

points (see Tables 2 and 3, respectively). They were told there was no right or wrong answers, that they should say their identification number and the name of the module when starting it. They were also instructed to identify the question each time they spoke into the recorder, e.g., response 1a or response 2c. Other general instructions included checking each

question as they responded, not opening any files under “Additional Information” until they had completed the module, and viewing all sections of the module from start to finish even if they were not asked specific questions regarding that segment.

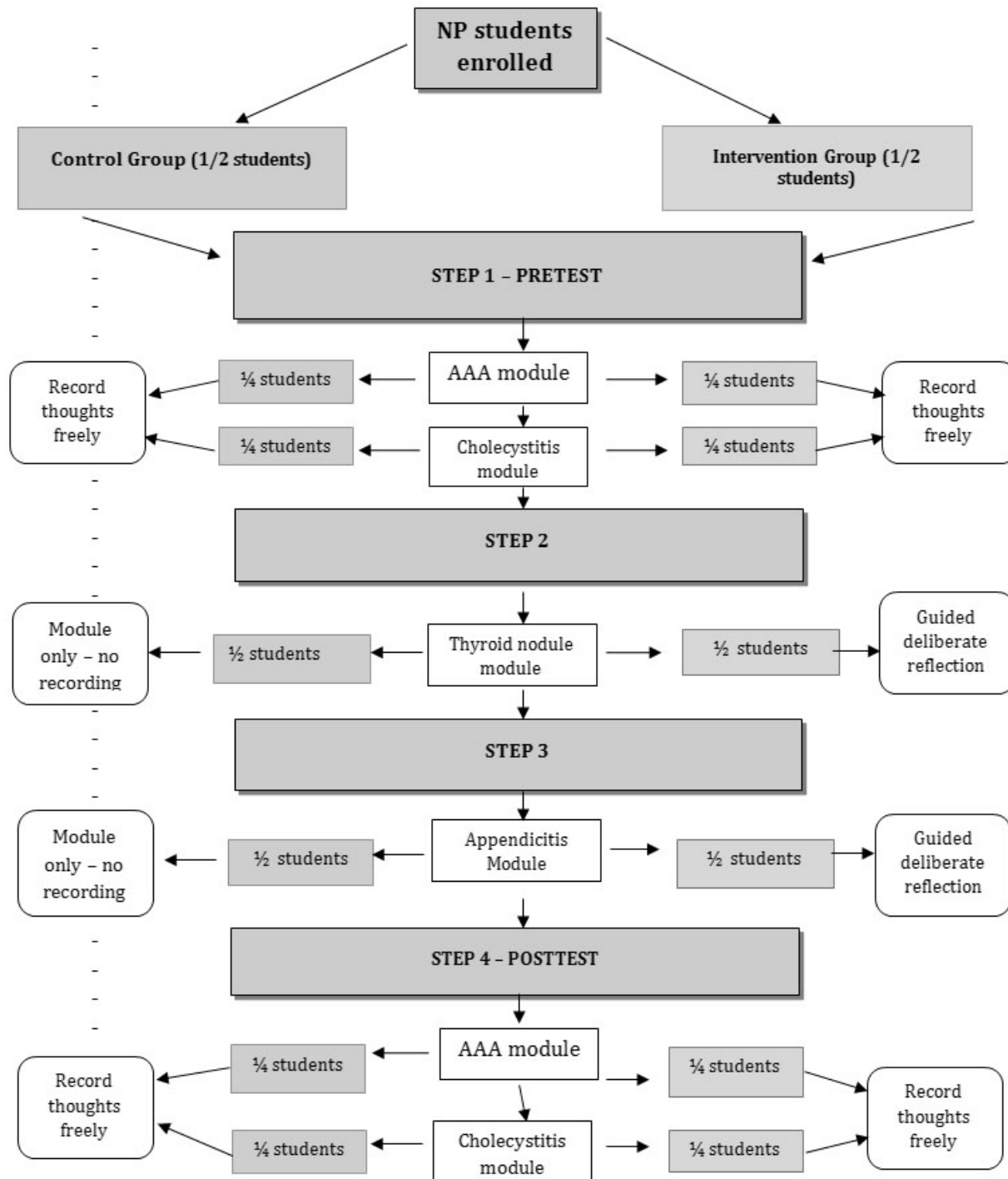


Figure 1. WISE study flowchart
 AAA: abdominal aortic aneurysm

Table 1. Free-thought guide

<ul style="list-style-type: none"> • We ask that you view four WISE-MD modules. • As you are viewing two of the modules, we would like you to complete a free-thought exercise. This means saying out loud whatever happens to come across your mind at any given moment as you are viewing the modules. Keep in mind there are no right or wrong answers. • IMPORTANT! Please make sure you stop the module a minimum of three times (we suggest doing so at the beginning, middle and end, but encourage you to stop more often).

Table 2. Deliberate reflection think-aloud instructions for thyroid nodule module

1) Before the thyroid nodule module begins, press record and respond to the following questions:	Check Box
1a. What are your initial thoughts on patients with thyroid nodule?	
1b. What kind of experience have you had with patients with thyroid nodules?	
1c. How confident are you in working with patients with thyroid nodules (1-10)?	
1d. How informed are you about the subject matter (1-10)?	
2) Before viewing the <u>History section</u> of the module, press record and respond to the following questions:	Check Box
2a. What will you be looking for in the history – what will help you differentiate?	
2b. What characteristics of the complaint or problem are most important to be clear about and why?	
2c. What are some possible pitfalls in the communication that you want to avoid?	
2d. Are there assumptions or biases in your thinking that you want to avoid?	
3) After viewing the <u>History section</u> of the module, press record and respond to the following questions:	Check Box
3a. What was most important finding and what does it mean?	
3b. What strategies did the provider use to achieve his goals?	
3c. What else could the diagnosis be and why?	
4) Before viewing the <u>physical examination (PE) section</u> of the module, press record and respond to the following questions:	Check Box
4a. What signs will you be looking for and why?	
4b. How will the PE help understand your History findings?	
5) After viewing the <u>PE section</u> of the module, press record and respond to the following questions:	Check Box
5a. What signs confirmed the diagnosis and why?	
5b. How do the PE and HX findings fit together?	
5c. Are there any other explanations for the findings?	
6) Before viewing the <u>Lab and Images</u> section of the module, press record and respond to the following question:	Check Box
6a. What are the most important tests to order and why?	
7) Before viewing the <u>Decision Making</u> section of the module, press record and respond to the following questions:	Check Box
7a. What do you think you would say to the patient knowing what you know now about the case? What possible treatment methods would you consider?	
7b. How did you arrive at this conclusion?	
7c. How do you think the patient is feeling about their treatment?	
7d. How would you communicate to them?	
8) After viewing the <u>Surgery</u> section of the module, press record and respond to the following questions:	Check Box
8a. Having seen the surgery, what complications if any might you now anticipate?	
8b. Having seen the surgery, how would you explain the symptoms of pain back to the patient?	
8c. Having seen the surgery, what if anything might you have done differently in the history and PE?	
9) After finishing the thyroid module, press record and respond to the following questions on a scale of 1 (least confident/informed) to 10 (most confident/informed):	Check Box
9a. How confident are you in working with patients thyroid nodules?	
9b. How informed do you feel now about managing a patient presenting with a thyroid nodule?	

Step 3

Both groups were instructed to review the appendicitis module, but the control group did so without using a digital recorder or instructions, and the intervention group did so

while using digital recorders to answer questions from the guided deliberate reflection think-aloud exercises (see Table 3). As for the thyroid nodule module, general instructions preceded deliberate reflection instructions for the appendici-

tis module.

Step 4/Posttest

The two modules (abdominal aortic aneurysm and cholecystitis) used in the pretest were again used in the posttest. Students in both the control and intervention groups who had viewed the abdominal aortic aneurysm module in the pretest viewed the cholecystitis module in the posttest, and

vice versa. All students were asked to record their thoughts freely while viewing the module, using the Free-Thought Guide as a tool (see Table 1). Upon completion of the study, students submitted their digital recorders to the study coordinator (author KS) for analysis. At this time, all students were sent a brief follow-up anonymous survey about their experience and use of the WISE modules.

Table 3. Deliberate reflection think-aloud instructions for appendicitis module

1) Before the appendicitis module begins, press record and respond to the following questions:	Check Box
1a. What are your initial thoughts on a patient with appendicitis?	
1b. What kind of experience have you had with a patient with appendicitis?	
1c. How confident are you in working with patients who may have appendicitis (1-10)?	
1d. How informed are you about the subject matter (1-10)?	
2) Before viewing the <u>History</u> section of the module, press record and respond to the following questions:	Check Box
2a. What will you be looking for in the history – what will help you differentiate?	
2b. What characteristics of the complaint or problem are most important to be clear about and why?	
2c. What are some possible pitfalls in the communication that you want to avoid?	
2d. Are there assumptions or biases in your thinking that you want to avoid?	
3) After viewing the <u>History</u> section of the module, press record and respond to the following questions:	Check Box
3a. What was most important finding and what does it mean?	
3b. What strategies did the provider use to achieve her goals?	
3c. What else could the diagnosis be and why?	
4) Before viewing the <u>PE</u> section of the module, press record and respond to the following questions:	Check Box
4a. What signs will you be looking for and why?	
4b. How will the PE help understand your History findings?	
5) After viewing the <u>PE</u> section of the module, press record and respond to the following questions:	Check Box
5a. What signs confirmed the diagnosis and why?	
5b. How do the PE and HX findings fit together?	
5c. Are there any other explanations for the findings?	
6) Before viewing the <u>Lab and Images</u> section of the module, press record and respond to the following question:	Check Box
6a. What are the most important tests to order and why?	
7) Before viewing the <u>Decision Making</u> section of the module, press record and respond to the following questions:	Check Box
7a. What do you think you would say to the patient knowing what you know now about the case?	
7b. What possible treatment methods would you consider? How did you arrive at this conclusion?	
7c. How do you think the patient is feeling about their treatment?	
7d. How would you communicate to them?	
8) After viewing the <u>Surgery</u> section of the module, press record and respond to the following questions:	Check Box
8a. Having seen the surgery, what complications if any might you now anticipate?	
8b. Having seen the surgery, how would you explain the symptoms of pain back to the patient?	
8c. Having seen the surgery, what if anything might you have done differently in the history and PE?	
9) After the conclusion of the appendicitis module, press record and respond to the following questions from 1 (least confident/informed) to 10 (most confident/informed):	Check Box
9a. How confident are you in working with appendicitis (1-10)?	
9b. How informed do you feel now about managing a patient presenting with possible appendicitis (1-10)?	

2.3 Data analysis

Data from students' digital recordings were transcribed into Word documents and imported into NVIVO™ version 10. Transcripts were coded iteratively by all authors, who drew on the critical thinking literature and outcomes from the Millennium Conference 2011 for potential categories and reached consensus on the final critical thinking coding categories.^[1] The study coordinator applied the critical thinking coding categories to the entire set of transcripts, and the coded transcripts were reviewed again three times. First, the number of lines in which each code was applied was reviewed and documented, with distinctions made between different examples. Second, analysis focused on individual participants' use of each category. Transcripts were then divided and assigned to authors to record gestalt impressions, track both positive and negative associations with each category, and reflect upon individual differences in interpretation. All authors met again to discuss and compare their findings from this re-review. Finally, MQ re-read all reviewers' coded transcripts and notes, and then summarized the results. That analysis determined five categories with 10 subcategories (see Table 4).

3. RESULTS

3.1 Participants

Of the 33 NP student participants, 11 dropped out of the study, and six failed to complete all parts of the study. Of the remaining 16 students who completed the study (43%), 15 were female and 1 male. Participants' mean age was 34 years (range = 25-50). Most participants had a baccalaureate degree (n = 13, 81.3%), and the remaining three had master's degrees. Most participants were Caucasian (n = 14, 87.5%), one was African American, and one was Asian American. Of those who completed the study, nine had been randomly assigned to the intervention group and seven to the control group.

3.2 Critical thinking categories

Analysis of participants' recorded data led to five categories and 10 subcategories of critical thinking (see Table 4). The five categories included takes perspective, considers alternatives, makes associations, anticipates outcomes, and self-assesses thinking process.

Table 4. Critical thinking categories, subcategories, and explanations

Category	Subcategory	Explanation
Takes perspective	None	Considering the patient's, doctor's, and nurse's perspectives <i>etc.</i>
Considers alternatives	None	What else could it be? Have I considered other options? Have I been thorough?
	Describes	Simply what I am seeing? What does it look like?
	Compares	What are the differences between helpful and non-helpful evidence? Taking things apart to rule in or rule out.
	Prioritizes/ Evaluates	What evidence/information (visual, verbal, <i>etc.</i>) is important? Prioritize evidence. What is important with or without the explanation/rationale? What is not important with/without explanation/rationale (justifying certain actions)?
Makes associations	Integrates	How do data from multiple sources (history, epidemiology, PE, labs and images) fit together—confirming or refuting? How am I putting things together and synthesizing, <i>e.g.</i> , how do various thoughts/concepts fit with each other?
	Examines assumptions	What was I taking for granted? Was I presupposing anything? Are there ways I usually think about this that aren't helpful?
Anticipates outcomes	Predicts outcomes	What will I be looking for? What does the future hold? Statements made with or without underlying reasoning or information used for prediction.
	Considers pitfalls	What negative outcomes do I need to watch out for? What are the possible "pitfalls" or dangers in thinking and/or communicating? What don't I want to miss (<i>e.g.</i> , pertinent negatives)?
Self-assesses thinking process	Assesses self-confidence	How sure am I? What are my reservations?
	Considers experience	What have I seen and done in the past?
	Evaluates learning style	Considers learning style works best or is preferred and what doesn't work, <i>etc.</i>

3.3 Comparison of critical-thinking outcomes by group

The control and intervention groups showed no difference in pre- and posttest free-thought critical-thinking outcomes

(see Table 5). However, NP students in the intervention group demonstrated a higher level of critical thought when prompted by questions in the deliberate reflection guide.

Table 5. Critical thinking outcomes by category and subcategory, with examples

Category	Subcategory	Examples from student narration
Takes perspective	None	<ul style="list-style-type: none"> I didn't like that the doctor replaced the bandage after she looked at the wound. Why didn't she just take the bandage off and put on a new one? That was definitely not a nurse taking care of that patient. She was not a NP. A surgeon should know better than to replace a dressing after taking it off a wound, whether it be clean or not. Other than that I think this was an excellent educational video. I would imagine the patient is feeling nervous and apprehensive. Using the word "cancer" and "biopsy" can be very alarming to the patient and especially since the patient's mother also has thyroid issues.
	Describes	<ul style="list-style-type: none"> You don't want to overlook something; could it be a PID? Could it be a tubal pregnancy? Could it be something else? Sure it could. So that differential diagnosis list will be important. Now my main question is how we decide if the patient needs the surgery or not? Do all patients with gall stones and those with the positive Murphy's sign – all get cholecystectomy or can we do anything else to help these patients?
Considers alternatives	Describes	<ul style="list-style-type: none"> The postoperative care section was extremely realistic, and excellent acting by the patient as well as during the physical exam ... The things that the patient said, those are things patients do actually say. And just showing the natural flow of the physician ...while she sort of simultaneously is assessing the patient and speaking with the patient, it's a very natural flow.
	Compares	<ul style="list-style-type: none"> We would be looking to see if it is painful, mobile, growing. Does it have regular borders, is it smooth, hard or soft; is it interfering with her swallowing or is it causing any other discomfort? In surgery portion, I noticed that there is the possibility of doing left lateral incisions for the repair depending on where the aneurysm was located and what it involves, what other branches it involves. And I found this interesting because in my practice I don't think I've seen a left lateral incision for an open repair. I've almost always seen the mid-line.
	Prioritizes/Evaluates	<ul style="list-style-type: none"> Definitely want to know how long she's had abdominal pain, where the location is, any extenuating factors, what makes the pain better/worse, movement/position? We'd want to know if there is any nausea, vomiting, diarrhea, fever or chills. Definitely need to be clear about the exact location of the pain, if it's radiating, where to, nature and quality of the pain? Does she have a fever ... any rebound tenderness? I would say the most important finding was a negative in that the patient does not have any symptoms of overactive production, i.e., being jittery or having a fast heart rate. The most important test to order would be a calcium level, parathyroid level, T3, T4 so see if they are in the normal range. The most important test to order would be a CBC with diff to look at white blood cell count to see if it is an infectious process.
	Integrates	<ul style="list-style-type: none"> With the imaging studies, it was interesting to know that abdominal aneurysms can be diagnosed just on x-ray viewing calcifications and ultrasound can help you size the aneurysm. These are fairly inexpensive tests that can be used to diagnose and measure. So far I've done the physical exam, the history, the epidemiology, seeing that this has a higher tendency towards men and with age probably as the vessels weaken and with hypertension that also weakens the vessels...important to get family history too as this patient had a male family member who died suddenly at a relatively young age of 59 and his own personal history of smoking and hypertension, no diabetes or other cardiovascular disease. He did say he had some intermittent claudication another sign that he peripheral artery disease and I wonder if he's ever had his carotid ultrasound done for occlusion. Her history and exam is benign. Not showing symptoms of having a hyper or hypo thyroid function. She does not have an enlarged thyroid gland. In fact, she hasn't even noticed it. It's not causing airway compromise or lymphadenopathy. It's not causing difficulty swallowing or impingement on local organs. It's not impeding venous return so there's no edema of the head and neck. So the two together, it sounds relatively benign, but I would get more information from ultrasound.
Makes associations	Examines assumptions	<ul style="list-style-type: none"> My initial thoughts on patients with thyroid nodules are that these nodules are caused by cancer.
	Predicts outcomes	<ul style="list-style-type: none"> ...looking for rebound tenderness, Rovzing sign with rebound tenderness in the left lower quadrant; psoas sign and a positive obturator sign upon physical exam. If negative I would lean away from a diagnosis of appendicitis, but if they are positive, then that leads you more towards the appendix and not the gall bladder or tubal pregnancy or pelvic inflammatory disease. So it's very important to correlate the findings on the physical exam with the signs, symptoms, mentioned in the history. ...complications could be perforation of the bowel, perforation of the bladder, uterus, nicking both the large or small bowel, bleeding and back pain from lying on the table or retroperitoneal bleeding. ...because she is completely asymptomatic and it was an incidental finding by physical exam, I would say that there is a likelihood that you would just watch and monitor her for any signs of new symptoms and progression or growth of the nodule, i.e., close monitoring in the setting of negative findings, negative lab and imaging studies, that it's likely benign. For a patient with an abdominal aortic aneurysm, it's important to take a good history; is the patient currently smoking? Any other medical conditions such as hypertension or other cardiac issues? When doing the physical examination, be sure to check all the pulses and auscultate for any bruits which can indicate the patient has occlusions.
	Considers pitfalls	<ul style="list-style-type: none"> Would want to do history and physical and supplement with some blood work. You definitely do not want to assume that the patient is med seeking and complaining of abdominal pain, you don't want to overlook something, could it be PID? Could it be a tubal pregnancy? Could it be something else? Sure it could. So that differential diagnosis list will be important. The most important test to order would be a urine culture and sensitivity to make sure we're not missing an infection, urinary infection or kidney infections. ...to avoid biases towards people who are overweight and believing that they may have done this to themselves through poor diet ... unhealthy lifestyle. Another complication would be signs and symptoms of a low calcium level so if the patient was having tremors or twitching, that could be a sign that the parathyroid glands had been removed or injured.
	Assesses self-confidence	<ul style="list-style-type: none"> As I'm going through this module I'm realizing my own need to just review the anatomy of the liver and the gall bladder and all of the different ducts to better understand where these stones are getting lodged. So I would go back and study that again on my own and then view this module again. Yeah, showing the virtual surgery with the computer graphics –that's excellent, that really helps with the anatomy. And now going into the actual surgery, yeah this is a great module.
Self-assesses thinking process	Considers experience	<ul style="list-style-type: none"> I know that abdominal aortic aneurysm can be a medical emergency usually associated with severe abdominal pain and there are many types of aneurysms like renal, ilia, popliteal. If the aneurysm is less than 5 cm the risks are usually considered minimal and usually surgery is not indicated. If it's greater than 5 cm, it's usually associated with higher risk of rupture. Also interesting was showing that cholecystitis is a spectrum of disease. I didn't know that before. ...I have had patients before who have come in for the aortic aneurysm repair and have had very cold feet after and almost purplish and very hard to find Doppler pulses...but the patient and family tell me this is better than before they had the surgery. It's obviously concerning to me.
	Evaluates learning style	<ul style="list-style-type: none"> The role playing with the patient and the patient interview, that's very helpful. That sort of brings the interview to life and then when they go back to the slides sort of summarizing the interview and the points and how the physician is working through the differential. This is very helpful for learning.

3.4 NP students' feedback on WISE modules

All students enrolled in the class, regardless of study participation, were surveyed for qualitative (see Table 6) and quantitative (see Table 7) feedback on the value of the WISE modules for NP education. This feedback included constructive recommendations to enhance the modules and the

learning process. Of the 16 students who responded to the survey, four had not participated in the study and 12 (75%) had participated.

Participants' recall of their confidence regarding each major component of the WISE modules before and after viewing the modules is presented in Figure 2.

Table 6. NP students' qualitative feedback on most/least useful aspects of WISE modules in the Advanced Health Assessment Course

Most useful aspect	Least useful aspect
Easy to understand and smooth flow make them very helpful in envisioning critical thinking pathway for each diagnosis.	Some of the lecturers spoke in a dry manner when they were against green screen. Others were excellent and held my attention.
Its completeness.	The surgical component was least useful although I thought it was still helpful because otherwise we are rarely exposed to that degree of detail ... Seeing it helps bring the whole picture together.
The visual learning from "start to finish" with an expert in the field and a real patient case. I ... realize how much of a visual learner I am...	Not being able to go back and re-listen to a few minutes of the modules while doing them.
Walking through the entire process of assessing for a condition	Seeing the actual surgery was very interesting but I think it is the least helpful for me and my nursing path.
I liked learning which tests to order and how to interpret them...especially viewing the CT of abdominal aortic aneurysm.	Actual surgical procedure because I won't be doing this.
Differential diagnosis, diagnostics, and treatment.	I thought it was all useful.
Integration of Hx and PE with diagnosis	I thought all aspects of the modules were excellent. My only suggestion is a format suggestion and that would be to not have the full body of the teacher speaking on the left side of the screen while the slides were on the right side of the screen. I found this to be distracting in the cholecystitis module.
I enjoyed seeing how the surgery was done. It makes you remember how much manipulation there is and why people are in so much pain.	Seeing the actual surgeries, but that was good as well.
It walks you through from beginning s/s to the end and follow-up.	Recording while watching; had to go back and listen/view again.
Observing the clinician perform the history and physical exam ... as a guide for future practice, how to talk to patients and perform the physical exam correctly.	
Patho mixed with patient complaints and creating a differential diagnosis were the most helpful because this is a new territory for me going from being an RN to an NP.	
Clinical decision making.	
Gives good example of patient encounter/Hx taking and PE. Good review/overview of disease/issue in question. More information to assist with learning process	

Table 7. NP students' quantitative feedback on use of WISE modules in the Advanced Health Assessment Course (N=16)

Module content	Not useful (%)	Somewhat useful (%)	Useful (%)	Very useful (%)
Pathophysiology	0	0	21.4	78.6
Developing a differential diagnosis	0	0	21.4	78.6
Ordering and interpreting the appropriate diagnostic tests	0	0	28.6	71.4
Seeing how the surgery is performed	0	7.1	50	42.9
Postoperative care	0	7.1	35.7	57.1
Developing critical thinking skills for clinical decision making	0	0	21.4	78.6
Preparing you to present cases succinctly to your preceptor	7.1	14.3	35.7	42.9

4. DISCUSSION

The results of this study did not support our hypothesis that the intervention would be effective in enhancing NP students' critical thinking on two WISE modules (abdominal aortic aneurysm and cholecystitis) as measured by the identified categories. This lack of intervention effectiveness was likely due to the study context. In other words, the outcomes were likely influenced by unmeasured factors in the course, curriculum, graduate school policies, and differences in students' and teachers' attitudes and assumptions.^[27] Our study was

designed to assess effectiveness, *i.e.*, to determine the effects of a program/policy under real world conditions rather than to assess efficacy,^[28] *i.e.*, to determine effects of the intervention delivered under optimal conditions. While the results did not support our hypothesis, they identify important questions warranting further study: 1) Were the results influenced by the saturation effect of busy students with no energy for the post-intervention modules? 2) Were students just trying to cram in the study requirements to get it done to fulfill their commitment to the study? and 3) Were the modules too long?

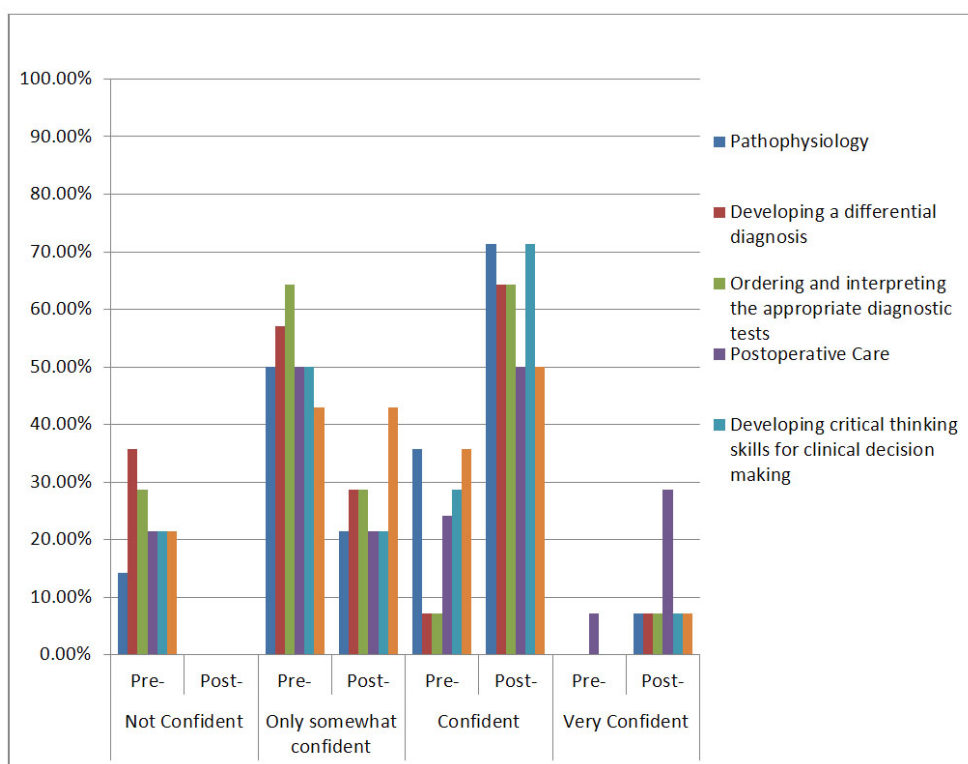


Figure 2. Comparison of participants' pre- and post-intervention confidence levels (N = 16)

Despite the lack of support for our hypothesis, we believe that deliberate reflection has value and generates additional questions for future studies. 1) Were we measuring the right concepts? 2) Are two guided deliberate reflections insufficient for students to internalize, without prompts, the guided/programmed clinical decision-making process? 3) Would a formal debriefing process (online or face to face) enhance the students' experience?

Future studies might consider repeating the deliberate-reflection guidance specific to each module to increase the likelihood of students developing and internalizing a thought pattern or process that would serve them in their clinical practices. This approach is supported by the suggestion (R. Grallo, personal communication, March 24, 2015) that criti-

cal thinking should be distinguished from forms of thinking that do "not lead specifically to judgment or decision making."^[29](p158) Furthermore, critical thinking as a response style may be habitual, *i.e.*, developed (or not) over years, implying that trying to re-think/learn a new thought response style requires exposure to expert modeling of critical thinking coupled with practice over time to develop a new pattern of thinking.^[30] Perhaps the deliberate reflection process could be used as a lens through which faculty can view the thinking process of struggling students, so that targeted strategies could be implemented. Another possibility is that deliberate reflection could be consistently used with the modules over time as a remediation tool to assist students who appear unable to think critically.

Our survey findings from NP students validate some feedback from medical students regarding the WISE-MD™ modules.^[28] Some NP students had not used the modules at all, and some regretted not using the modules more. Some students remarked that the modules were too long and cumbersome, and they were frustrated that they could not stop and rewind sections. Consistent with findings from medical students,^[27] NP students expressed dismay that they could not fast forward through some sections. They noted in particular their interest in fast forwarding past the section related to actual surgery, which they anticipated would have less value for them as nurses because they would not be performing the surgery. Of note, however, some nursing students found viewing the actual surgeries valuable, providing a better understanding of the procedure and improving their ability to explain (anticipatory guidance) to patients why they would experience postoperative pain/discomfort. This knowledge would be valuable for advanced practice nurses to employ in their clinical practice since surgical consults and referrals are part of regular practice for NPs in primary and acute care settings.

4.1 Limitations

This pilot study was conducted at a single academic institution, with a limited number of students and only 43% of them completing the study. Another limitation was the short time frame of the study. Another limitation was that the intervention group was only requested to use the deliberate-reflective guidance two times. A recent study of critical thinking in undergraduate nursing students found that there was no significant difference between intervention groups until the students had been exposed three times to a simulation exercise versus single or double dosing.^[5] Therefore, our findings may lack generalizability to advanced practice nursing students across the country.^[28,30] The study was also limited by measuring outcomes based on several researcher-defined or not consensually defined constructs: 1) critical thinking, which lacks an expert consensus definition, 2) the process of deliberate reflection, developed by the study team, and 3) researcher-developed, not previously tested categories of critical thinking. Finally, in the post-intervention survey, participants did not self-identify whether they had been in the control or intervention group.

4.2 Implications for nursing education

The post-intervention survey feedback indicated that participants in both the intervention and control groups valued using the WISE modules. Graduate nursing faculty have incorporated the WISE modules into clinical courses for all nursing students. Based on our findings, we propose requiring free-thought reflections with one or two WISE

modules for faculty to understand how struggling students may be approaching a patient encounter. Such students' remediation plan could then include having them record their deliberate reflection while viewing WISE modules. As in the study, students would be guided to verbalize and record their critical thinking processes for faculty review. Unlike in the study, these students would be coached to repeat the process under faculty guidance and with feedback on the reflections, which may facilitate students internalizing the critical thinking process into their approach to patients in clinical practice. Typical students may benefit from taking time out at regular intervals to digest the prodigious amounts of textual materials offered in their course, providing a way to better integrate the material than struggling through the material in the absence of reflection. One might also argue that use of a multimodal platform like WISE would augment students' self-study or lecture preparation that typically involves mastery of textual material. This possibility is supported by a recent personal communication with the interim director of a university center that offers family practice and pediatrics modules (designed by the same company as for WISE-MD™) in remediation efforts with medical students (Scott Wellman, January 17, 2015). He developed a guide for medical students to use to ensure they remain actively engaged as they consider each patient case in the modules.

5. CONCLUSION

Despite no difference in unprompted outcomes between groups, the intervention group often verbalized more thoughtful clinical decision-making. We speculate that the deliberate-reflection guidance intervention students throughout only two modules was insufficient for them to internalize the critical-thinking process. We propose using free-thought reflections with one or two WISE-MD™ modules to identify struggling students' clinical decision-making process. These students' remediation plan could include recording their deliberate-reflection process while viewing WISE-MD™ modules. Students would be guided to verbalize and record their critical-thinking processes for faculty review until students sufficiently integrate the process into clinical decision-making. Overall the WISE modules are available at over 100 U.S. medical schools of which many have graduate nursing programs as part of their health sciences campuses. Critical thinking is an essential skill that needs to be internalized to provide patients with safe care and high quality outcomes. Any tools that can teach, improve and nurture good critical thinking skills need to be utilized.

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CONFLICTS OF INTEREST DISCLOSURE

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