Use Authorization

In presenting this dissertation in partial fulfillment of the requirements for an advanced degree at Idaho State University, I agree that the Library shall make it freely available for inspection. I further state that permission to download and/or print my dissertation for scholarly purposes may be granted by the Dean of the Graduate School, Dean of my academic division, or by the University Librarian. It is understood that any copying or publication of this dissertation for financial gain shall not be allowed without my written permission.

Signature _____

Date _____

THE EFFECTS OF SCENARIO-BASED E-LEARNING TUTORIALS AS PREPARATION FOR THE FLIPPED CLASSROOM: LESSONS FROM A BEGINNING NURSING COURSE

by

Gaylen Max Jensen

A dissertation

submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy in the Department of Instructional Design

Idaho State University

Summer 2015

Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the dissertation of GAYLEN JENSEN find it satisfactory and recommend that it be accepted.

_____

Dr. Dotty Sammons,
Major Advisor

_____

Dr. Alan Frantz,
Committee Member

_____

Dr. Craig Johnson,
Committee Member

_____

Dr. Karen Neill,
Committee Member

_____

Dr. James Creelman,
Graduate Faculty Representative

Idaho State
UNIVERSITY

Office for Research Integrity
921 South 8th Avenue, Stop 8046 • Pocatello, Idaho 83209-8046

September 25, 2014

Gaylen Jensen, MA
980 Westwood Drive
Rexburg, ID 83440

RE: Your application dated 9/23/2014 regarding study number 4160: Dissertation on the Effects of Scenario-based Mode of Instruction on Student Learning

Dear Mr. Jensen:

I agree that this study qualifies as exempt from review under the following guideline: 1. Research on educational practices in educational settings. This letter is your approval, please, keep this document in a safe place.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

You are granted permission to conduct your study effective immediately. The study is not subject to renewal.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

BYU IDAHO | Academic Administration
Brigham Young University–Idaho • 210 Kimball Building • Rexburg, ID • 83460-1690

August 8, 2014

Dear Gaylen,

Your request to use human subjects for the study entitled *The Use of Scenarios in e-Learning Tutorials as Preparation for the Flipped Classroom: Improving Outcomes for Freshman Nursing Students* is approved for 12 months from the date of this letter.

Please notify the IRB if you intend to make any significant modifications to the study's design or implementation.

Good luck with your study.

Regards,

Scott J. Bergstrom, Ph.D.
Chair, BYU-Idaho Institutional Review Board

Name Scott J. Bergstrom, Ph.D. | Phone: (208) 496-1136 | Fax: (208) 496-1104 | bergstroms@byui.edu

Acknowledgements

I would like to express appreciation to the members of my dissertation committee—Dr. Dotty Sammons, Dr. Karen Neill, Dr. Craig Johnson, Dr. Alan Franz, and Dr. Jim Creelman—for their help and advice in guiding my research. Dr. Sammons' consistent and timely review of my work, encouragement, and insightful advice was extremely helpful. I appreciate the time Dr. Johnson was willing to spend with me to talk over concerns related to statistics.

There are many people that I appreciate who helped me with the technical aspects of creating direct instruction and scenario-based e-tutorials. Carma Miller, the nursing professor who first asked me to turn her PowerPoint lectures into e-tutorials so that she could flip the classroom, has always been an uplifting source of encouragement and advice. Sam Butikofer, the nursing professor who taught both of the classes of students involved in this study, added and changed quiz and exam questions and otherwise accommodated me for the sake of my research. Tana Hunter, another nursing professor, helped us with additions and changes to assessment questions by reviewing, approving, and making suggestions. When it came time to create nursing scenarios, three people were very helpful: Carma Miller, Sherry Terry, and Makaila Nevil. Carma gave me ideas for several scenarios and reviewed and commented on every scenario. Sherry, a practicing nurse with many years of experience, was willing and anxious to contribute to the cause of education by taking time from her busy schedule to review every scenario in order to make them more realistic. Makaila, a student employee, wrote many of the stories that went through the review cycle and were refined and turned into scenario-based e-tutorials. Three nursing instructors spent a multitude of hours review and commenting on the instructional validity of the direct instruction and scenario-based e-

tutorials: Rod Sanders, Jo Ann Dalling, and Sam Butikofer. All of these people are the busiest people I know and yet were gracious toward me and absolutely willing to help me achieve this goal.

I am grateful to Idaho State University for providing the opportunity to work on a degree that changed the direction of my career. I also thank the University where I work—Brigham Young University-Idaho—for the financial support and encouragement to pursue an advanced degree and the opportunity to move to a new career within the organization.

Finally, I want to thank my wife, Lisa, who has encouraged me to improve myself and never complained all those times when I could have been working on projects she had in mind, but instead, I went in early, stayed late, and spend Saturdays and holidays working on my course work and dissertation.

I dedicate this degree to my children and grandchildren. Education—learning—is important to me. I hope they will come to realize its importance in their own lives.

Table of Contents

List of Figures

List of Tables

Abstract

The purpose of this study was to compare the effects of scenario-based e-tutorials and direct instruction e-tutorials as a way for students to prepare for the flipped classroom. The main question was whether it was more effective, as measured by assessments, to have students receive scenario-based e-tutorials or direct instruction e-tutorials. Another question was whether scenario-based e-tutorials would affect how well students performed on cognitively high versus low order assessment questions. Participants in the study were college students in their first year of a nursing associate degree program. Assessment results of students in one class who received scenario-based e-tutorials were compared with students in another class who received direct instruction e-tutorials. The experiment revealed that students who received direct instruction e-tutorials did significantly better on assessments than those who received scenario-based e-tutorials. Scenario-based e-tutorials had no significant impact on student performance relative to high order or low order questions. This study provides empirical evidence that it is more effective for students to prepare for the flipped classroom by receiving direct instruction e-tutorials rather than scenario-based e-tutorials, at least in this context: college students in the early stages of a nursing program, taking a class that was content-intensive and knowledge-based, and using e-tutorials to prepare for the flipped classroom.

CHAPTER I

Introduction

There is a movement in the field of higher education to replace traditional faculty lectures with student inquiry, discussion, problem-solving, and group work activities that more fully engage students' intellect. To maximize the benefits of these in-class activities, students must prepare before class, receiving the information they previously would have gained through the lecture. This preparation can be done in any number of ways including reading a textbook, watching a pre-recorded lecture, or interacting with an e-learning tutorial. Replacing the lecture in class with preparation before class is a form of "flipping the classroom," and has been found to be effective in improving the learning gains of students (Pierce & Fox, 2012). In the flipped classroom format, students prepare for class by attending to lower order learning, such as knowledge and comprehension (Bloom, 1956), and then come to class better able to participate in higher order learning opportunities, such as applying, analyzing, synthesizing, and evaluating (Bloom, 1956). E-learning tutorials—one of the ways students prepare for classes—have been found to be more effective and engaging when infused with multimedia and interactivity (Evans & Gibbons, 2007). Multimedia combines text, narration, pictures, illustrations, and videos in ways that promote student interest and engagement (Mayer, 2005). Interactivity within e-learning tutorials involves students more fully and facilitates deeper learning by allowing them to answer questions, make choices, and control timing, pacing, and navigation (Evans & Gibbons, 2007).

An e-learning tutorial with multimedia and interactivity can be made more authentic and place students in a more realistic context by using a scenario-based or

story-based approach (Clark, 2013). Stories can potentially grab students' attention and help them apply their new knowledge to more authentic situations. In scenario-based learning, higher order cognitive skills are brought to bear even as students are developing lower order understanding. Students and teachers are more satisfied and think they learn more when scenario-based approaches are used (Hider, 2010). However, studies that report satisfaction with scenario-based approaches show no evidence of learning gains or only show learning gains in comparison with no instruction at all (Brunero & Lamont, 2010; Grossman, Stewart, Jaspers, & Chapman, 2007; Hider, 2010; Kose, Koc, & Yucesoy, 2013; Lisko & O-Dell, 2010; Persson, Fyrenius, & Bergdahl, 2010).

Instructional objectives and assessment questions may be categorized according to a revision of Bloom's taxonomy. The revised taxonomy has six levels—in order, from low to high—in the cognitive process dimension: remember, understand, apply, analyze, evaluate, and create (Anderson et al., 2001). Instructional objectives and assessment questions may be categorized according to lower order (remember, understand) and higher order cognitive skills (apply, analyze, evaluate, create). Modes of instruction can also be thought of in terms of lower and higher order instruction or learning activities. The type of interactivity used within instructional events in an e-learning tutorial can encourage surface-level or deep-level cognitive processing (Kennedy, 2004). For example, an e-tutorial may have the learner remember the name of a concept, which would be a low order or surface-level cognitive processing activity, or the e-tutorial may ask the learner to analyze concepts by dragging and dropping several concepts into one of two categories, which would be a high order or deep-level cognitive processing activity. Although there are exceptions, scenario-based instruction usually deals with higher order

cognitive skills, whereas direct instruction often deals with low order skills (Brunero & Lamont, 2010). Using a scenario-based method of instruction as preparation for flipped classroom, activities can introduce higher order cognitive skills early in the teaching/learning process, even as learners are simultaneously being introduced to lower order cognitive skills. Previous research has not examined whether using higher order pre-class activities, such as scenario-based e-tutorials, supports mastery of content at either the lower or higher end of Bloom's taxonomy, especially in a flipped classroom context.

Purpose of the Study

The present study compared two modes of before-class preparation for the flipped classroom: direct instruction and scenario-based instruction. Both modes of instruction—direct and scenario-based—were delivered online as e-learning tutorials. The purpose of the research is to investigate whether scenario-based e-learning tutorials as compared to direct instruction e-learning tutorials produce improved outcomes of the flipped classroom as evidenced by improved assessment scores. Assessment scores were compared between students who received direct instruction e-tutorials and those who received scenario-based instruction e-tutorials as preparation for the flipped classroom. The comparison analyzes student outcomes based on their performance on lower order versus higher order questions on assessments in order to evaluate the effects of scenario-based instruction in relation to lower and higher order cognitive skills.

Research Questions

Two research questions summarize the purpose of this study, which is to investigate whether scenario-based e-learning tutorials improve student preparation for the flipped classroom.

1. Is there a significant difference in student performance on assessment items between students who receive scenario-based e-tutorials before class as compared to students who receive direct instruction e-tutorials before class in preparation for the flipped classroom when controlling for gender, prior grade point average, and pretest score?

2. Is there a significant difference in student performance on low versus high order assessment items between students who receive scenario-based e-tutorials before class as compared to students who receive direct instruction e-tutorials before class in preparation for the flipped classroom when controlling for gender, prior grade point average, and pretest score?

Research Design

The present study consisted of a repeated measure, non-equivalent-groups design (Trochim & Donnelly, 2006). The context for the experiment was an undergraduate nursing course on medical surgical nursing at a medium-sized private university in the Intermountain West of the United States. The course was flipped through the use of e-learning tutorials, which provided the students with either direct instruction or scenario-based instruction as preparation for class on four topics: the endocrine system, the upper gastrointestinal system, the lower gastrointestinal system, and the musculoskeletal system. The class spent about one week during a trimester on each of the four topics.

Students who received the direct instruction e-learning tutorials were in the control group. Students who received the scenario-based e-learning tutorials were in the treatment group. The class, from trimester to trimester, was made up of a cohort of about 40 nursing students. The study was conducted over two consecutive trimesters in order to achieve a larger sample size of approximately 80, or 40 students in each group (n=80). The control group was a convenience sample of students enrolled in the course during one trimester and the treatment group was a convenience sample of students enrolled in the same course another trimester. The control condition was randomly selected to occur during the second trimester; therefore the treatment condition occurred during the first trimester. Although the groups were non-equivalent, they were expected to be very similar, as discussed in Chapter 3. A pretest of both groups at the beginning of each trimester was used to compare the equivalence of the groups based on their previous knowledge. During the first trimester, the treatment group received four scenario-based e-tutorials as preparation for the classroom. During the second trimester, the control group received four direct instruction e-tutorials as preparation for the classroom. After participating in each e-tutorial, students in both groups took a tutorial quiz during the first few minutes of the next class, which measured their understanding at that time. During face-to-face class meetings, both groups participated in equivalent activities aligned with the learning modules, as indicated in the common course syllabus. After participating in class activities and completion of other assignments for the topic being studied, both groups took a content exam approximately one week after class, which measured their understanding at that time. The experiment was conducted with repeated treatments and measures during each trimester as depicted in Figure 1.

Groups		Pre-test	Repeated measures for each topic of study			
			Endocrine	Upper GI	Lower GI	Musculo-skeletal
Treatment Group (1st trimester – scenario-based)	N	O_1	S_1 O_2 C O_3	S_2 O_4 C O_5	S_3 O_6 C O_7	S_4 O_8 C O_9
Control Group (2nd trimester – direct instruction)	N	O_1	D_1 O_2 C O_3	D_2 O_4 C O_5	D_3 O_6 C O_7	D_4 O_8 C O_9

Figure 1. Research Design Overview. Both groups (N) receive a pretest (O_1). The treatment group, during the first trimester, receives four scenario-based e-tutorials (S_1, S_2, S_3, S_4). The control group, during the second trimester, receives four direct instruction e-tutorials (D_1, D_2, D_3, D_4). A tutorial quiz (O_2, O_4, O_6, O_8) is administered for both groups after each e-tutorial during class (C). A content exam (O_3, O_5, O_7, O_9) is administered to each group approximately one week after each class.

A repeated-measures mixed ANCOVA (analysis of covariance) was used to determine if a significant difference was detected in assessment scores between those who receive scenario-based instruction and those who receive direct instruction. Repeated-measures mixed ANCOVA allows for the consideration of several factors (treatment versus control condition, question level, topic, and assessment type) while controlling for gender, pretest score, and prior grade point average (Leech, Barrett, & Morgan, 2011). The control and treatment groups were compared to see if there was a significant difference in assessment scores and to see if the control condition significantly affected student performance on lower order questions versus higher order questions.

Assumptions

The selection of students to be in a cohort within the nursing program is a rigorous and competitive process. Students selected typically have a high ACT/SAT score and grade point average. Once selected for the program, it is unlikely that they will drop out. When registered as part of a cohort for the course in this study, it is unlikely

that they will drop the course. In order to remain in the nursing program and pass the course, students must maintain sufficiently high grades and are therefore highly motivated to do well on assignments and assessments. It was assumed that students would review the e-tutorials in this study, because it would help them do better on the assessments and that they would complete the quizzes and exams in order to maintain sufficient grades.

Limitations

This study sought to determine if there was a cause-effect relationship between scenario-based e-learning tutorials—the cause—and better student preparation for classroom activities, indicated by assessment scores—the effect. Limitations are those factors that could interfere with establishing the true nature of the relationship being studied. Threats to internal validity, discussed below, were eliminated as much as possible in order to assure that if there was a significant effect, it could be attributed to the experimental treatment (Campbell & Stanley, 1966).

The selection of students in the present study was a convenience sample of students taking the course. Students in the course were a cohort of students from the nursing program and were not a random selection from among the general university population. Students in the nursing program are quite homogenous. They are of similar academic abilities, age, and ethnic background with proven capability, future potential, and motivation. Further, students in the nursing program from one cohort to another are quite homogeneous. One section of the class is taught each trimester and has around 40 students. Although the control group was different from the treatment group, they were expected to be roughly equivalent and therefore any observed effects would be due to the

treatment and not differences between individuals in the groups. The similarity of the groups was checked by comparing pretest results, demographic information, and prior academic history of each class.

The threat of *history* refers to events that occur in addition to the experiment that might have an effect on the observation (Campbell & Stanley, 1966). In this study, the control group and treatment group were taking the same class during different trimesters. The potential problem was that the classes could be different enough to confound the effects of the treatment. This threat was mitigated by the fact that the instructor, content, assignments, and assessments were identical from one trimester to another.

Experimental mortality refers to the "… loss of respondents from the comparison groups" (Campbell & Stanley, 1966). Loss of students from the study could result from dropping the class or not taking the assessments. This potential threat was mitigated by the competitive nature of the nursing program. Students were very unlikely to drop out of the program or drop the course and the need to keep grades up made it unlikely that they would miss assessments. This potential threat was mitigated through the inclusion criteria outlined in Chapter 3.

A potential social interaction threat is that students who are in different groups may talk with each other about the e-tutorials or they may take the e-tutorials together. This threat, called *experimental treatment diffusion* (Trochim & Donnelly, 2006), was not expected to be a significant concern, since the control and treatment groups were in separate trimesters with little if any social interaction.

Delimitations

External validity refers to how well the findings of the present study can be generalized to other populations in different settings at different times (Bracht & Glass, 1968). Threats to external validity are identified below.

The students in this study were of similar age, ethnicity, religion, aptitude, and motivation in a private university in the Intermountain West. The ability to generalize the findings of the study may be limited to similar students in similar settings.

The students in this study were members of a cohort of nursing students taking a nursing course covering specific topics – the endocrine, upper gastrointestinal, lower gastrointestinal, and musculoskeletal systems. The ability to generalize the findings of the study beyond these topics or nursing education may be limited.

The present study sought to determine if scenario-based instruction was more effective than direct instruction when delivered as an e-learning tutorial as preparation for the flipped classroom. The ability to generalize the findings of the study may be limited to similar modes of instruction and delivery in the context of preparation for the flipped classroom. However, established principles of instructional design have been followed in designing both the direct instruction and scenario-based e-tutorials; therefore, the context of scenario-based instruction may possibly be transferable to other scenario-based instruction in other content areas. Embedding this study in a flipped classroom setting may constrain the findings to that same setting; the findings may not be generalizable to all applications of scenario-based e-tutorials.

This study investigated scenario-based instruction in the context of first year nursing students. It did not consider more advanced nursing students, although that would

be an interesting topic for further research, since more advanced students would be dealing with higher order cognitive skills. The ability to generalize the findings of the study may be limited to beginning nursing majors.

Significance of the Study

The use of scenario-based or story-based e-learning to improve learning has been gaining in popularity. Scenario-based e-learning has been touted as one of the best ways to motivate students and promote active, authentic, situated, learn-by-doing, contextualized, and interesting learning (Clark, 2013). Studies indicate that students and instructors are more satisfied with scenario-based learning and report learning gains, but those studies are often compared with no instruction at all (Hider, 2010). In the field of nursing, scenario-based learning is considered to be very effective (Dutra, 2013). Yet there is little empirical evidence that shows learning gains due to scenario-based e-learning. Herreid and Schiller (2013) advocate the use of case study teaching, specifically to "start developing cases that include preclass videos" (p. 64). Clark (2013) advocates the use of scenario-based e-learning and encourages more research on the subject, including "…comparisons of scenario-based with directive lesson designs in different problem domains and with different learners to make more precise recommendations regarding when and for whom scenario-based e-learning is the more effective approach" (p. 143).

This study adds to the educational body of knowledge by providing an empirical answer to whether scenario-based e-learning tutorials have a significant impact on preparation for the flipped classroom for first year nursing students in a medium-sized

private university in the Intermountain West of the United States. The results of this study influence future directions for curriculum design.

Definitions

ADDIE: One of the most basic instructional design models, which uses a framework of analysis, design, development, implement, and evaluate to guide decisions for the creation of instruction (Gagne, Wager, Golas, & Keller, 2005).

Direct instruction: A general term that refers to instructional that is organized, structured, and sequenced with clear explanations and illustrations of the concepts being taught, such as a lecture, demonstration, or video (Great Schools Partnership, 2014).

Direct instruction e-tutorial: In the context of this study, the term refers to an e-tutorial that presents the learning content in a direct instructional approach (see direct instruction). The direct instruction e-tutorial is used before class by students in the control group to prepare for classroom activities.

E-tutorial: Synonymous with e-learning tutorial.

E-learning tutorial: In the context of this study, the term refers to a multimedia and interactive presentation of learning content available to learners over the Internet, available practically anytime, anywhere, on-demand. For the purposes of this study, e-learning tutorial or e-tutorial can refer to either direct instruction or scenario-based online instructional modules.

Flipped classroom: Taking the lecture content out of the classroom and making it available for the student to view before class. Classroom time is then spent doing homework, group work, discussions, inquiry, or a variety of other activities (Fulton, 2012).

High order cognition: In the context of this study, this term refers to the four highest of six cognitive dimensions of the revised Bloom's taxonomy: *apply, analyze, evaluate,* and *create* (Anderson et al., 2001).

Interactivity: The learner responding to the presentation of the learning content and vice-versa. A spectrum of interactivity includes control of timing, pacing, and navigation, drag and drop activities, assessment, and making choices (Domagk, Schwartz, & Plass, 2010).

Low order cognition: In the context of this study, this term refers to the two lowest of six cognitive dimensions of the revised Bloom's taxonomy: *remember* and *understand* (Anderson et al., 2001).

Multimedia: The presentation of learning content as words, in the form of text or narration, and pictures, in the form of illustrations, photos, animation, or video, with the intention of promoting learning (Mayer, 2005).

Scenario-based e-learning: A story-based online interaction with the learner, who is placed in a realistic context and assumes the role of an actor responding to authentic challenges, making choices, and seeing the consequences in increasingly complex situations (Clark, 2013).

Scenario-based e-tutorial: In the context of this study, the term refers to an e-tutorial that presents the learning content in a scenario-based approach (see scenario-based e-learning). The scenario-based e-tutorial is used before class by the students in the treatment group to prepare for classroom activities.

CHAPTER II

Review of Literature

A literature review is conducted to examine relevant research on the topics covered in the present study. First, literature about the flipped classroom is examined, including the advantages, challenges, form and extent of pre-class preparation, and examples of successes. Next, the use of multimedia and interactivity within e-learning tutorials as means for preparation for the flipped classroom is examined, including: multimedia principles that can be used to improve student learning; levels of interactivity that cause the learner to take a more active role in and more responsibility for their own learning; and how multimedia and interactivity can encourage higher order cognitive processing within the learner's mind. This is followed by a discussion of Bloom's revised taxonomy, including the levels of the *Cognitive Processing Dimension* and the ways in which scenario-based learning encourages thinking in the higher order levels. Finally, the use of scenario-based learning in nursing and other disciplines is examined including the theories that support scenario-based learning, the studies that have examined scenario-based learning, student and teacher satisfaction with scenario-based learning, and the evidence that demonstrates learning gains as a result of scenario-based learning.

The Flipped Classroom

Traditionally, classroom time is spent with the teacher lecturing – presenting the content to the students through direct instruction. A flipped classroom takes the lecture out of the classroom and makes it available to the students before they come to class. Class time is spent in activities that promote critical-thinking skills, such as peer teaching, inquiry, group discussions, problem solving, or reviewing case studies. In a

flipped classroom, the lecture-style coverage of content is done before coming to class through a variety of methods, such as reading, watching a video-lecture, or reviewing an online presentation. Fulton (2012) enumerated several advantages of the flipped classroom including: (1) students are able to move at their own pace, moving quickly through material they understand and slowing down and reviewing material they do not understand; (2) doing homework in class, sometimes in front of the class, gives teachers better insight into the difficulties students are experiencing and gives students opportunities to teach each other; (3) online presentations or videos can be updated as needed and are available anytime, anywhere, on-demand and can be reviewed by the students as often as needed; (4) classroom time is freed up and can be used in more creative and effective ways; and (5) student achievement, engagement, interest, and satisfaction is enhanced. Pierce and Fox (2012) noted that an advantage of the flipped classroom is that "the responsibility and ownership of learning is transferred from the teacher to the students through participation in interactive activities" (p. 1). Two additional purposes for flipping an engineering course have been pointed out: the ability to present course material in several different formats to accommodate various learning styles and to "encourage students to become self-learners and help prepare them for how they will need to learn as practicing engineers" (Mason, Shuman, & Cook, 2013, p. 430).

On the other hand, there are challenges that accompany the flipped classroom. Talley and Scherer (2013) suggest that students need to spend more time in preparation for a flipped classroom than a traditional classroom. Tune, Sturek, and Basile (2013) reported that students in a physiology flipped class were less than enthusiastic mainly due to the increased workload, even though they also felt the flipped approach facilitated their

learning. This attitude improved, but never fully went away (Tune et al., 2013). Surprisingly, students in a flipped engineering class reported spending less preparation time and showed learning gains over students in a traditional class (Mason et al., 2013). Another challenge to the flipped classroom is that teachers often believe they will not be able to adequately cover the subject-matter content. However, Mason et al. (2013), using video lectures as pre-class preparation for an engineering flipped classroom, were able to cover more content over the course of the trimester, getting a week ahead and covering two more topics than the traditional classroom. In addition, upon observing that students felt overwhelmed by the number of resources available, Mason et al. recommended that more structure and guidance be provided. Additional obstacles to the flipped classroom were the need for "sufficient technical support to facilitate delivery" of pre-class preparation activities (Tune et al., 2013, p. 320), the amount of time it takes to develop and implement learning material (Mason et al., 2013), and the probability of students showing up to class who have not yet viewed the assigned content (Bergmann & Sams, 2010).

When flipping the classroom, preparation for class – how students prepare for class and the amount of time they spend preparing – becomes an important consideration. Commonly, but not always, preparation time increases. Normally, students who are new to the flipped classroom concept are initially resistant and may come to class unprepared. This can be mitigated by giving a short quiz or homework assignment related to the preparatory work that is due before or at the beginning of class (Herreid & Schiller, 2013). Tune et al. (2013) consider the in-class quiz as a critical motivating factor in both student preparation for class and ultimate improvements in grades. Students will be

encouraged to prepare for class if the material is of good quality, if it affects their grade, and if they can see it is relevant to the classroom activity and not just busy-work. Preparation for class is usually associated with some sort of online activity, such as reading, listening to a podcast, watching a video, a video lecture, or an interactive presentation. In a science class (Talley & Scherer, 2013), students prepared for the flipped classroom by watching a video recording of the lecture and then recording and uploading their own video of themselves teaching the same lecture to an imaginary class. The instructor then used the videos in class to address misconceptions. Herreid and Schiller (2013) advocate the use of case study teaching before class and to "start developing cases that include preclass videos" (p. 64). They gave several examples of pre-class videos that are story- and drama-based, such as, "a forensic case in which DNA is used to solve a crime" and "a young man dying of a metabolic disease" and "a prison in Russia beset by multiple drug-resistant TB" (p. 64). An undergraduate social science course used a narrated PowerPoint presentation as the pre-class preparation, while students in the control condition had access to the same PowerPoint presentation after class (Lewis & Harrison, 2012). Those in the treatment condition – those in the flipped classroom – performed significantly better on quizzes and exams. Another way to deliver flipped content is to record a screencast of the instructor speaking while drawing on the computer screen, such as working a mathematical problem (Bergmann & Sams, 2010).

Studies confirm that flipping the classroom can lead to improved assessment scores. In one study, engineering students performed as well or better on assessments, with significant improvement on specific types of questions (Mason et al., 2013). One study (Pierce & Fox, 2012) investigated the flipped classroom in a renal

pharmacotherapy module that used video podcasts of lectures as preparation and discussion of cases during the class period. The study found that students performed significantly better on examinations. Talley and Scherer (2013) reported student performance in a science class was significantly higher in the flipped classroom when compared to a previous year of traditional methods. A study of graduate students in a pysiology class showed significant improvement in exams scores for students in the flipped classroom attributed mainly to listening to pre-recorded lectures, taking a quiz in class, followed by a question and answer problem solving period (Tune et al., 2013).

Flipping the classroom is yielding positive results in a variety of settings, using a number of different methods involving a presentation that is reviewed by students before class. It stands to reason that the type and quality of presentation has relevance on the effect it may have on student learning. The following sections will address ways in which those presentations may be more appealing to students and instructionally effective.

Multimedia and Interactivity

Video-capturing a lecture is not the only way to flip the classroom. Although Bergmann and Sams (2010) used a video capture of their computer screen as they lectured and solved mathematical problems, they also noted there should not be too much focus on video, but rather on the "learning object" (p. 31), which could be an online simulation. Henkel (2010) describes using a PowerPoint that asks questions and branches according to the correct or incorrect answer, providing more instruction as needed for students in a medical curriculum. The present research used a web-based presentation with multimedia *and* interactivity—thus a discussion on the two will ensue.

Multimedia. The use of multimedia principles to improve learning has been well studied and has been shown to be effective when used correctly (Mayer, 2005). Mayer and Moreno (2003) have proposed a theory of multimedia learning based on three assumptions: (1) dual-channel assumption, that leaners "possess separate systems for processing pictorial and verbal material…"; (2) limited-capacity assumption, that "each channel is limited in the amount of material that can be processed at one time…"; and (3) active-processing assumption, that "… meaningful learning involves cognitive processing including building connections between pictorial and verbal representations…" (Mayer & Moreno, p. 43). Foundational to these assumptions and multimedia principles is the need to design instruction that considers cognitive load. The goal is to prevent the learners from experiencing cognitive overload and avoid distracting them with extraneous cognitive load. The multimedia principle states that students learn better when both words (printed, displayed, or spoken) and pictures (illustrations, photos, or videos) are used. Some of the world's leading multimedia researchers have identified several multimedia effects (Mayer, 2005), which are listed below with a brief description of the condition that leads to more effective learning.

- Split-attention Effect: Physically and temporally integrate words and pictures so that the learner does not need to waste cognitive load by mentally integrating them (also see spatial contiguity and temporal contiguity principles) (p. 135).
- Modality Effect: Use graphics (pictures, illustrations, etc.) and narration rather than graphics and printed text so that learners can receive the information simultaneously through both the visual and audio channels (p. 147).

- Redundancy Effect: Do not present the same information in more than one format in order to minimize cognitive load, for example do not present on-screen text along with a narration of the on-screen text (p. 159).
- Segmenting Effect: Present instruction in learner-controlled segments rather than a continuous unit (p. 169).
- Pre-training Effect: Introduce learners to the names and characteristics of the main concepts before instruction begins (p. 169).
- Coherence Effect: Exclude extraneous material that detracts the learner from what is to be learned (p. 183).
- Signaling Effect: Add cues that highlight the main points or organization of the essential content of instruction (p. 183).
- Spatial Contiguity Effect: Present content that belongs together, such as words and pictures, near to rather than far from each other and on the same page or screen (p. 183).
- Temporal Contiguity Effect: Present content that belongs together, such as words and pictures, simultaneously rather than successively (p. 183).
- Personalization Effect: Narrate in a conversational voice instead of a formal style of speaking (p. 201).
- Voice Effect: Narrate with an accent similar to the learners' accent rather than a foreign accent or a computer-generated voice (p. 201).
- Image Effect: Do not distract the learner by showing a picture of the person speaking (p. 201).

- Guided-discovery Effect: When a discovery-based environment is used, incorporate guidance to reduce the amount of time spent "spinning wheels" (p. 215).
- Worked-out Example Effect: In the initial stages of learning a new skill, incorporate worked-out examples to help the learner see the big picture (p. 229).
- Collaboration Effect: Incorporate collaborative online learning activities (p. 247).
- Self-explanation Effect: Encourage the learner to generate self-explanations (p. 271).
- Animation Effect: Use static diagrams rather than animation (p. 287).
- Navigation Effect: Provide the learner with the ability to navigate from place to place within the instruction (p. 297).
- Site-map Effect: Provide learners with the ability to see where they are within the overall instruction (p. 313).
- Prior-knowledge Effect: Multimedia principles that enhance instruction for novices may hinder experts (p. 325).

Interactivity. One multimedia principle is the interactivity effect. Interactivity allows the learner to influence the flow of information by controlling timing or pacing, choosing content, and answering questions. Interaction, in terms of multimedia, is all about the choices the learner makes and the way the instructional program responds. Interaction allows the learner to take an active part in constructing knowledge. Evans and Gibbon (2007) tested the interactivity effect on business majors who were learning about

the operation of a bicycle pump. An experiment was conducted with some learners taking a multimedia lesson and others taking a multimedia lesson with interactivity. In this case, interactivity included pacing the speed of the instruction, dragging and dropping part names at the correct location, and a simulation showing the operation of the pump and the resulting growth of a balloon. Those who were part of the interactive group compared to those in the multimedia only group spent more time in the instruction, took less time to complete the assessments, performed similarly on the assessments, and scored significantly better on transfer-tests, indicating they had achieved deeper learning (Evans & Gibbons, 2007).

Domagk, Schwartz, and Plass (2010) define interactivity in this context as "… reciprocal activity between a learner and a multimedia learning system, in which the [re]action of the learner is dependent upon the [re]action of the system and vice versa" (p. 1025). Some studies show that the interactivity effect does help students gain deeper learning, others show mixed results, and still others find no improvement or drawbacks to interactivity (Domagk et al., 2010). Domagk et al. (2010) state that such mixed results "… may simply reflect divergent approaches to what is meant by interactivity" (p. 1024). There are varying levels of interactivity that may be deployed in interactive e-learning tutorials, such as control of pacing and navigation, formative assessments, branched scenarios, reflective activities, and social interaction. Kennedy (2004) pointed out many scholars' conceptions of interactivity as a reactive-proactive continuum, whereby the learner at the reactive end of the continuum "… is a relatively passive receiver of information and knowledge" and the learner at the proactive end of the continuum "… is an active participant in the construction of his or her own knowledge" (Kennedy, p. 45).

Moreno and Mayer (2007) identified five common types of interactivity: (1) dialoguing, whereby, for example, the learner is asked a question, the learner answers, and the learner receives feedback; (2) controlling, whereby the learner is able to control the pace (fast or slow) and pause, play, rewind, fast-forward, replay, move a seek bar, etc.; (3) manipulating, whereby the learner is able to set parameters, move objects on the screen, run a simulation, etc.; (4) searching, where the learner is able to seek content, for example, an Internet search; and, (5) navigating, whereby the learner is able to choose where to go (such as a menu) and move from place to place within the instruction, such as forward and backward. The authors further described a continuum of interactivity ranging from low to highly interactive, depending on the communication between the learner and the instruction system. In this respect, many multimedia presentations may have no interactivity. For example, video lectures used as pre-class preparation for the classroom are very low in interactivity. A highly interactivity tutorial might have the learner manipulate an animation in order to understand the relationships, using the higher order cognitive skill of analyzing. Evans and Gibbons (2007) said, "… interactive systems facilitate deep learning by actively engaging the learner in the learning process…" and that those "… who seek to foster deep learning (as opposed to mere factual recall) should adopt the incorporation of interactivity as a design principle" (p. 1147). Although there are exceptions, low interactivity presentations generally involve low-level cognitive skills and high interactivity presentations generally involve high order cognitive skills.

The intention of using multimedia and interactivity in a presentation that prepares students for the flipped classroom is to more fully engage the students with more

effective instruction. However, the use of interactivity may also have implications on the cognitive level – low to high – of learning that takes place.

Bloom's Revised Taxonomy

Bloom's taxonomy provides a means to classify "… statements of what we expect or intend students to learn as a result of instruction" (Krathwohl, 2002, p. 212). A revision of Bloom's taxonomy defines a continuum, from low to high, of cognitive skills, called *the cognitive process dimension* (Anderson et al., 2001). The cognitive process dimension is divided into six categories: remember, understand, apply, analyze, evaluate, and create. For the purposes of the present study, lower order cognitive skills include the categories of remember and understand and higher order cognitive skills include the remaining cateories of apply, analyze, evaluate, and create. Lower order cognitive skills are foundational and need to be learned as preparation for the learning of higher order cognitive skills.

Bergmann and Sams (2010) described the flipped classroom as "… delivering all low order content prior to the face-to-face instructional time" (p. 29). Normally, when students review presentations before class, they receive direct instruction, which usually attends to lower order cognitive skills. Higher order cognitive skills are then covered in the classroom. However, Talley and Scherer (2013) stated one of their purposes was "to have students apply higher level thinking skills as outlined in Bloom's revised taxonomy" before coming to class (p. 343). This was accomplished by having students view a video of the lecture, create a video of themselves teaching the same content to an imaginary class, and upload their video to the instructor. Class time would then be spent correcting

misunderstandings and omissions. This exercise in higher order thinking seemed to be the major contributor to the improved performance of the students that was observed.

Meaningful learning is at the higher end of the cognitive skill scale. According to Anderson et al. (2001), moving beyond rote learning and toward meaningful learning "…is consistent with the view of learning as knowledge construction, in which students seek to make sense of their experiences" (p. 65). "Two of the most important educational goals are to promote retention and to promote transfer (which, when it occurs, indicates meaningful learning)" (Anderson et al., p. 63). While retention or remembering focuses on the past, transfer – making sense of the past and being able to use it in new contexts – focuses on the future. In order for learning to be meaningful or deep, it needs to move beyond lower order and toward higher order cognitive skills. One of the intents of the flipped classroom is for students to take responsibility for and take a more active role in their own learning. Mayer and Moreno (2002) say that the purpose of their multimedia research is to "… focus on how to design multimedia messages that promote meaningful learning" (p. 108). One of the intents of interactivity is to "… facilitate deep learning by actively engaging the learning in the learning process..." and that "educational designers who seek to foster deep learning (as opposed to mere factual recall) should adopt the incorporation of interactivity as a design principle" (Evans & Gibbons, 2007, p. 1147).

Although there has been much research on the effectiveness on the flipped classroom, there has been little research that examines whether activities that prepare students for the classroom are low or high cognitive level activities and what effect that has on student learning.

Scenario-based E-learning

Scenario-based e-learning is a story-based online interaction with the learner, who is placed in a realistic context and assumes the role of an actor responding to authentic challenges, making choices, and seeing the consequences in increasingly complex situations (Clark, 2013). Scenario-based learning is similar to story-based, case-based, and problem-based learning. It is related to simulation learning, but is not as realistic, detailed, or process-oriented. It places the learners in realistic contexts and works them through a real-life-like scenario, often asking questions and providing feedback. It has its roots in concepts such as learning by doing and situated learning. Learning by doing can be seen as moving beyond lower-level cognitive skills (remember and understand) and toward the higher order cognitive skill of applying, executing, carrying out, or – doing. Schank (1995) points out that learning by doing should be the state of affairs and closely ties learning by doing with stories or micro-scripts. He posits that we learn and organize our knowledge in scripts. In other words, our stories or our experiences are implicit ways in which we build our cognitive skills. He said, "Human memory is story based," and that "stories illustrate points better than simply stating the points themselves because, if the story is good enough, you usually don't have to state your point at all…" (Schank, 1990, p. 12). Scenario-based learning builds on this by using stories to help learners build their knowledge. This works best if the story is memorable, meaningful, and realistic. Making a story more realistic leads to the concept of situated cognition. Concerning situated cognition, Gagne et al. (2005) said, "The guiding principle to be derived is that learning that occurs in authentic contexts where it can be meaningfully applied is more likely to be remembered and recalled when needed" (p. 6). Situated learning as proposed by Lave and

Wenger (1991) is learning that takes place within the same setting as the original material to be learned and is closely akin to apprenticeship. Van Merrienboer and Sweller (2005) stated that "… real-life tasks should be the driving force for complex learning" (p. 147). In the case of scenario-based e-learning, a realistic-as-practical setting is produced in a virtual setting. Simulation-based learning is perhaps the ultimate way to achieve situated learning by doing. Scenario-based learning tries to achieve the advantages of simulation with less expenditure of time and resources.

Merrill (2013) encourages instruction that moves beyond lower cognitive levels. The four instructional strategy levels, called the First Principles of Instruction, move instruction, step by step, to higher cognitive levels: (1) Activation – telling how to do; (2) Demonstration – showing how to do; (3) Application – doing or applying skills to solve problems; and (4) Integration – becoming an expert or solving real-world problems or doing real-world tasks (p. 22). The ideal scenario-based e-learning tutorial would achieve the highest of the four levels – solving or doing real-world problems or tasks. The use of scenario-based learning is intended to achieve and correct what was expressed by Jonassen (1991) who, when speaking of the instructional sin of decontextualizing learning, stated:

> The most effective learning contexts are those which are problem- or case-based and activity-oriented, that immerse the learner in the situation requiring him or her to acquire skills or knowledge in order to solve the problem or manipulate the situation. Most information that is taught in schools, however, is stripped of its contextual relevance and presented as truth or reality. Our youth are daily subjected to acquiring countless facts and rules that have no importance,

relevance, or meaning to them because they are not related to anything the learners are interested in or need to know. (p. 36)

"Active student engagement is necessary, and one of the best ways to get it is to use stories that catch the students' interest and emotion" (Herreid & Schiller, 2013, p. 65). An important aspect of scenario-based learning is for the learners to make decisions and see the consequences of their actions.

In a study of undergraduate medical students in India that investigated the use of case-based learning, significant gains in students' performance were observed and it was recognized that traditional didactic lectures resulted in students who have "… sound knowledge or medical science, but … are often found deficient in the performance of clinical skills and problem solving..." and concluded that case-based learning "… motivates students toward self-directed learning and to develop analytic and problem-solving skills…" (Gade & Chari, 2013, p. 356).

In a study of high school horticulture students that investigated the use of web-delivered problem-based learning, no significant learning gains were observed, but greater student engagement and satisfaction were noted (Grossman et al., 2007).

An undergraduate course for medical students used a scenario within a PowerPoint presentation with questions that would branch according to the answer. For incorrect answers, detailed explanations were offered along with a link to more rigourous training. This tutorial was published for the web and made available to the student online before coming to class. The teacher felt it was very useful to lecture to students who had already been thinking about the subject and who had questions from the beginning of

class. The students felt the tutorial was very useful in helping them learn, but there were no data that conclusively showed learning gains (Henkel, 2010).

In a study of undergraduate students in a computer science course in Turkey that investigated the use of story-based e-learning, significant learning gains were observed, as well as the completion of more course activities, a faster learning rate, and greater satisfaction in the method (Kose et al., 2013).

Several studies have reported that students and teachers are satisfied with scenario-based learning and believe it is more effective than direct instruction. These researchers all recommend further use of scenario-based learning. However, while these studies show positive attitudes among students, teachers, and researchers toward scenario-based learning, the studies either show no emprical evidence of learning improvements or simply show learning gains in the treatment group with no comparison to a control group (Brunero & Lamont, 2010; Hider, 2010; Hsu, 2011; Hsu & Hsieh, 2006; Persson et al., 2010; Smith, Gillham, McCutcheon, & Ziaian, 2011; Tait, Tait, Thornton, & Edwards, 2008).

Summary of the Literature

Student learning improves when the strategy of the flipped classroom is used, because it frees more time in class for higher order cognitive activities (Pierce & Fox, 2012). In order for the flipped classroom to succeed, it is important that students fulfill the pre-class preparation. Students will be encouraged to prepare for the flipped classroom if there is a grading consequence, such as a quiz (Herreid & Schiller, 2013). The pre-class preparation is often a video-lecture, but can also be an e-learning tutorial. An e-tutorial can be more effective if it uses multimedia principles that help students to

improve their learning (Mayer, 2005) and if it uses interactivity to encourage more active involvement and the use of higher order cognitive skills (Evans & Gibbons, 2007). Scenario-based learning can help students develop higher order cognitive skills, even as they receive lower-level direct instruction. Scenario-based learning as a preparation activity for the flipped classroom may help students begin to develop a higher order mentality before class (Brunero & Lamont, 2010). The flipped classroom, scenario-based methodology, and the use of multimedia and interactivity in e-learning tutorials are all meant to invite students to take a more active role, learn more effectively, develop higher order cognitive skills, and take responsibility for their own learning (Dutra, 2013; Hsu, 2011; Kennedy, 2004; Mayer, 2005; Pierce & Fox, 2012). For these reasons, researchers have advocated the use of scenario-based learning (Clark, 2013; Tait et al., 2008). Students and teachers believe scenario-based learning helps students learn more effectively. Researchers report that scenario-based learning results in better learning gains for students, but often in comparison with no instruction or in the absence of a controlled experiment (Brunero & Lamont, 2010; Hider, 2010; Hsu, 2011; Hsu & Hsieh, 2006; Persson et al., 2010; Smith et al., 2011; Tait et al., 2008). There is a need for further research of using the scenario-based method of instruction in the form of e-tutorials as an effective means of preparation for the flipped classroom (Clark, 2013; Brunero & Lamont, 2010). This study investigated the use of scenario-based e-tutorials as a means of preparing for the flipped classroom and helps to fulfill that gap in the research.

CHAPTER III

Methodology

The purpose of the present research is to investigate whether scenario-based approaches in a set of four e-learning tutorials helped students be better prepared for in-class discussions and group activities. The study compares two modes of pre-class preparation for the flipped classroom: direct instruction and scenario-based instruction. The study compares the effects of pre-class preparation modes on the performance of students on lower and higher order questions on tutorial quizzes and content exams. The questions addressed by this study are:

1. Is there a significant difference in student performance on assessment items between students who receive scenario-based e-tutorials before class as compared to students who receive direct instruction e-tutorials before class in preparation for the flipped classroom when controlling for gender, prior grade point average, and pretest score?

2. Is there a significant difference in student performance on low versus high order assessment items between students who receive scenario-based e-tutorials before class as compared to students who receive direct instruction e-tutorials before class in preparation for the flipped classroom when controlling for gender, prior grade point average, and pretest score?

The following sections describe the participants in the study, how they were selected, how the experiment was conducted, who received the treatment and when, and how the control and treatment were developed and validated. Finally, methods for collecting and analyzing the data are discussed.

Participants

The participants in the study were nursing students in the second trimester of their first year of study at a private university in the Intermountain West. Students must submit an application to be considered for admission into the nursing program. Admission is competitive and based on college grade point average, performance on standardized tests, aptitude, and potential. Approximately 40 students are selected each trimester to form a cohort for the nursing program. Even though students in their first year of study are considered freshmen in the nursing program, most have had several trimesters of college experience, including some prerequisite courses.

The selection of students to be in the nursing program is a rigorous and competitive process. Students selected typically have an ACT score of 21 or higher and a college grade point average (GPA) of 3.5 or higher. In order to remain in the nursing program, students must maintain a sufficiently high average percentage (75%) on their quiz and exam scores. Students within a nursing cohort are quite homogenous. They are of similar academic abilities, age, and ethnic background with proven capability and future potential. Further, students in the nursing program are quite homogeneous from one cohort to another. Table 1 summarizes a comparison of academic and demographic characteristics of three nursing cohorts who previously took the medical surgical nursing course.

Table 1

Summary Comparison of Characteristics of Three Previous Nursing Cohorts

	3rd Trimester 2013	1st Trimester 2014	2nd Trimester 2014
Mean Age	23.3	22.1	23.2
Mean college GPA	3.66	3.66	3.74
Mean ACT	22.5	23.9	23.5
Gender – female	79.5%	75.6%	70.73%
Ethnicity – White	94.9%	90.2%	95.1%
Western US Origin	89.7%	85.4%	84.6%

Sampling

The participants in the study were a convenience sample of nursing students enrolled in a medical surgical nursing class in two consecutive trimesters. Each cohort, and therefore each class, had approximately 40 nursing students. The first trimester cohort was randomly chosen to receive the treatment condition and as a consequence the second trimester cohort received the control condition. Each group had different students, but the groups from each trimester were anticipated to be practically equivalent, because: (1) selection of students for the nursing program results in students of fairly equivalent skills; (2) the same instructor taught the class both trimesters; and (3) the content, assignments, and assessments was the same both trimesters. The expectation that the two groups were very similar was checked with a pretest at the beginning of each trimester, which is reported in Chapter 4. This is further demonstrated during data analysis through a comparison of the two classes in terms of GPA, ACT, gender, and ethnicity.

In order to be included in the study, students had to be at least 18 years of age and had to complete the pretest, the four tutorial quizzes, and the four content exams related to the study. Students were allowed to decline to participate in the research study with no

adverse consequence. Only students who actively consented to participate in the study had their data included. All students, whether they chose to participate in the study or not, were required to complete the tutorials, quizzes, and examinations, since all of those were course expectations. It was expected that most students, when presented with informed consent assuring their anonymity and confidentiality, would opt to stay in the study; however, the final number of students participating could have differed from the total number of students in the course.

Research Design

The current study consists of a quasi-experiment, non-equivalent-groups design with repeated measures. The study was conducted over two consecutive trimesters with two different cohorts of students. The first trimester cohort was the treatment group and received scenario-based e-tutorials as preparation for class on four topics: the endocrine system, the upper gastrointestinal system, the lower gastrointestinal system, and the musculoskeletal system. The scenario-based e-tutorials had not been used in the class before and covered the topics using a scenario- or story-based approach. The second trimester cohort was the control group and received direct instruction e-tutorials as preparation for class on the same four topics. The direct instruction e-tutorials had been used in class before and covered the topics in an organized, top-down sequence. Each group took a pretest at the beginning of each trimester, in order to compare the equivalence of the groups. After each e-tutorial was reviewed by both the control and treatment groups, there was the administration of a tutorial quiz during the next class and a content exam approximately a week after class—hence the repeated measures in the design.

Procedures

This section describes the experimental treatment of the current research and the process followed in the development of the instructional modules.

Experimental treatment. The instruction of a university nursing course was flipped through the use of four e-learning tutorials, which provided the students with direct instruction as preparation before class on the topics of the endocrine system, the upper gastrointestinal system, the lower gastrointestinal system, and the musculoskeletal system. Another set of e-tutorials was developed using the same content, except delivered in a scenario-based method. Students in the first trimester received scenario-based e-tutorials, which was the treatment condition. Students in the second trimester received direct instruction e-tutorials, which was the control condition. A discussion of the development of the e-tutorials or instructional modules ensues.

Development of the instructional modules. An instructor in the nursing department, who is not the researcher in the present study, was lecturing with PowerPoint presentations during class on thirteen major topics during the trimester. The instructor felt it would help students develop higher order cognitive skills to flip the classroom by having students study the PowerPoint presentations before class, leaving classroom time for discussion, inquiry, and group activities. The instructor wanted to make the PowerPoint presentations more engaging and accessible over the Internet. The presentations for four of the thirteen major topics were selected to be transformed into interactive, multimedia e-learning tutorials. The researcher of the present study, an instructional design professional, worked closely with the nursing instructor to develop the e-tutorials. The main features added were narration, pictures, illustrations, videos, and

formative assessments. The e-tutorials were used by students for two trimesters. Anecdotally, some students liked the new approach and felt it helped them learn the topics better. The instructor noted that some students, who had struggled to achieve sufficient grades on prior assessments, did much better on the assessments. At the same time, some students complained about the time it took to prepare for class and preferred to be told in a lecture what they needed to know. However, the instructor commented that the new approach was a vast improvement.

In keeping with the goal of encouraging development of higher order cognitive skills among the students, there was a desire to see if making the e-tutorials more authentic or realistic through scenario-based approaches might result in more improvements. It was decided to take the four topics that had been turned into direct-instruction e-tutorials and develop them into scenario-based e-tutorials. The scenario-based e-tutorials contain the same content as the direct-instruction e-tutorials, but present the content in the context of stories. For example, the direct instruction e-tutorial introduces metabolic bone disease directly, one topic after another as seen in Figure 2.

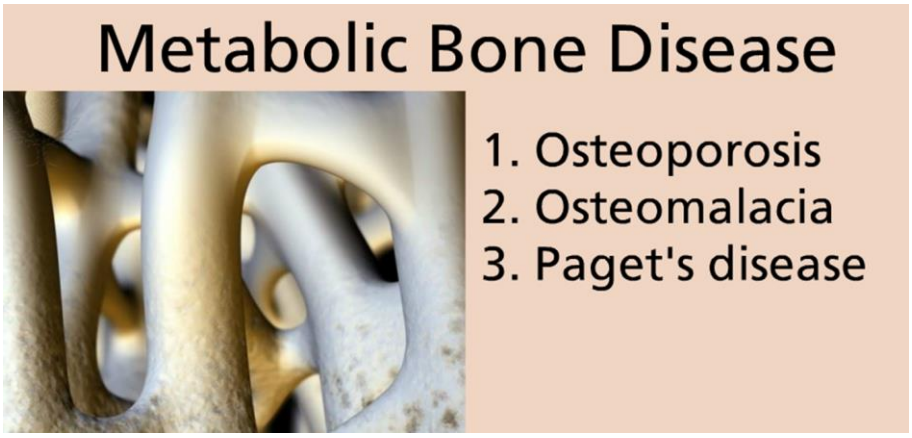


Figure 2. Example of Direct Instruction Approach. Content is presented directly, where the learner explores three metabolic bone diseases.

However, the scenario-based e-tutorial introduces the same topic with a story of Jane and the pain she is experiencing, as shown in Figure 3. As the story unfolds, the learner explores three metabolic bone diseases and determines which one is causing Jane's problem.

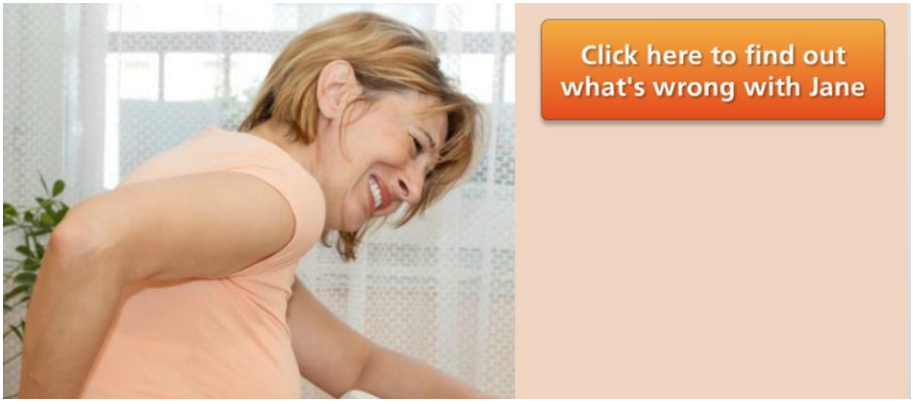


Figure 3. Example of Scenario-Based Approach. Content is presented in the context of a story about Jane, who is experiencing a metabolic bone disease. As the story unfolds, the learner explores three metabolic bone diseases and determines which one is causing Jane's problem.

In this study, the presentation of direct instruction e-tutorials during the second trimester was the control condition and the presentation of the scenario-based e-tutorials during the first trimester was the treatment condition. A schedule showing the timing of instruction for each of the major topics and of the e-tutorials during a fourteen week trimester is shown in Figure 4.

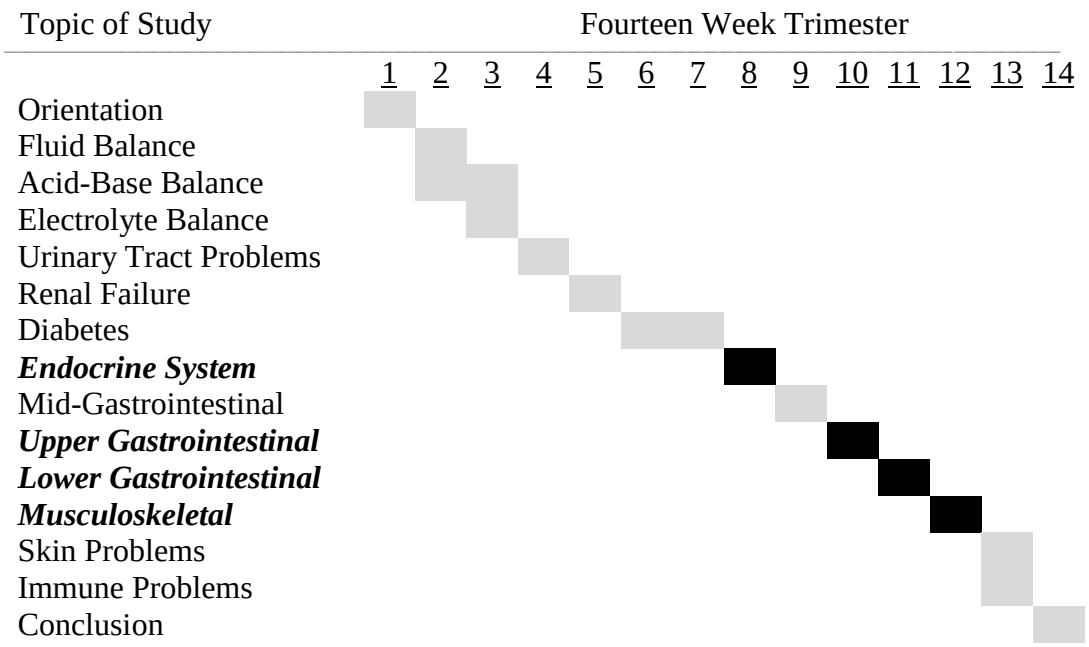


Figure 4. Schedule of Instruction. Shaded areas indicate the week when a topic of study is taught during a fourteen week trimester. Areas shaded in black indicate when topics in this study were taught using e-tutorials.

The development of the scenario-based e-tutorials was based upon the framework of the ADDIE model of instructional design, and each step—analysis, design, development, implementation, and evaluation—is described below (Gagne et al., 2005).

Analysis phase. During the analysis phase, it was important to determine the need for instruction as well as the solution. This was done by considering several aspects during the analysis phase including: rationale, target audience, learner characteristics, learning influences, learning environment requirements, what will be learned, instructional goal, instructional objectives, project delivery options, learner constraints, project timeline, instructional differences, and pedagogical considerations (Moulton, Strickland, Strickland, White, & Zimmerly, 2010).

Rationale. The primary need for scenario-based e-learning tutorials was to prepare students for higher order cognitive activities in the classroom. In order to

participate in higher order cognitive activities, there must be a firm foundation in lower level cognitive tasks, such as remembering and understanding. Direct instruction e-tutorials tend to deliver lower level cognitive information, with an occasional crossover into higher order cognitive areas, for example when presenting formative assessments. Scenario-based e-tutorials tend to deliver higher order cognitive information, with references to lower order information to provide the necessary scaffolding for students to build their understanding. In the development of scenario-based e-tutorials, there is an expected tug of war between the desire to present realistic scenarios and the need to provide background information. In theory, classroom activities in the flipped classroom can utilize higher order cognitive skills (such as analysis and evaluation), because lower order concepts (that call for memorization and understanding) have already been presented to the students during their preparation for class through e-learning tutorials. The use of scenario-based e-learning tutorials will expose the students to more realistic scenarios and higher order cognition even while they are learning content at a lower level of cognition. It was expected that calling upon higher order cognitive processes earlier would result in better learning advances and learners taking more responsibility for their own learning without waiting passively to be told what they needed to know.

Target audience. The target audience consisted of two cohorts of second trimester freshmen in the nursing program who were enrolled in two consecutive trimesters of an introductory course at a medium-sized private university in the Intermountain West of the United States.

Learner characteristics. Historically, students in the course investigated by this study have typically been White (more than 90%), female (over 70%), around 23 years of

age, and from the Western United States (over 80%). The students have been very motivated to perform well in class, because they could not stay in the nursing program if they did not maintain an average score of at least 75% on assessments. More details about the participants can be found in Appendix A1.

Learning influences. A scenario-based approach to instruction has the potential to improve the mindset of students in the nursing cohort. The need to pass exams at certain levels of competence can encourage a mindset that coincides with a frustration expressed by one of the instructors—that students just want to be told what they need to know to pass the exam. A scenario-based approach may lead to more of a mindset of, "I need to learn more so I can make good decisions concerning people who need medical assistance." Several qualities that may influence learning, such as gaining the learner's attention, making the instruction relevant, and building learner confidence are documented in Appendix A2.

Learning environment requirements. The direct instruction e-learning tutorials and the scenario-based e-learning tutorials were delivered online through the university's learning management system. Students interacted with the instruction at their convenience on a personal computer with a mouse, keyboard, and speakers. They may have repeated the interaction as they desired from practically anywhere and anytime. The instruction was such that they can do it all at once or chunk it into smaller portions. It was easy for the students to come back to specific areas that they needed to spend more time on. Tutorial quizzes were taken in the classroom during the first few minutes of the first class for the particular topic of study. Content exams were taken at the university testing center after all classes for the particular topic of study were completed, which was

approximately one week after the tutorial quizzes.

What will be learned. Of all the topics covered in the course, four topics were developed into e-learning tutorials: the endocrine system, the upper gastrointestinal system, the lower gastrointestinal system, and the musculoskeletal system. Direct instruction e-tutorials and scenario-based e-tutorials were developed for each of these topics. The course instructors reported the following: (1) students need to learn enough about the problems associated with each topic to be able provide care for patients and help educate their patients about their condition; (2) for the various conditions under each topic, students need to understand its pathophysiology, signs and symptoms, diagnosis, and treatment; and (3) students need to know what to do when presented with a problem and understand the consequences of their actions.

Instructional goal. The goal of developing scenario-based e-learning tutorials is to present engaging and realistic scenarios that will cause the students to make decisions and see the consequence of their actions. It is theorized that learning in authentic contexts will make the learning more meaningful and provide scaffolding for students to construct their own knowledge of the topics, which will be more memorable and easy to recall as needed.

Instructional objectives. Of the thirteen major topics taught during a fourteen week trimester, four topics taught in four separate weeks were selected for the development of scenario-based e-tutorials: the endocrine system, the upper gastrointestinal system, the lower gastrointestinal system, and the musculoskeletal system. The instructional objectives for each topic are outlined in Appendix A3 and categorized in accordance with the revised Bloom's taxonomy (Anderson et al., 2001).

Most of the objectives are categorized as lower order cognitive skills, such as remembering, understanding, describing, relating, discussing, identifying, explaining, and comparing. Each objective has been reviewed and evaluated by subject matter experts (nursing instructors) for relevance to the course content.

The direct instruction e-tutorials, which were already implemented and in use, were evaluated by three subject matter experts and were compared to the instructional objectives in order to validate the current direct instruction. The subject matter experts viewed and took a survey for each e-tutorial. The results of their evaluation and validation of instruction (Appendix A4) indicate the instructional content is aligned with the instructional objectives.

A concept map of instructional intent for each topic is shown in Appendix A5. Two nursing instructors, one who currently teaches and one who formerly taught the course, evaluated the concept maps of instructional intent and compared them with the instructional objectives in order to validate the instructional intent. The results of their evaluation and validation of instructional intent appear in Appendix A6, which indicate that the instructional intent used when designing and developing scenario-based e-tutorial meets the instructional objectives. The concepts maps of instructional intent were used in the design of the scenario-based e-tutorials.

Project delivery options. The direct instruction and scenario-based e-tutorials were published as web-accessible modules, available to computer devices that have a web browser. The e-tutorials were uploaded and made available to students through the university content management system. A link to the content was placed in the learning management system for typical use by the students. Students were able to interact with

the e-tutorials as many times as they wanted and it was available practically anywhere and anytime.

Learner constraints. Students at the university in the current study were expected to have their own personal computer and were accustomed to using the university learning management system for all classes. Students had to have access to a high speed internet connection to access the e-tutorials. In most cases this was available in their housing complexes, but if not, they may have used computers in the university library to access the e-tutorials. Students in the nursing program had the prerequisite knowledge for the topics of instruction by virtue of the prerequisites to this course, which include: Introductory Nursing, Introduction to Nursing, Human Anatomy and Physiology I, and Human Anatomy and Physiology II.

Project timeline. The approximate timeline for each step of the ADDIE process that produced scenario-based e-learning tutorials is shown in Table 2.

Table 2

Timetable for the Instructional Design of Scenario-Based Modules

Phase	Begin	End
Analyze	May 2014	June 2014
Design	July 2014	August 2014
Develop	August 2014	September 2014
Implement	September 2014	October 2014
Evaluate	October 2014	November 2014

Instructional differences. The selected cohorts of nursing students were relatively homogenous and were not expected to have significant differences in ability. However, every student is different and has his or her own way of learning. There is a wide

accommodation of learning styles in the e-learning tutorials, which include narration for listeners, transcripts for readers, lists of highlights, illustrations, videos, challenging assessments, and learner control over pace, timing, and navigation.

Pedagogical considerations. Multimedia principles were extensively used in the direct instruction e-tutorials as well as the scenario-based e-tutorials in order to take advantage of the available strategies for learning gains (see the *Multimedia and Interactivity* section in Chapter 2). Interactivity was also used extensively in the e-tutorials for both modes of instruction to help the learner be more actively involved, stay interested, navigate and control pacing, and think through higher order formative assessments. A scenario-based approach was used in the development of treatment e-tutorials in order to create a more realistic setting, cause learners to use higher order cognition by making decisions, and allow learners to formatively learn as they see the results of their decisions (see the *Scenario-based E-learning* section in Chapter 2).

Design phase. The purpose of the design phase was to design the e-tutorials of each of the four topics that would achieve the instructional objectives through the use of a scenario-based approach. The direct instruction already existed. The main effort was to adapt the existing instruction into a scenario-based approach. In this section, the design of the scenario-based e-tutorials is described and will include a task analysis, a method for designing nursing scenarios, a module flowchart, and storyboards.

Task analysis. The purpose of the task analysis was to determine the sequence of tasks the learner would complete to meet the learning objectives. The task analysis revealed that the most important outcomes were for the nursing students to learn how to care for patients who experience a disorder, to recognize complications and when to

inform the health care provider, and to teach patients how to respond to their condition. Other tasks were prerequisite to those outcomes, such as understanding the anatomy and physiology of the system and the multitude of disorders associated with it, recognizing the signs and symptoms of the disorders, understanding the diagnostic assessments or tests for the disorders, and knowing what kind of prevention, treatment, surgery, or medication is available for the disorders. The task analysis appears in Appendix B1.

Designing nursing scenarios. The method for designing a nursing scenario, developed specifically for this study, was to: (1) describe a realistic situation about a patient in order to gain the interest of the student and provide clues as to what the medical problem may be; (2) provide medical history about the patient and have the student look for pertinent clues; (3) provide patient vital signs and nursing assessments and have the student identify clinically significant conditions; (4) provide the diagnosis or have the student discover the diagnosis through formative assessment; (5) provide the treatment or have the student discover the best treatment through formative assessment; (6) have the student identify the appropriate nursing care; (7) have the student identify what the patient needs to know about his or her condition; and (8) have the patient return with a related condition and continue the story by repeating the steps. The steps for designing a nursing scenario are explained in more detail in Appendix B2. The concept maps of instructional intent (Appendix B5) were helpful in identifying which scenarios were needed to accompany the disorders of each topic. During the instruction of the four topics, 15 categories of major disorders with 44 specific disorders were discussed. Time constraints did not allow for 44 scenarios, so it was necessary to identify disorders for which scenarios were developed. This process involved discussing the possible scenarios

with nursing faculty. After deliberation, it was decided there were 16 scenarios that needed to be developed for the four topics of instruction: six scenarios for the endocrine system, three scenarios for the upper gastrointestinal system, three scenarios for the lower gastrointestinal system, and four scenarios for the musculoskeletal system. More detailed information about the selected scenarios appears in Appendix B3. The initial concepts for nursing scenarios were arrived at through brainstorming with the subject matter expert, a nursing faculty member. The scenarios were fleshed out by the instructional designer. As scenarios were written, they were proofread and critiqued by two nurses—one who used to teach the course and another currently working in the nursing industry with 20 years of experience. A sample nursing scenario appears in Appendix B4.

Module flowcharts. After nursing scenarios were designed, they were integrated with the direct instruction. This was a bit of a chicken and egg problem—does the scenario come first or the direct instruction? The students needed the direct instruction to perform well in the scenario. On the other hand, the scenario would make learning the direct instruction more relevant, realistic, and interesting. Therefore, the scenarios and the direct instruction were integrated to achieve a balance of the competing needs. For each topic of study, a module flowchart outlines how scenarios and direct instruction were integrated. A sample of a module flowchart appears in Appendix B5.

Storyboards. The storyboard is an organizing tool that helps the instructional designer sequence slides of a presentation as well as the elements that make up a slide, such as the narrative, pictures, menu, navigation, and notes. It is a useful medium for iterative design between an instructional designer and a subject matter expert. A sample storyboard used in a nursing scenario appears in Appendix B6.

Development phase. During the development phase, the design is turned into a working learning environment—in this case, scenario-based e-tutorials. This section will describe the tools used to develop the e-tutorials and the formative evaluation and validation of instruction of the e-tutorials.

Development tools. The e-tutorials were created using Articulate Storyline, which allows for the creation of highly interactive online and mobile courses. Other tools included Adobe Photoshop for the editing of images, Audacity and Adobe Audition for the editing of audio, Adobe Illustrator for the creation of illustrations, Microsoft PowerPoint for the creation of storyboards, and Microsoft Word for the creation of concept maps, module flowcharts, and scenarios.

Formative evaluation. As e-tutorials were developed, they underwent a number of checks for accuracy, quality, and validity. During the creation of the e-tutorials, the instructional designer iteratively reviewed and made corrections. When an e-tutorial was tentatively finished, student assistants reviewed it and noted any concerns and then the instructional designer made corrections. The corrected tutorial was then reviewed by a nursing faculty member who formerly taught the course and an experienced nurse working in the industry. Any problems or concerns noted by these two subject matter experts were addressed by the instructional designer. The corrected e-tutorial was subjected to a process to validate the instruction, described next.

Validation of instruction. The scenario-based e-tutorials were evaluated by three subject matter experts (nursing faculty) and were compared to the instructional objectives in order to validate the instruction. After viewing the instruction, the subject matter experts (SMEs) took a survey for each e-tutorial. The e-tutorials were edited and revised,

based upon the suggestions of the SMEs. The results of their evaluation and validation of instruction (shown in Appendix C) indicate that the instruction meets the instructional objectives.

Implementation phase. The implementation phase takes the developed instruction and puts it in place for delivery to the learners. The e-tutorials reside in a computer directory structure of web accessible files. The files were uploaded to the university content management system and a link to the content was obtained. The link is referred to within the university learning management system for students enrolled in the course. Links to the e-tutorials are shown in Appendix D.

Evaluation phase. Although evaluation is listed as the last phase, it actually occurs during each step. It happens constantly as assumptions are questioned and each step is scrutinized. It is most obviously manifest when a subject matter expert is consulted, such as the iterative reviews of scenarios during the design phase and the formative evaluation and validation of instruction during the development phase. During the evaluation phase, problems and concerns were raised that usually resulted in changes that corrected the problems or concerns. Evaluation naturally continued to occur during the implementation phase as problems became manifest and needed to be corrected. Summative evaluation of the final product occurred as the effectiveness of scenario-based e-tutorials was compared with the effectiveness of direct instruction e-tutorials and conclusions were drawn, which is the purpose of the present study.

Instrumentation

The measurement instruments used in the study to determine the effectiveness of direct instruction e-tutorials compared to scenario-based e-tutorials are described in this

section. There are nine points of assessment during the course of this study, consisting of one pre-test, four tutorial quizzes, and four content exams. All of the assessments, except the pre-test, were existing assessments regularly used by the class. Some questions were added to quizzes and exams in order to achieve the right number of questions and the right mix of high and low order questions. Questions that were added to quizzes or exams were created by the course instructor and validated by a prior instructor of the course. Each assessment is described below.

Every subject or student in the experiment took a pretest during the third week of class. The pretest is a paper test given in class that consists of 25 multiple-choice questions related to the four topics of study. The purpose of the pretest was to compare the first and second trimester students to check the assumption that both classes of students had similar levels of knowledge.

After participating in each e-learning tutorial, students took a tutorial quiz during the first few minutes of the class immediately following the pre-class preparation. This quiz provided a reason for the students to complete the e-tutorial and measured their understanding at that time. There were four tutorial quizzes, one for each topic of study. The four quizzes were paper quizzes given in class. Each quiz had ten multiple-choice questions of which five were high order and five were low order questions. Details of each tutorial quiz are found in Appendix E1.

Approximately one week after reviewing the e-learning tutorial and after taking the tutorial quiz, participating in classroom room activities, and completing all assignments, students took a content exam at the testing center, which measured their understanding at that time. There were four exams, one for each topic of study. Each

content exam had 35 multiple-choice questions of which 14 (or 40%) were high order and 21 (or 60%) were low order questions. Details of each content exam are found in Appendix E2.

In general, exams in the course occurred approximately every two weeks. Students took exams at the testing center at their convenience during a three to four day time frame. Since exams occurred about every two weeks, they covered multiple topics. For example, the exam that included questions about the endocrine system also contained questions about diabetes. In that exam, only questions about the endocrine system were accounted for in the study and constituted the first content exam. Likewise, the exam that covered the upper gastrointestinal system also covered the lower gastrointestinal system. Questions in that exam were considered separately in the study and constituted the second and third content exams. The exam that included questions about the musculoskeletal system also included questions about the immune and integumentary systems. Only questions in that exam that related to the musculoskeletal system were accounted for in the study and constituted the fourth content exam. The approximate timing during the trimester for tutorial quizzes and content exams related to the present study is shown in Figure 5.

	Monday	Tuesday	Wed	Thursday	Friday	Saturday
Week 3		Pretest in class				
Week 8				1st quiz in class	←— 1st exam ——	
Week 9	—→|					
Week 10						
Week 11		2nd quiz in class				
Week 12		3rd quiz in class			←2nd & 3rd exam —	
Week 13	—→|	4th quiz in class			←— 4th exam —→|	
Week 14						

Figure 5. Approximate Timing of Tutorial Quizzes and Content Exams. Shaded areas indicate the time frame during which students took the exam at the testing center. The second and third content exams were taken as one exam, but the questions were separated and considered the second and third content exams in this study.

Data Collection

Demographic information of every student in the study was collected, including name, age, marital status, gender, ethnicity, home state, ACT score, and prior college grade point average. This information was used to check the assumption that both classes are homogeneous.

Pretest scores of every student in the study were collected during the third week of each trimester. The pretest was a paper and pencil test administered by the teacher during class. The pretests were collected by the teacher and given to the researcher. The first trimester pretest scores were compared with the second trimester scores to test the assumption that the students in the treatment group are very similar to students the control group in terms of previous knowledge.

Tutorial quiz scores of every student in the study were collected. Each trimester there were four tutorial quizzes, one for each topic of the endocrine, upper gastrointestinal, lower gastrointestinal, and musculoskeletal system. Tutorial quizzes were paper and pencil quizzes administered by the teacher during class. The quizzes were

collected by the teacher, graded, recorded in the grade book, and then given to the researcher for analysis. The researcher coded the student performance on tutorial quizzes in terms of high order and low order assessment scores.

Content exam scores of every student in the study were collected. Each trimester there were four content exams, one for each topic of the endocrine, upper gastrointestinal, lower gastrointestinal, and musculoskeletal system. Content exams were computer-based exams proctored by the campus testing center. The researcher had computer-based access to the results and coded the student performance on content exams in terms of high order and low order assessment scores.

The researcher coded pretest, quiz, and exam scores, as described above into a spreadsheet. In a separate step, the researcher did a random spot check of 10% of the pretest, quiz, and exam scores to check for accuracy of coding. Accuracy of coding was verified to be correct.

Data Analyses

The data used in the analysis to answer the research questions consisted of condition (control or treatment), gender, prior GPA, pretest score, and sixteen assessment scores. The data were analyzed using SPSS (version 21) as a repeated-measures mixed ANCOVA. The sixteen assessment scores of each student, which were the dependent variables in the repeated measures analysis, were entered in SPSS as subsets of topic, assessment type, and question level. SPSS differentiated each score as within-subjects factors. The condition—treatment or control—was entered into the analysis as a between-subjects factor. Gender, GPA and pretest were entered as covariates in the analysis.

The prior GPA, pretest scores, and gender of students in the treatment and control groups were compared to check the assumption that both groups were very similar. Before the analysis was performed, it was not known whether gender would play a significant role in student performance on assessments. GPA, pretest scores, and gender were used as covariates in the analysis just in case there were any differences between the two groups in those regards.

The present research accounted for and investigated several factors: (1) *assessment scores* – repeated measures of student performance on assessments – which are dependent variables in the study; (2) *condition*, whether the group received the control or treatment condition; (3) the *topic,* endocrine, upper gastrointestinal, lower gastrointestinal, or musculoskeletal system; (4) the *assessment type*, either a tutorial quiz or a content exam; and (5) the *question level*, whether the assessment item was a cognitively high or low order question. See Table 3 for a summary of factors, factor levels, and variable types.

Table 3

Summary of Factors, Factor Levels, and Variable Types

Factors	Factor Levels	Variable Type
Assessment Scores	Continuous data	Dependent
Condition	Treatment Control	Independent
Topic	Endocrine System (1) Upper Gastrointestinal System (2) Lower Gastrointestinal System (3) Musculoskeletal System (4)	Independent
Assessment Type	Tutorial Quiz (1) Content Exam (2)	Independent
Question Level	High Order (1) Low Order (2)	Independent
Gender	Male Female	Covariate
Pretest Score	Continuous data	Covariate
Prior GPA	Continuous data	Covariate

The dependent variables—the assessment scores—are repeated measures of each student in the study. For each student there are 16 repeated measures: four topics by two assessment types by two question levels. See Table 4 for an example of how the collected data are entered with a row for each student.

Table 4

An Example of Collected Data Entered with One Row per Student

Topic					Endocrine (1)				Upper GI (2)				Lower GI (3)				Musculo-skeletal (4)			
Assessment Type					Quiz (1)		Exam (2)		Quiz (1)		Exam (2)		Quiz (1)		Exam (2)		Quiz (1)		Exam (2)	
Question Level					High (1)	Low (2)	High (1)	Low (2)	High (1)	Low (2)	High (1)	Low (2)	High (1)	Low (2)	High (1)	Low (2)	High (1)	Low (2)	High (1)	Low (2)
Student Number	Condition (Treatment/Control)	Gender	Prior GPA	Pretest Score	Assessment Score 1 (1,1,1)	Assessment Score 2 (1,1,2)	Assessment Score 3 (1,2,1)	Assessment Score 4 (1,2,2)	Assessment Score 5 (2,1,1)	Assessment Score 6 (2,1,2)	Assessment Score 7 (2,2,1)	Assessment Score 8 (2,2,2)	Assessment Score 9 (3,1,1)	Assessment Score 10 (3,1,2)	Assessment Score 11 (3,2,1)	Assessment Score 12 (3,2,2)	Assessment Score 13 (4,1,1)	Assessment Score 14 (4,1,2)	Assessment Score 15 (4,2,1)	Assessment Score 16 (4,2,2)
1	**T**	**M**	**3.8**	**86**	**80**	**84**	**88**	**92**	**76**	**82**	**92**	**94**	**76**	**80**	**89**	**92**	**77**	**81**	**91**	**95**
2	**C**	**F**	**3.9**	**91**	**78**	**85**	**89**	**91**	**80**	**84**	**91**	**95**	**77**	**78**	**91**	**87**	**82**	**89**	**92**	**83**
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

Note. Example of two rows of student data is displayed in boldface.

In this study, a repeated-measures mixed ANCOVA was used to analyze the data. ANCOVA—analysis of covariance—was used to control for variability in gender, pretest score, and prior GPA. Including all the assessments as repeated measures and the covariates in a single ANCOVA analysis can tell "whether considering more than one independent variable at a time gives you additional information over and above what you would get if you did the appropriate *basic* inferential statistics for each independent variable separately" (Leech et al., 2011, p. 150). The advantage of using ANCOVA is

that it can be used to "adjust or control for differences between the groups based on another, typically interval-level variable, called the covariate" (Leech et al., 2011, p. 150). Considering all the factors in a single analysis as well as the effect of covariates may reduce variation and make the correct finding of a significant result more likely. In other words, the statistical power of the study may be increased.

There are assumptions that should be met in order for the repeated-measures mixed ANCOVA to be valid, including: (1) independence of observations; (2) normality of the error terms; (3) homogeneity of variances; and (4) sphericity (Leech et al., 2011, p. 176). The first assumption was met by the research design, in that the score of any given student does not affect the score of any other student. The second assumption, normality of the error terms, was checked by analyzing Q-Q Plots and running a normality check on the residuals of the scores. The third assumption, homogeneity of variances, was checked during the analysis using Levine's statistic. The fourth assumption was checked with Mauchly's test of sphericity. When assumptions were not met, appropriate remedial action was applied.

CHAPTER IV

Results

The purpose of this study was to determine if significant differences in student achievement scores are based upon whether students prepare for the flipped classroom by receiving scenario-based or direct instruction e-tutorials. The study was conducted over two trimesters, from September 2014 to April 2015, at a medium-sized private university in the Intermountain West of the United States. This chapter presents the results of the study in answering the two research questions:

1. Is there a significant difference in student performance on assessment items between students who receive scenario-based e-tutorials before class as compared to students who receive direct instruction e-tutorials before class in preparation for the flipped classroom when controlling for gender, prior grade point average, and pretest score?

2. Is there a significant difference in student performance on low versus high order assessment items between students who receive scenario-based e-tutorials before class as compared to students who receive direct instruction e-tutorials before class in preparation for the flipped classroom when controlling for gender, prior grade point average, and pretest score?

This chapter presents a description of the sample and covariates, descriptive and inferential statistics relevant to the study, and the results of the data analyses for each of the two research questions. The chapter concludes with a summary of the research results.

Descriptive Statistics of the Sample and Covariates

A cohort of students in a medical surgical nursing class the third trimester of 2014 and another cohort from the first trimester of 2015 were the test subjects. Students in the third trimester of 2014 were the treatment condition and students in the first trimester of 2015 were the control condition.

All students in both cohorts—41 in the third trimester of 2014 and 43 in the first trimester of 2015—signed a consent form, agreeing to be in the research. There was no need to drop anyone from the study, since all participants in both trimesters completed the pretest, the four relevant quizzes, and the four relevant exams. During the two trimesters, no one withdrew from the study.

The participants in both classes appeared to be very similar in terms of age, gender, origin, and academic ability. There was no significant difference, $t(82)=-0.524$, $p=0.602$, in the age of students between the treatment and control groups. There was no significant difference, $t(82)=0.786$, $p=0.434$, in the covariate, GPA of students, between the treatment and control groups. There was no significant difference, $t(82)=1.040$, $p=0.301$, in the ACT scores of students between the treatment and control groups. Likewise, there was no significant difference, $t(82)=-0.110$, $p=0.913$, in the covariate, pretest scores of students, in the treatment and control groups. See Table 5 for a demographic and academic comparison of the two classes—the treatment and control groups. The data indicated the treatment and control groups were well matched for the experiment.

Table 5

Comparison of Treatment and Control Nursing Cohorts

	3rd Trimester 2014 (Treatment Group)		1st Trimester 2015 (Control Group)	
Number of Participants	41		43	
Gender[a] – female	68.3%		76.7%	
Ethnicity – White	90.2%		93.0%	
Origin – Western US	95.1%		86.1%	
	Mean	SD	Mean	SD
Age	24.2	6.31	23.5	6.45
GPA[a]	3.83	0.22	3.87	0.20
ACT	22.9	4.21	23.8	3.39
Pretest[a]	81.0	8.71	80.7	10.45

Notes. [a]Gender, GPA, and Pretest are covariates.

Descriptive Statistics of the Dependent Measures

The descriptive statistics of the dependent measures—the quiz and exam scores—are displayed in Table 6. The data reveal that the mean score for students in the control group was higher than students in the treatment group for every topic, assessment type, and question type, with one exception—high order questions on the Upper GI quiz.

Table 6

Descriptive Statistics of the Dependent Measures (Assessment Scores)

Topic	Assessment Type	Question Type	Treatment (n=41) Mean	SD	Control (n=43) Mean	SD
Endocrine	Quiz	Low	73.66	16.39	**75.81**	19.79
		High	64.88	18.32	**66.98**	16.26
	Exam	Low	83.39	11.17	**88.93**	5.85
		High	70.73	10.57	**77.41**	10.09
Upper GI	Quiz	Low	67.80	19.94	**72.56**	21.83
		High	**78.05**	12.49	70.70	17.10
	Exam	Low	86.53	7.60	**93.02**	5.44
		High	81.88	10.96	**83.55**	8.33
Lower GI	Quiz	Low	73.17	23.07	**77.21**	24.13
		High	79.51	16.42	**80.93**	19.50
	Exam	Low	79.67	8.04	**83.28**	7.30
		High	73.69	7.73	**74.25**	10.35
Musculoskeletal	Quiz	Low	56.58	15.43	**59.53**	21.60
		High	70.24	19.56	**78.60**	21.56
	Exam	Low	84.32	9.24	**90.25**	6.89
		High	61.67	11.49	**70.27**	12.46

Note: The higher of the two mean scores in each row is in boldface.

Assumptions

Prior to conducting the repeated measures mixed ANCOVA, assumptions of normality of the error terms, homogeneity of variances, and sphericity were checked.

Normality. In the collected data, each student had sixteen scores, which constituted the repeated measures. Unstandardized residuals were computed for each of the scores. Analysis of the Q-Q Plots of each of the scores seemed to indicate normality of data for many of the residuals of the scores. For example, Figure 6 shows the Q-Q Plot for the unstandardized residuals of the musculoskeletal quiz low order questions. However, some curvature was noted in many plots. For example, Figure 7 shows the Q-Q Plot for the unstandardized residuals of the musculoskeletal quiz high order questions. A normality test indicated that five of the sixteen sets of assessment scores were normal.

They included: (1) The Upper GI quiz low questions; (2) Lower GI exam high questions; (3) Lower GI exam low questions; (4) Musculoskeletal quiz low questions; (5) Musculoskeletal exam high questions.

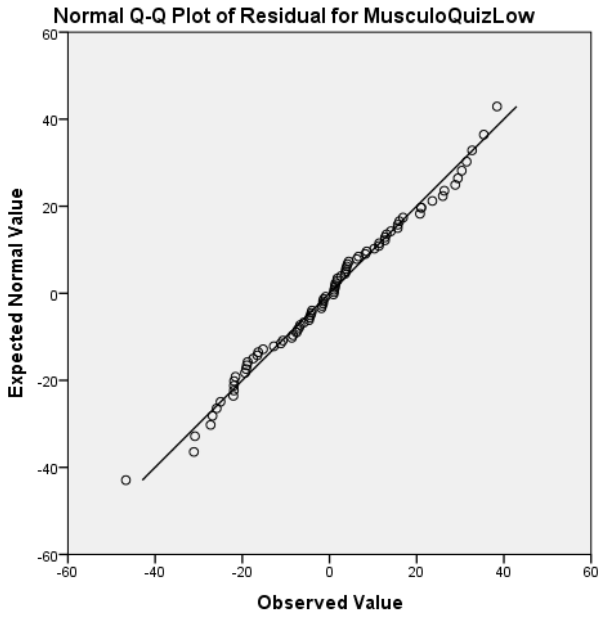


Figure 6. Normal Q-Q Plot of Musculoskeletal Quiz Low Order Questions. The plot of standardized residuals appears to be normal.

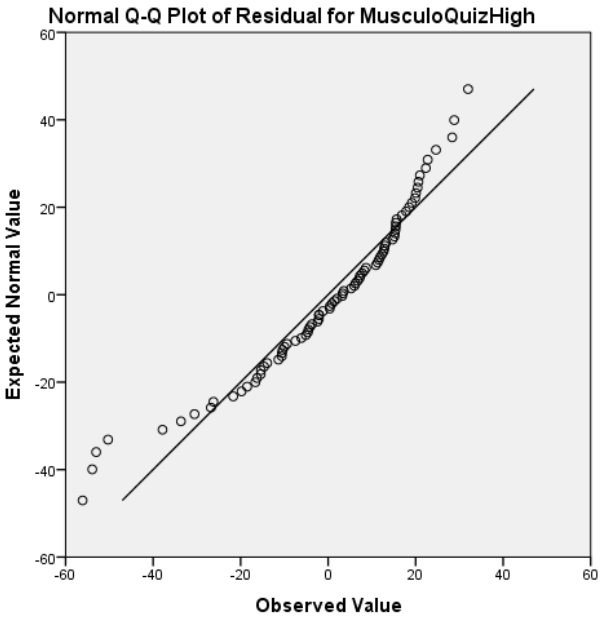


Figure 7. Normal Q-Q Plot of Musculoskeletal Quiz High Order Questions. The plot of standardized residuals appears to have curvature.

To deal with the problem of non-normal data, an arcsine data transformation of each of the sixteen assessment scores was performed (Chanter, 1975). Each of the sixteen assessment scores was transformed using Equation 1, where r is the number of questions correctly answered and n is the number of questions in a quiz or exam:

$$\theta=\sin^{-1}\sqrt{\left\{\frac{1}{4n}+\left(1-\frac{1}{2n}\right)\frac{r}{n}\right\}} \quad (1)$$

A normality test of the unstandardized residuals of the transformed assessment scores indicated that twelve of the sixteen data sets were normal, leaving four that were not: (1) Endocrine quiz high questions; (2) Endocrine quiz low questions; (3) Upper GI quiz high questions; and (4) Musculoskeletal exam high questions. Three of the four non-normal data sets were from quizzes. It is not surprising that quiz data sets would not be normal, since they only have five questions. Given the low number of quiz questions, it is remarkable that five out of eight quiz data sets were normal after the arcsine data transformation. Writing about normality, Leech et al. (2011) commented that ANOVA is "quite robust to violations of normality" (p. 30). With this in mind, the researcher decided to continue the analysis using the transformed data set. The descriptive statistics of the transformed data set appear in Table 7.

Table 7

Descriptive Statistics of the Transformed Data Set Dependent Measures

Topic	Assessment Type	Question Type	Treatment (n=41) Mean	SD	Control (n=43) Mean	SD
Endocrine	Quiz	Low	1.018	.170	**1.040**	.212
		High	.928	.178	**.948**	.159
	Exam	Low	1.158	.146	**1.227**	.094
		High	.996	.111	**1.076**	.130
Upper GI	Quiz	Low	.964	.207	**1.020**	.237
		High	**1.063**	.144	.989	.177
	Exam	Low	1.193	.104	**1.302**	.107
		High	1.139	.136	**1.147**	.108
Lower GI	Quiz	Low	1.030	.250	**1.071**	.266
		High	1.090	.190	**1.110**	.219
	Exam	Low	1.101	.098	**1.147**	.095
		High	1.026	.084	**1.036**	.117
Musculoskeletal	Quiz	Low	.847	.145	**.884**	.220
		High	.988	.204	**1.086**	.237
	Exam	Low	1.163	.116	**1.257**	.120
		High	.905	.130	**.994**	.137

Note: The higher of the two mean scores in each row is in boldface.

Homogeneity of Variances. Levene's test of the transformed data set indicated that the assumption of homogeneity of variances of all sixteen of the assessment scores was met (see Appendix F).

Sphericity. Mauchly's test of sphericity for the transformed data set indicates that this assumption was met ($\chi^2(5) = 9.188$, $p = 0.102$).

Research Question One

The results of the repeated-measures mixed ANCOVA were used to assess whether there was a significant difference in student performance on assessment items between students who receive scenario-based e-tutorials before class (the treatment) as compared to students who receive direct instruction e-tutorials before class (the control) in preparation for the flipped classroom. Using the transformed data set and controlling

for gender, GPA, and pretest score in the analysis, there was a significant difference in student performance based on the condition, $F(1, 79) = 12.35$, $p = .001$, $\eta_p^2 = .135$, with student scores in the control group significantly higher than student scores for the treatment. In other words, students who received direct instruction e-tutorials had significantly better scores than students who received scenario-based instruction e-tutorials. Gender and GPA are not significant indicators of student scores. Pretest score is a significant indicator of student performance. The test results of the analysis, which show the between-subjects effects, are displayed in Table 8.

Table 8

Tests of Between-Subjects Effects of the Transformed Data Set

Source	df	MS	F	p	η_p^2
Intercept	1	1.189	21.83	<**.001**	.217
Condition	1	.673	12.35	**.001**	.135
GPA	1	.124	2.28	.135	.028
Pretest	1	25.721	25.72	<**.001**	.246
Gender	1	.001	.018	.893	<.001
Error	79	.054			

Notes: Significant findings in boldface. Significant at the p<0.05 level.

A plot of the estimated marginal means split out by topic for the control and treatment conditions of the transformed data set is shown in Figure 8. The plot shows the control condition outperforming the treatment condition in all topics.

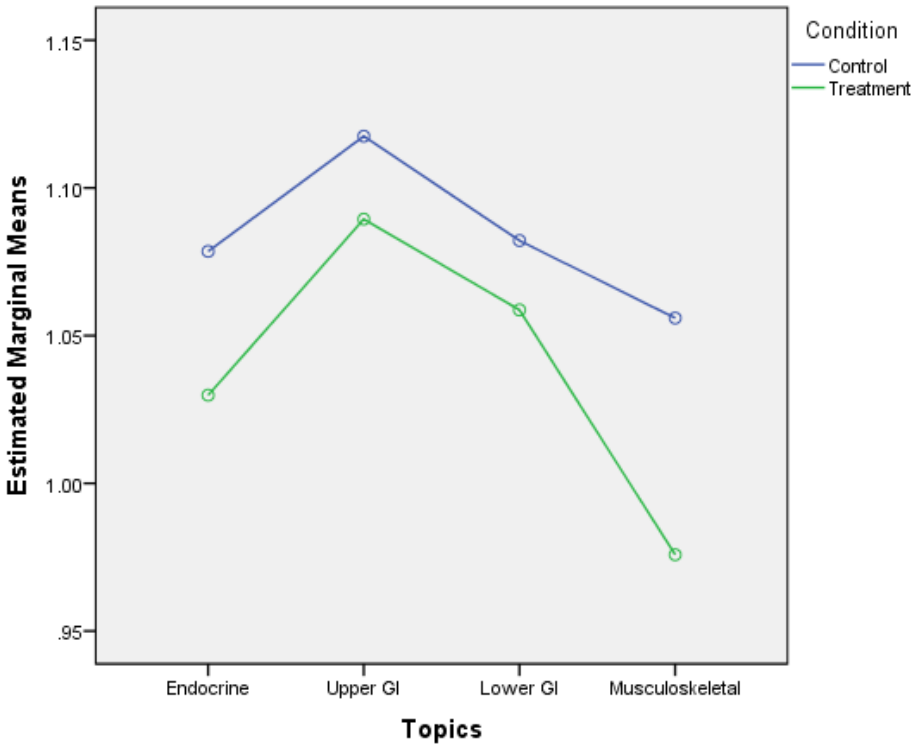


Figure 8. Estimated Marginal Means by Topics. A comparison of the control and treatment conditions by topic show the control condition outperforming in all topics.

Research Question Two

The results of the repeated-measures mixed ANOVA were used to assess whether there is a significant difference in student performance on low versus high order questions (the question level) between students who receive scenario-based e-tutorials (the treatment) before class as compared to students who receive direct instruction e-tutorials (the control) before class in preparation for the flipped classroom. Tests of within-subjects effects of the transformed data set indicate that student performance from the standpoint of the question level was not significantly affected by the type of e-tutorial received before class, $F(1, 79) = 2.484$, $p = .119$, $\eta_p^2 = .030$. Of the fifteen within-subjects effects in the analysis, none were significant except three: topics, assessment types, and the interaction between assessment types and pretest scores, which appear in Table 9.

Table 9

Tests of Within-Subjects Effects

Source	df	MS	F	p	η_p^2
Topics	3	.078	3.522	**.016**	.043
Topics*Condition	3	.055	2.494	.061	.031
Topics*GPA	3	.058	2.637	.050	.032
Topics*Pretest	3	.047	2.144	.095	.026
Topics*Gender	3	.025	1.121	.341	.014
Assess Type	1	.143	4.776	**.032**	.057
Assess Type*Condition	1	.106	3.542	.064	.043
Assess Type*GPA	1	<.001	0.015	.902	<.001
Assess Type*Pretest	1	.374	12.517	**.001**	.137
Assess Type*Gender	1	<.001	.002	.969	<.001
Question Level	1	.040	1.813	.182	.022
Question Level*Condition	1	.054	2.484	.119	.030
Question Level*GPA	1	.021	.973	.327	.012
Question Level*Pretest	1	.077	3.523	.064	.043
Question Level*Gender	1	.001	.052	.820	.001

Notes: Question level interaction with condition is not significant. Significant findings in boldface. Significant at the $p<0.05$ level.

A plot of the estimated marginal means split out by question types for the control and treatment conditions is shown in Figure 9. The plot shows the control condition outperforms the treatment condition on both question types and the spread is smaller for high order questions than low order questions, but not significantly so.

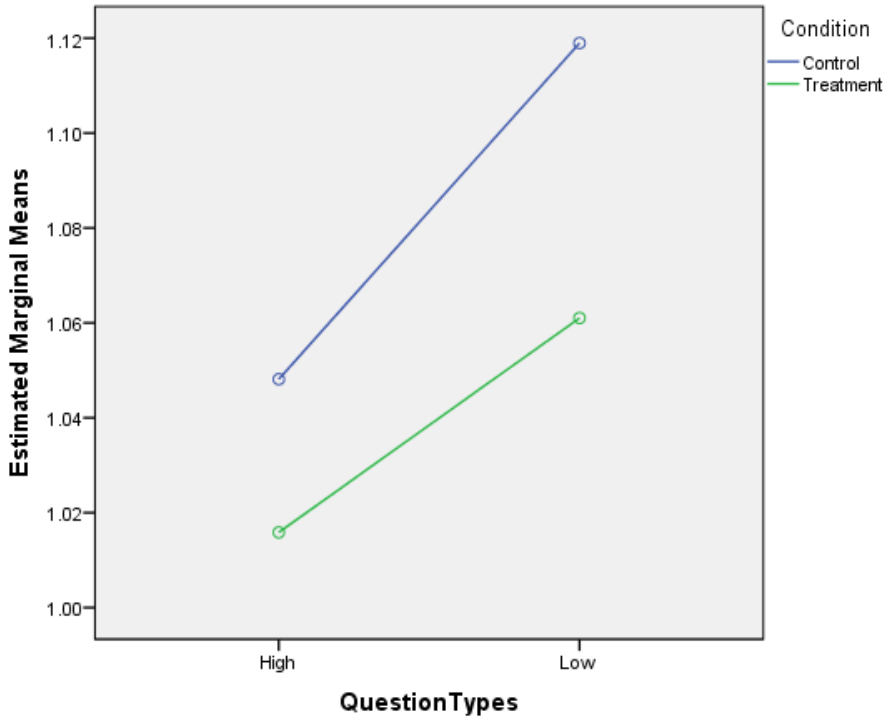


Figure 9. Esimated Marginal Means by Question Type. The control condition outperforms the treatment condition on both question types. The spread is smaller for high order versus low order questions, but not significantly so.

Summary of Results

The purpose of this study was to determine if student performance on assessments is better, depending on whether students received scenario-based e-tutorials or direct instruction e-tutorials. Further, the study sought to determine if student performance on assessments with high versus low order questions were affected by whether students receive scenario-based e-tutorials or direct instruction e-tutorials. The data analysis indicates that students who received direct instruction e-tutorials did significantly better than those who received scenario-based e-tutorials. Further, the analysis indicates that student performance on high order question types versus low order question types was not significantly affected by whether students received direct instruction or scenario-based e-tutorials.

CHAPTER V

Discussion

The present study addresses a gap in research on the use of scenario-based methods of instruction in the form of e-tutorials as an effective means of preparation for the flipped classroom (Clark, 2013; Brunero & Lamont, 2010). According to the literature reviewed, the scenario-based methodology has been found to be effective in improving student learning outcomes; it has been hypothesized that scenarios invite students to take a more active role, learn more effectively, develop higher order cognitive skills, and take responsibility for their own learning (Dutra, 2013; Hsu, 2011; Kennedy, 2004; Mayer, 2005; Pierce & Fox, 2012). In this study, through research question one, the researcher sought to determine whether there was a significant difference in assessment scores between students who receive direct instruction e-tutorials or scenario-based e-tutorials as preparation for the flipped classroom. The researcher also sought to examine whether there was a significant difference in student assessment scores on high versus low order questions between students who receive direct instruction e-tutorials or scenario-based e-tutorials as preparation for the flipped classroom.

In this research study, both the direct instruction e-tutorials and the scenario-based e-tutorials were used as preparation for the flipped classroom and both used multimedia and interactivity to encourage interest, activity, and responsibility for learning on the part of the students. Researchers advocate the use of scenario-based learning (Clark, 2013; Tait et al., 2008). Researchers report that scenario-based learning results in better learning gains for students (Brunero & Lamont, 2010; Hider, 2010; Hsu, 2011; Hsu &

Hsieh, 2006; Persson et al., 2010; Smith et al., 2011; Tait et al., 2008). However, this study provides evidence to the contrary.

Interpretation of Results

The researcher thought, as the literature suggests, that the use of scenario-based e-tutorials by students as preparation for the flipped classroom would result in greater learning gains for students. In this study, learning gains were measured by student performance on quizzes and exams. The researcher feared that despite greater learning gains due to scenario-based e-tutorials, it would be difficult to show a statistically significant difference. To the researcher's surprise, a statistically significant result was found, but it was in the opposite direction—that direct instruction e-tutorials resulted in greater learning gains.

Research question 1. Analysis of the data confirmed, in answer to research question one, that there is a statistically significant difference in the assessment scores in favor of students who use direct instruction e-tutorials as preparation for the flipped classroom over those who use scenario-based e-tutorials. Gender in the predominately female classes and prior grade point average were not statistically significant indicators of how well students did on the assessments. However, student performance on the pretest was a statistically significant indicator of how well students performed on the post assessments. The pretest covered, in a more elementary form, the same topics that were covered in the e-tutorials and assessments. It makes sense that students who came to the study with a better remembrance of the topics they learned previously would have had an advantage.

Research question 2. In theory, scenario-based e-tutorials should have caused students to use high level cognitive skills, since scenarios emphasized application, synthesis, and evaluation, while direct instruction e-tutorials focused on comprehension and basic content knowledge. The researcher thought students who received scenario-based e-tutorials would have performed better on high level questions than students who received direct instruction e-tutorials. However, students in the treatment condition—those who received scenario-based e-tutorials—did not perform as well as students in the control condition on either high or low order questions. Although the performance gap of high order question types narrowed for those who received scenario-based e-tutorials, it did not do so significantly, as indicated by the within-subjects factor *Question Level*.

Although other within-subjects factors—*Topics*, *Assess Type*, and *Assess Type*Pretest*—had significant findings, they had little to do with the research questions in the study. The significant finding of *Topics* indicated that students consistently scored lower on two of the four topics—endocrine and musculoskeletal systems. The significant finding of *Assess Type* indicated that students consistently scored lower on quizzes than on exams. This is not surprising since the exams were taken at the testing center and were higher-stakes assessments than the quizzes. The significant finding of an interaction between assessment types and pretest scores indicated that assessment scores on quizzes or exams varied unexpectedly as the pretest score varied.

Implications and Practical Recommendations

Based on the findings of this study, there are several implications and recommendations for those considering the use of scenario-based instruction e-tutorials as means to prepare for the flipped classroom. Also discussed in this section are the

circumstances within an authentic learning environment which could affect the findings and possible ways to ameliorate the effects.

Preparation activities. In order to maximize the benefits of the flipped classroom, students must prepare before class. Bergmann and Sams (2010) identified one of the problems with the flipped classroom as the likelihood of students showing up to class who have not yet viewed the assigned content. In the current study, it is possible that students did not take the time to receive the scenario-based or direct instruction e-tutorials before coming to class. Presumably this problem would have been random and affected both classes equally. The researcher's assumption before the experiment—that students will review the e-tutorials, because it will help them do better on the assessments and maintain sufficient grades—may not be enough to ensure the preparation actually occurs. The research study had no means to force or verify student interaction with the e-tutorials and no way to keep track of how much time students spent receiving the e-tutorials. It is very important for students who are preparing for the flipped classroom to complete the preparation e-tutorials or else the advantages of the flipped classroom will be lost. Students may be motivated to complete the e-tutorials if they know they have to take a preparation quiz before coming to class or a pop-quiz in class, which have questions based on the information learned in the e-tutorials (Herreid & Schiller, 2013; Tune et al., 2013). Another way to motivate the students would be to require the completion of an assignment that is based on the information in the e-tutorial, which is due before class. If the teacher of the class has the means to automatically track the completion of e-tutorials and the time spent, points could be awarded, which could also be motivational.

E-tutorial time demands. Talley and Scherer (2013) suggest that students need to spend more time in preparation for a flipped classroom than a traditional classroom. Tune, Sturek, and Basile (2013) reported that students in a physiology flipped class were less than enthusiastic mainly due to the increased workload, even though they also felt the flipped approach facilitated their learning. The nursing course in the present research study was a freshman course and topics in the e-tutorials covered a lot of information. Because the e-tutorials covered so much information, they were lengthy. The direct instruction e-tutorials took more than an hour to complete. The addition of scenarios to the scenario-based e-tutorials caused them to take even longer. The increase in size resulting from the transformation of direct instruction e-tutorials into scenario-based e-tutorials can be seen in Table 10, as well as the estimated time to complete the e-tutorials.

Table 10

A Comparison of Size and Estimated Time to Complete of E-Tutorials

Topic	Direct Instruction Slides	Scenario Based Slides	Percent Slide Increase	Direct Instruction Minutes	Scenario Based Minutes	Percent Minute Increase
Endocrine	138	184	33	90	133	48
Upper GI	118	161	36	64	88	38
Lower GI	118	170	44	98	122	25
Musculoskeletal	96	145	51	92	127	38

It is possible that this increase of time to complete a scenario-based e-tutorial may have caused a decrease in student participation. Consideration should be given to the amount of time scenario-based e-tutorials take and, if necessary, chunk the e-tutorials into shorter segments in order to motivate the students to complete them.

Covering a lot of information. Students who are preparing for the flipped classroom need to learn foundational knowledge before coming to class. This will

prepare them to build upon that foundation during class. When preparing for the flipped classroom, it appears concentrating on low level cognitive skills is the most effective use of time. High level skills can be developed later in class and during subsequent activities and assignments. The classes in the study occurred in the early stages of the nursing curriculum, covered more informational content than concepts, and covered a lot of ground in a short amount of time. The classes had a limited amount of time (about one week per topic) to cover major body systems. In classes such as these, that deal with a lot of information in a short amount of time, it appears direct instruction e-tutorials are the more effective use of time to prepare for the flipped classroom. This would seem to contradict Kose et al. (2013), who observed significant learning gains and the completion of more course activities in a study of undergraduate students in a computer science course in Turkey that investigated the use of story-based e-learning. However, that study was not within the context of preparation for the flipped classroom.

Recommendations for Future Research

There continues to be a need for further research of the effectiveness of scenario-based methods in other settings, other fields of study, and other modes of learning. The findings of this study may only apply to nursing students in an undergraduate nursing course of medical surgical nursing at a medium-sized private university in the Intermountain West of the United States. Further, the findings may apply only in the context of students receiving e-tutorials as preparation for the flipped classroom. This section puts forth recommendations for further research in conditions where scenario-based learning may be advantageous.

Other settings. This researcher recommends that the effectiveness of scenario-based methods be researched in other locations and in other fields of study besides nursing. Perhaps there are there some fields that lend themselves better to scenario-based methods than others. Another aspect of the setting that should be investigated is the mode of learning and the various stages within the learning process. Modes of learning include face-to-face, hybrid, online, competency, and everything in between. The stages of learning include preparation for class, attending class, after class assignments, and everything in between. This study investigated the learning stage of preparing for the flipped classroom in a face-to-face learning mode. Other modes of learning and other stages within the learning process should be investigated to see if scenario-based learning is effective in those settings.

Reduce confounding activities. In the present study, students in both classes had other preparation activities to do before class in addition to the e-tutorials, such as chapter reading assignments and practice questions. It is possible students may have chosen other activities besides e-tutorials to prepare for the flipped classroom. Students may have spent more time on other activities and less on the e-tutorials. This can have a confounding effect, making it difficult to distinguish whether learning differences were caused by differing e-tutorials or by other preparation activities. Similarly, the students attended class and completed assignments and other activities between the time they took the preparation quiz and the time they took the content exam. These other activities and assignments may have diluted the effect of the e-tutorials making it difficult to know if the exam results were because of the e-tutorials or something else. This researcher recommends that in future research, such confounding activities be reduced or controlled

by: (1) eliminating other activities that compete with scenario-based learning activities; (2) measuring the effects of scenario-based learning immediately after completion of scenario-based learning activities; and (3) verifying that students spent time and completed the scenario-based learning activities.

Concepts rather than information. In the present research, the students were in a freshman course and the topics in the e-tutorials covered a lot of information. Each of the topics—major body systems—were covered in only a week. Conveyance of so much information may be best done in a direct instruction rather than a scenario-based approach. It may be that scenario-based approaches are best when conveying conceptual knowledge. For example, Brunero and Lamont (2010) reported favorable results when using scenario-based learning to teach nurses how to handle difficult nurse-patient relationships, which is more conceptual than informational. This researcher recommends that future research of scenario-based e-tutorials investigate the teaching and learning of distinct concepts rather than a broad amount of information.

High versus low order cognition. There has been little research that examines whether preparation activities should be oriented toward high or low order cognition. Scenario-based instruction usually deals with higher order cognitive skills, whereas direct instruction often deals with low order skills (Brunero & Lamont, 2010). Future research could investigate whether attending to low order concepts before class and leaving high order concepts for the classroom experience is a better course of action.

Courses that are more advanced. Classes in the present research were made up of freshman nursing students. In advanced nursing courses, there is more emphasis on learning and applying concepts rather than gathering information. Students in advanced

nursing courses use a higher level of cognition. Future research should investigate if scenario-based methods are more effective in advanced nursing courses as well as advances courses in fields other than nursing. Attention should be paid to whether the content being taught is conceptual or informational.

Clinical skills. A study of undergraduate medical students in India that investigated the use of case-based learning observed significant gains in students' performance and recognized that traditional didactic lectures resulted in students who are deficient in problem solving and clinical skills (Gade & Chari, 2013). Future research should investigate whether the use of scenario-based methods would be more effective in a clinical setting where clinical skills are learned and assessed.

Qualitative measures. In this study it was conjectured that the length of the scenario-based e-tutorials may have demotivated the students, causing them to spend less time learning from the e-tutorials. Qualitative measures, such as interviews or surveys, could give insights into what the students think about their experiences with scenario-based learning.

Conclusions

Most of the literature related to scenario-based e-learning encourages its use. Many studies encourage its use based on surveys or interviews of students and instructors. Some studies demonstrate learning improvements, but few are based on a head-to-head comparisons. The importance of this study is that it provides an empirical comparison of scenario-based e-tutorials and direct instruction e-tutor and finds that when used as preparation for the flipped classroom in an entry-level nursing course, scenario-based e-learning is less effective than direct instruction. The study is also

important because it found that scenario-based e-tutorials compared with direct instruction e-tutorials did not improve students' performance on high level questions. More studies on the effectiveness of scenario-based learning in other settings, fields of study, and modes of learning need to be investigated.

References

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., . . . Wittrock, M. C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* New York: Addison Wesley Longman, Inc.

Bergmann, J., & Sams, A. (2010, February). Flipped learning: Maximizing face time. *Learning & Development*, 28-31.

Bloom, B. S. (1956). *Taxonomy of educational objectives, handbook I: The cognitive domain.* New York: Longman.

Bracht, G. H., & Glass, G. V. (1968). The external validity of experiments. *American Educational Research Journal, 5*(4), 437-474.

Brunero, S., & Lamont, S. (2010). The 'difficult' nurse–patient relationship: Development and evaluation of an e-learning package. *Contemporary Nurse, 35*(2), 136-146.

Campbell, D. T., & Stanley, J. C. (1966). *Experimental and quasi-experimental designs for research.* Boston: Houghton Mifflin Company.

Chanter, D. O. (1975). Modifications of the Angular Transformation. *Applied Statistics*, 354-359.

Clark, R. C. (2013). *Scenario-based e-Learning.* San Francisco: Pfeiffer.

Domagk, S., Schwartz, R. N., & Plass, J. L. (2010). Interactivity in multimedia learning: An integrated model. *Computers in Human Behavior, 26*(2010), 1024-1033.

Dutra, D. K. (2013). Implementation of case studies in undergraduate didactic nursing courses: a qualitative study. *BMC Nursing, 12*(15), 1-9.

Evans, C., & Gibbons, N. J. (2007). The interactivity effect in multimedia learning. *Computers & Education, 49*(2007), 1147-1160.

Fulton, K. P. (2012). 10 reasons to flip. *Phi Delta Kappan, 94*(2), 20-24.

Gade, S., & Chari, S. (2013). Case-based learning in endocrine physiology: An approach toward self-directed learning and the development of soft skills in medical students. *Advances in Physiology Education, 37,* 356-360.

Gagne, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005). *Principles of instructional design.* Belmont, CA: Wadsworth.

Great Schools Partnership. (2014, August 8). *Direct Instruction*. Retrieved from The Glossary of Education Reform: http://edglossary.org/direct-instruction/

Grossman, P., Stewart, T., Jaspers, M., & Chapman, B. (2007). Integrating web-delivered problem-based learning scenarios to the curriculum. *Active Learning in Higher Education, 8*(2), 139-153.

Henkel, C. K. (2010). Creating interactive learning objects with PowerPoint: Primer for lecture on the autonomic nervous system. *Medical Teacher, 32*(e), 355-359.

Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching, 42*(5), 62-66.

Hider, R. (2010). Differential white cell counts: An e-learning resource. *Bioscience Horizons, 3*(1), 10-20.

Hsu, L.-L. (2011). Blended learning in ethics education: A survey of nursing students. *Nursing Ethics, 18*(3), 418-430.

Hsu, L.-L., & Hsieh, S.-I. (2006). An exploration of scenario discussion in a web-based nursing course. *Journal of Nursing Research, 14*, 155-164.

Jonassen, D. H. (1991, June). Thinking technology: Context is everything. *Educational Technology,* 35-37.

Kennedy, G. E. (2004). Promoting cognition in multimedia interactivity research. *Journal of Interactive Learning Research*, 43-61.

Kose, U., Koc, D., & Yucesoy, S. A. (2013). Design and development of a sample "Computer Programming" course tool via story-based e-learning approach. *Educational Sciences: Theory & Practice, 13*(2), 1235-1250.

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory Into Practice, 41*(4), 212-218.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York: Cambridge University Press.

Leech, N. L., Barrett, K. C., & Morgan, G. A. (2011). *IBM SPSS for intermediate statistics.* New York: Routledge.

Lewis, S. J., & Harrison, M. A. (2012). Online delivery as a course adjunct promotes active learning and student success. *Technology and Teaching, 39*(1), 72-76.

Lisko, S. A., & O-Dell, V. (2010). Integration of theory and practice: Experiential learning theory and nursing education. *Nursing Education Perspectives, 31*(2), 106-108.

Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. *IEEE Transactions on Education, 56*(4), 430-435.

Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning.* New York City: Cambridge University Press.

Mayer, R. E., & Moreno, R. (2002). Aids to computer-based multimedia learning. *Learning and Instruction, 12*, 107-119.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist, 38*(1), 43-52.

Merrill, D. M. (2013). *First principles of instruction: Identifying and designing effective, efficient, and engaging instruction.* San Francisco: Pfeiffer.

Moreno, R., & Mayer, R. (2007, June 22). Interactive multimodal learning environments. *Educational Psychology Review, 19*, 309-326.

Moulton, S., Strickland, J., Strickland, A., White, J., & Zimmerly, L. (2010). Online course development using the ADDIE model of instruction design: The need to establish validity in the analysis phase. *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2010* (pp. 2046-2054). Cheasapeake, VA: AACE.

Persson, A.-C., Fyrenius, A., & Bergdahl, B. (2010). Perspectives on using multimedia scenarios in a PBL medical curriculum. *Medical Teacher, 32*, 766-772.

Pierce, R., & Fox, J. (2012). Vodcasts and active-learning exercises in a "Flipped Classroom" model of a renal pharmacotherapy module. *American Journal of Pharmaceutical Education, 76*(10), 1-5.

Schank, R. C. (1990). *Tell me a story.* New York: Macmillan Publishing Company.

Schank, R. C. (1995). *Technical report no. 60.* Retrieved March 6, 2014, from Institute for Learning Sciences: http://cogprints.org/637/1/LearnbyDoing_Schank.html

Smith, C., Gillham, D., McCutcheon, H., & Ziaian, T. (2011). Scenariation: Scenario generation for online teaching in nursing and health sciences. *British Journal of Educational Technology, 42*(6), 962-972.

Tait, M., Tait, D., Thornton, F., & Edwards, M. (2008). Development and evaluation of a critical care e-learning scenario. *Nurse Education Today, 28*, 970-980.

Talley, C. P., & Scherer, S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a "Flipped" STEM course. *The Joumal of Negro Education, 82*(3), 339-347.

Trochim, W. M., & Donnelly, J. P. (2006). *The research methods knowledge base.* Mason, Ohio: Atomic Dog Publishing.

Tune, J. D., Sturek, M., & Basile, D. P. (2013). Flipped classroom model improves graduate student performance in cardiovascular, respiratory, and renal physiology. *Advances in Physiology Education, 37*, 316-320.

van Merrienboer, J. J., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*(2), 147-177.

APPENDIX A

Analysis Phase

APPENDIX A – 1

Learner Characteristics

Analysis Phase

Learner Characteristics

In general, students enrolled in previous courses are on average 22 years of age, are primarily White females, and are second trimester nursing majors in the nursing program with several trimesters of college experience.

1. General characteristics of the target population (Source: University student records of students enrolled in medical surgical nursing course)			
	2013 3rd Trimester	2014 1st Trimester	2014 2nd Trimester
1.1 Age – Range	20-47	19 to 30	19-36
– Mean	23.3	22.1	23.2
– Median	23	22	21
1.2 Academic characteristics			
GPA– Range	3.35 to 3.95	2.77 to 4.00	2.93 to 3.98
– Mean	3.66	3.66	3.74
– Median	3.68	3.78	3.78
ACT– Range	18-31	17 to 33	18 to 31
– Mean	22.5	23.9	23.5
– Median	22	24.0	23
1.3 Group characteristics			
Gender – Female	75.6	75.6%	70.7%
– Male	24.4	24.4%	29.3%
Ethnic – White	92.7%	90.2%	95.1%
– Hispanic	2.4%	4.9%	2.4%
– Other	4.9%	4.9%	2.5%
State – ID	46.2%	43.9%	39.0%
– CA	15.4%	12.2%	19.5%
– UT	12.8%	12.2%	4.9%
– WA	10.3%	7.3%	7.3%
– OR	2.6%	4.9%	9.8%
– Other	12.7%	19.5%	19.5%
1.4 Grade Level	First year nursing students with previous college experience		
1.5 Content topic area	Medical surgical nursing		
2. Entry characteristics of the			

target population	
2.1 Attitude toward learning	Students are second trimester freshmen who were admitted into a very competitive nursing program. Failure to pass competency level requirements will result in termination from the program. Positively, this pressure will motivate them to succeed. Negatively, this pressure tends to cause them to care more about their grade than what they are learning.
2.2 Learning or modality preferences	Students prefer class lectures ("Tell me what I need to know to pass the test") over online preparation activities. Students have requested podcasts of preparation activities so they can listen while they travel.
2.3 Is it reasonable to expect that the material can be cognitively mastered by these learners?	Yes. The material will be covered over a six week period, which is a reasonable time frame to master the material.
2.4 What is the motivation for the learners to complete the e-learning tutorials.	A quiz will be given prior to class that will affect their grade.
3. What prior knowledge is needed for learner success?	
3.1 List prerequisite skills	Students will need basic computer skills to navigate e-learning tutorials.
3.2 List prerequisite course work	Introductory Nursing, Introduction to Nursing, Human Anatomy and Physiology I, Human Anatomy and Physiology II.
3.3 Are there any prerequisite motor skills?	Typing and manipulation of computer devices.
4. What is the learners' performance level?	
4.1 Current level	The students in the nursing program are academically experienced and capable. They have had some previous exposure to the concepts in the e-learning tutorials.
4.2 Target level	The students will gain in-depth understanding of concept they were previously exposed to.
5.0 How did you obtain the learner characteristics?	Statistical information on the students was obtained from student records of the students in the course. General information was obtained from instructors who have taught the course.

APPENDIX A – 2

Learning Influences

Analysis Phase

Learning Influences

Qualities that influence the learning of students in this study are documented below.

1. Getting the learners attention	
1.1 How will you capture the learner's interest on the first encounter?	A patient with a realistic medical dilemma related to the topic of study will be introduced at the start.
1.2 What techniques are you thinking about using to produce inquiry?	Learners will be presented with unfamiliar situations and will need to refer to sources of information in order to make decisions that affect the patient.
1.3 What techniques are you thinking about using to maintain the learner's attention?	The patient's condition will continue to unfold as the learners make decisions, requiring further inquiry and decisions. Multimedia and interactivity will be used.
2. How will you make the learning relevant?	
2.1 What is your plan for meeting learner needs?	Realistic scenarios will help learners prepare for class discussions, group work, clinical labs, and exams.
2.2 How will you provide learners with appropriate choices?	Scenarios will require students to make choices and feedback will be provided. Necessary background information will be available.
2.3 How will you explain to the learners their responsibilities?	Feedback will explain the reasoning behind correct and incorrect decisions.
3. Learner Confidence	
3.1 How will you positively influence the learners' confidence?	Confidence grows as students learn more and make correct decisions. Feedback will help students understand the reasoning behind decisions.
3.2 Which function of the learning unit will support this effort toward learner confidence?	As learners successfully navigate through scenarios, they will gain confidence that what they are learning can be applied through making good decisions. Learners will feel more prepared for group discussion, clinical labs, and assessments.
4. Learner Satisfaction	

4.1 What activity will you provide for the learners to apply the new knowledge or skill?	Scenarios will naturally provide learners with opportunities to make decisions based upon the content information they are learning.
4.2 What method will you use for the learners to express their satisfaction with the instruction?	Learners may complete the course evaluation to express concerns on any subject, including their satisfaction with the instruction.
5. In what way will this instruction provide for learners with differential abilities?	Learners will be able to work at their own pace and repeat instruction as needed. Learners can listen to and/or read the narration. Illustrations, pictures, and videos in the instruction cater to a variety of learning styles.
6. How does this instruction respond to any particular learning trait?	The instruction will be most helpful for those who learn by doing and those who learn better when they can see how theory applies in realistic settings.

APPENDIX A – 3

Classification of Instructional Objectives

Analysis Phase

Classification of Instructional Objectives – Endocrine System

1. Apply knowledge of the normal anatomy of, physiology of, and assessments of endocrine glands when providing nursing care for patients with endocrine disorders.
2. Compare and contrast the manifestations of disorders that result from hyper-function and hypo-function of the endocrine glands.
3. Describe the nursing implications for medications prescribed to treat disorders of the endocrine glands.
4. Understand how to provide appropriate nursing care for the patient before and after surgeries for abnormalities of the pituitary, thyroid, and adrenal glands.
5. Use knowledge of the nursing process as the basis for providing care to patients with disorders of the endocrine system.

Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	***Understand***	***Apply***	***Analyze***	***Evaluate***	***Create***
Factual		Objectives 3 & 4	Objective 5			
Conceptual		Objective 2	Objective 1			
Procedural						
Metacognitive						

Analysis Phase

Classification of Instructional Objectives – Upper Gastrointestinal System

1. Describe the pathophysiology of common disorders of the mouth, esophagus, and stomach.
2. Relate manifestations and diagnostic tests to the pathophysiologic processes involved in the upper gastrointestinal problems.
3. Explain interdisciplinary care for patients with upper gastrointestinal disorders.
4. Describe the role of the nurse in interdisciplinary care of patients with upper gastrointestinal problems.

Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	***Understand***	***Apply***	***Analyze***	***Evaluate***	***Create***
Factual	Objectives 1 & 3	Objective 4				
Conceptual		Objective 2				
Procedural						
Metacognitive						

Analysis Phase

Classification of Instructional Objectives – Lower Gastrointestinal System

1. Explain the pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of patients with bowel motility disorders, acute or chronic inflammatory bowel disorders, non-inflammatory bowel disorders, neoplastic disorders, and structural and obstructive bowel disorders.
2. Discuss the purposes, nursing implications, and health education for the patient and family related to the medications used to treat bowel disorders.
3. Explain the rationale for using selected diets that are low-residue, gluten-free, and high-fiber, including diets for diarrhea and constipation.
4. Describe selected surgical procedures of the bowel, including colostomy, colectomy, and ileostomy.

Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	***Understand***	***Apply***	***Analyze***	***Evaluate***	***Create***
Factual		Objective 2				
Conceptual		Objectives 1, 3 & 4				
Procedural						
Metacognitive						

Analysis Phase

Classification of Instructional Objectives – Musculoskeletal System

1. Describe the functions of the musculoskeletal system.
2. Identify manifestations of impairment of the musculoskeletal system.
3. Explain the etiology, pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of musculoskeletal disorders.
4. Discuss the purposes, the nursing implications, and health education for the patient and family related to the prevention and treatment of specific musculoskeletal disorders.

Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	***Understand***	***Apply***	***Analyze***	***Evaluate***	***Create***
Factual	Objective 1	Objective 2				
Conceptual		Objectives 3 & 4				
Procedural						
Metacognitive						

APPENDIX A – 4

Validation of Instruction

Analysis Phase

Validation of Instruction for Endocrine System – Direct Instruction e-Tutorials

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the endocrine system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

The tutorial meets this learning objective: Apply knowledge of normal anatomy, physiology and assessments of the endocrine glands when providing nursing care for patients with endocrine disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

The tutorial meets this learning objective: Compare and contrast the manifestations of disorders that result from hyper-function and hypo-function of the endocrine glands.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe the nursing implications for medications prescribed to treat disorders of the endocrine glands.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1			X		
Subject Matter Expert #2				X	
Subject Matter Expert #3				X	

The tutorial meets this learning objective: Know how to provide appropriate nursing care for the patient before and after surgeries for abnormalities of the pituitary, thyroid, and adrenals.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1			X		
Subject Matter Expert #2				X	
Subject Matter Expert #3				X	

The tutorial meets this learning objective: Use knowledge of the nursing process as the basis for providing care to patients with disorders of the endocrine system.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2				X	
Subject Matter Expert #3				X	

The narration in the tutorial has a conversation tone from what sounds like a fellow student.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2			X		
Subject Matter Expert #3					X

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Videos in the tutorial adequately do one or more of the following: demonstrate something; help the learner apply what he/she is learning; show the reality of something; or is interesting and relevant.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The learner has adequate control over pacing of the tutorial. (Pacing refers to the ability to control the pace of moving from slide to slide, stopping and starting narration or video, replay slides and video, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The learner has adequate control over navigation within the tutorial. (Navigation refers to the ability to move from slide to slide and move around from place to place.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial allows the learner to be more actively involved in his/her learning. (Interactivity refers to clicking the mouse, hovering the mouse over an object, mouse drag-and-drop, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

Comments

Subject matter expert #1	Response
If medications are part of this tutorial, I would like to see a specific section for standard medications associated with each hormone teaching module.	More emphasis on medication may be done in a future revision.
Also, insulin is one of the most powerful hormones and other than a brief slide on the pancreas, this should be highlighted.	Insulin is covered in a different topic (Diabetes).
Love the graphics and the periodic tests. This is an excellent tutorial.	

Subject matter expert #3	Response
On the Effects of Aging PowerPoint, the title and the picture are overlapping. Move the picture down so the title can be read. On that same slide, bold the words or edit so that the words can be read more clearly with the picture in the background.	All of these issues were corrected.
In the slide on Cushings Syndrome, the Priority Nursing Diagnosis slide has much delay.	Delay was corrected.
In the slide on Addison's, all Diagnoses appear at once; it is not timed adequately with the reader.	Timing was adjusted.
Phyeocytochroma...NIH website goes to the Equella page ...not to NIH...just did not know if the students had to use Equella, direction unclear?	Confirmed that the link is going to the NIH website.
Love the videos and the ability for the student's to insert the concepts in their own words, then compare to the instructor....great for critical thinking.	

Analysis Phase

Validation of Instruction for Upper Gastrointestinal System – Direct Instruction e-Tutorials

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the upper gastrointestinal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe the pathophysiology of common disorders of the mouth, esophagus, and stomach.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Relate manifestations and diagnostic tests to the pathophysiologic processes involved in the upper gastrointestinal problems.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain interdisciplinary care for patients with upper gastrointestinal disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2				X	
Subject Matter Expert #3				X	

The tutorial meets this learning objective: Describe the role of the nurse in interdisciplinary care of patients with upper gastrointestinal problems.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Videos in the tutorial adequately do one or more of the following: demonstrate something; help the learner apply what he/she is learning; show the reality of something; or is interesting and relevant.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Comments

Subject matter expert #1	Response
The endoscopy sections (there are two pictures of this) show a person holding the scope up to their eye. The modern practice is looking at what you are doing on a big screen TV.	Picture of endoscopy with doctor looking at monitor is now used.
Consider NOT reading word for word the learning objectives as they appear, or shorten those objectives to a few words and then read word for word.	Learning objectives slide was removed.
You have the title "upper GI series" but immediately move to anatomy and physiology of the entire system. Either change the name to "GI" or compartmentalize the lectures and reviews to indicate upper, middle and lower GI systems.	Changed slide title to "Overview of the GI Tract."
The gastrointestinal system overview is very basic and I felt like it took too long to get through the activity. Maybe a matching game or just a few A&P sites, but not all. One of the drag and drop menus included both duodenum and the small intestines. The duodenum is part of the small intestines so it's a little confusing. Cool activity though.	Concentrated on a review of the upper GI and removed many of the slides, so it will take the student less time to complete.
In the Gastric analysis section, the text is over a dark background and it is difficult to read. This was also true for a screen in the stomatitis interventions section.	Text now appears with a white background.
A multiple choice answer reads: a. Mild exercise b. All of the above c. Plenty of rest d. Drinks plenty of fluids. I would make the all of the above as the last option.	"All of the above" is now the last option.
The Healthy fiber intake activity has no volume or voice.	Narration added.
The voice comes in late on stomach problems.	Delay was removed.
I love the McGraw Hill link with the test results e-mailed to the instructor.	
This contains basic information. If the audience is for RN students, then I would want you to include medication use, lab values etc.	Future improvement.
I really enjoy this type of presentation. It keeps me engaged and wanting to learn more.	

Subject matter expert #2	Response
Have the narrator speak slower.	Future improvement.
Allow students to go back and retake quiz questions if they miss them.	Changed to allow students to retake.
The diagnostic test quiz question: What helps decrease the risk of constipation and bowel obstruction after an upper GI series? The answer -- All of the above needs to be moved to a "D" selection instead of a "C" selection.	Changed so "All of the above" will be the last answer.

Subject matter expert #3	Response
Should talk more about Barrett's esophagus.	Future improvement.
In the Digestive Process, one questioned keyed incorrectly, another name for the GI tract.	?
In the same test, the option of All of the above was the first option...awkward	“All of the above” is now the last option.
On inserting an NG, oral route can be used as well as the nasogastric	This has been added to the transcript.
On the Stomatitis .ppt, bold words...hard to read over the picture	Corrected.
Gastro slide: speaker pronounced exacerbation incorrectly....left out some letters	Future improvement.
The pic of the woman bending over...cannot see the words at all	Corrected.
When describing melena and hematemesis, unclear of the connection of the word and the definition...speaker just talks about the lay term (blood in the vomitus) with out saying the word on the slide to make the connection (hematemesis)...	Noted in the transcript.
When speaker talks on the Gastric Cancer slide, she pronounces pnuemonia like "ammonia".	Future improvement.
On the 6 step Dissasembly line... need to give the students the capability to go back and forth of the 6 steps rather than having to listen to it all before they can do that.	Students are able to click on the 6 steps at will.
Speaker leaves out a syllable in the word peristalysis...	Future improvement.
#6 slide...defecation is misspelled..not dification Liked the option of review.	Corrected.

Analysis Phase

Validation of Instruction for Lower Gastrointestinal System – Direct Instruction e-Tutorials

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the lower gastrointestinal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain the pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of patients with bowel motility disorders, acute or chronic inflammatory bowel disorders, non-inflammatory bowel disorders, neoplastic disorders, and structural and obstructive bowel disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Discuss the purposes, nursing implications, and health education for the patient and family related to the medications used to treat bowel disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1			X		
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain the rationale for using selected diets that are low-residue, gluten-free, and high-fiber, including diets for diarrhea and constipation.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe selected surgical procedures of the bowel, including colostomy, colectomy, and ileostomy.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3			X		

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Videos in the tutorial adequately do one or more of the following: demonstrate something; help the learner apply what he/she is learning; show the reality of something; or is interesting and relevant.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial allows the learner to be more actively involved in his/her learning. (Interactivity refers to clicking the mouse, hovering the mouse over an object, mouse drag-and-drop, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2				X	

Subject Matter Expert #3					X

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Comments

Subject matter expert #1	Response
A stronger link or assessment of medications used for GI illness	Future enhancement
I would like to see a score at the end of the exam to see how well I did	Future enhancement
Love the graphics	
The first video that took you through the digestive system was too long. Again, great graphics, but I became more and more less interested because of the speed.	Future enhancement

Subject matter expert #2	Response
I had a few videos that wouldn't play, but I have not heard any students say they couldn't view them	Browser security issue

Subject matter expert #3	Response
Perhaps that anyone having ulcerative colitis for 10 years or more is encouraged to have a complete colectomy	Instructor advised against this change
Might add not to use the "donut" device for hemorrhoids	Not added
Can input information that the HOB for the patient is elevated so there is no aspiration with the NG in place as well	Not added
Slide about occult blood: can draw attention to many other diseases, not just cancer	Not added
Explain what a polyp is earlier in the tutorial, before the colonoscopy	Definition of polyp was added
Speaker is tentative at the end of the colonoscopy slide, pronouncing flatus was delayed, nice for a redo of that slide	Future enhancement
Diagnostic test video, Crohn's video, appendicitis video, not working. Several others as well	Browser security issue
Document: diverticulitis is from an immune response? Did not know this?	No mention of immune response in presentation
Pronunciation of steatorrhea, slough ... perhaps redo?	Future enhancement

Some of the back buttons do not work..(Malabsorption disorder, colorectal cancer, hernias s/s,IBS video,).	Back button issues were fixed
Hemorrhoids slide volume too low	Corrected
Can also feel external hemorrhoids under the signs and symptoms	Added to script
On the polyp slide, the picture is covering some of the words	By design
Please look at the recommendations of the sig/colon.... seems more colonoscopies are done the entire colon can be viewed...not as many sigmoids done these days...	Future enhancement
On the IBS slide, the words read 3X and the speaker said 2X....	Problem not clear
In the Intestinal Obstruction slide, the speaker begins the dialogue before there is a picture	Problem not reproduced
Need more bullet points or organization on the Intest Obstr small/large...differences not clear	Future enhancement
In the Intes Obstr- Interventions/teaching...speaker stopped during the dialogue, mispronounced endoscopy, later C-diff mispronounced...	Speaker pause removed; change to pronunciation in future enhancement
In the picture of the Salem Sump...need to capitalize the sump in the picture	Corrected
Before the question of abdominal peritoneal resection, might want to define first somewhere.	Added definition
I disagree with the answer of the question about alternating diarrhea/constipation .is a sign that the person has colon cancer.....the bowel pattern of iBS is alternating diarrhea/constipation...perhaps the answer could be "a change in bowel habits" but not the IBS pattern..	Changed the question
Slide which has peritoneal lavage is not explained...or at least indicate why it is there on the slide	Picture not found in presentation
Leukopenia misspelled...perhaps it is correct with a c but I have not seen it (Ulcerative Colitis slide)	Leukopenia not found in presentation
Question on UC with ileostomy...need to restate saying that a patient who had UC had to have an ileostomy	Modified the question
Question on TPN...need to define what that is first?	Term defined
Reader does a great job for the most part. I would question some of the pronunciation of some of the words. Very well put together.	
I would suggest breaking this tutorial into two sections... took about three hours to complete. Perhaps if shorter, students could "digest" easier. Overall, very nicely done.	Consider for future enhancement

Analysis Phase

Validation of Instruction for Musculoskeletal System – Direct Instruction e-Tutorials

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the musculoskeletal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

The tutorial meets this learning objective: Describe the functions of the musculoskeletal system.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Identify manifestations of impairment of the musculoskeletal system.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain the etiology, pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of musculoskeletal disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Discuss the purposes, the nursing implications, and health education for the patient and family related to the prevention and treatment of specific musculoskeletal disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Videos in the tutorial adequately do one or more of the following: demonstrate something; help the learner apply what he/she is learning; show the reality of something; or is interesting and relevant.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial allows the learner to be more actively involved in his/her learning. (Interactivity refers to clicking the mouse, hovering the mouse over an object, mouse drag-and-drop, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Comments

Subject matter expert #1	Response
(Is there anything missing from the instruction that you think should be there?) Medication and other alternative treatments to disease	Future enhancement

Subject matter expert #2	Response
I think this module is the best out of all the ones I have seen. I really liked this module very much.	

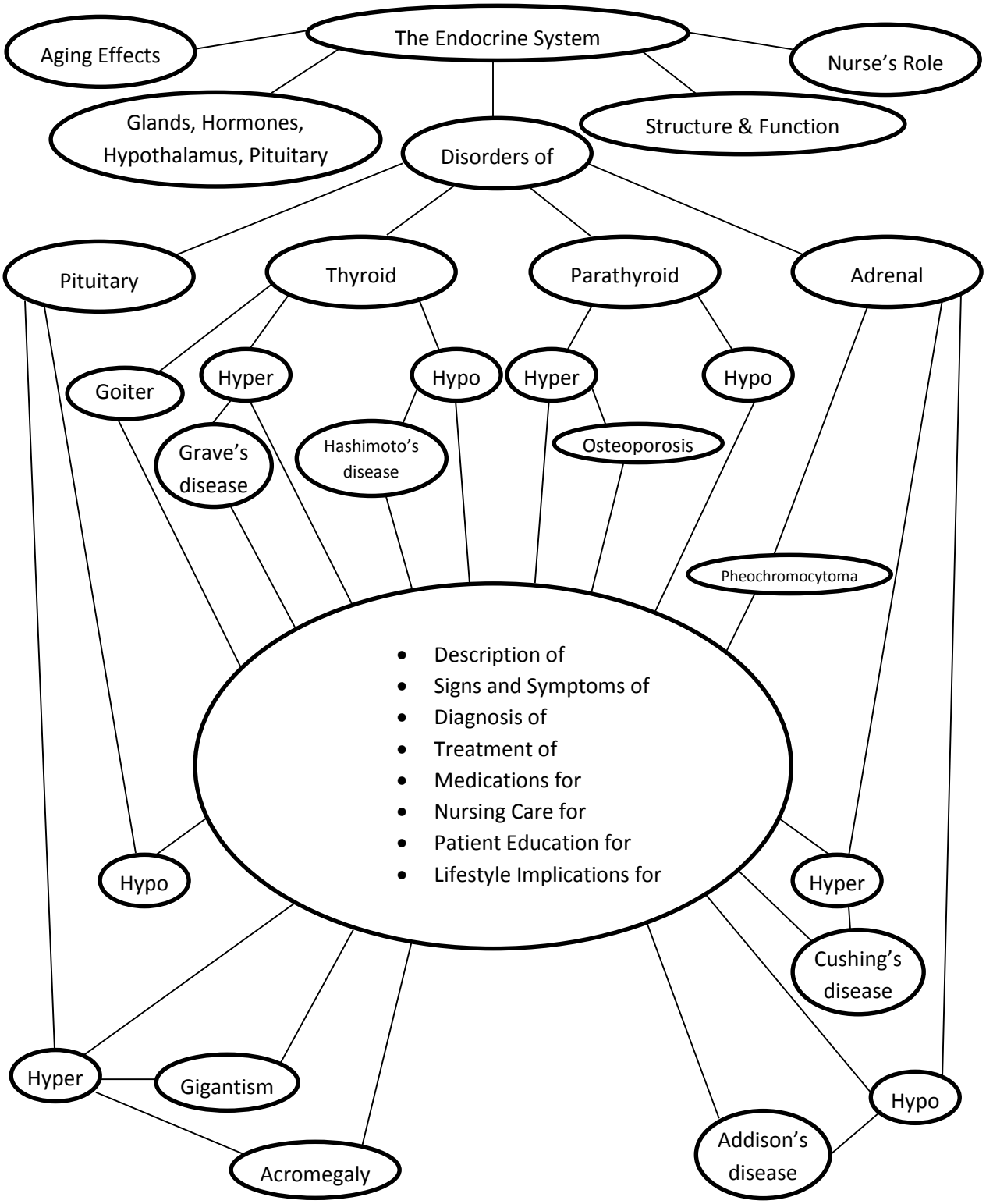
Subject matter expert #3	Response
(Is there anything missing from the instruction that you think should be there?) Bone spurs and nutrition.	Future enhancement

APPENDIX A – 5

Concept Maps of Instructional Intent

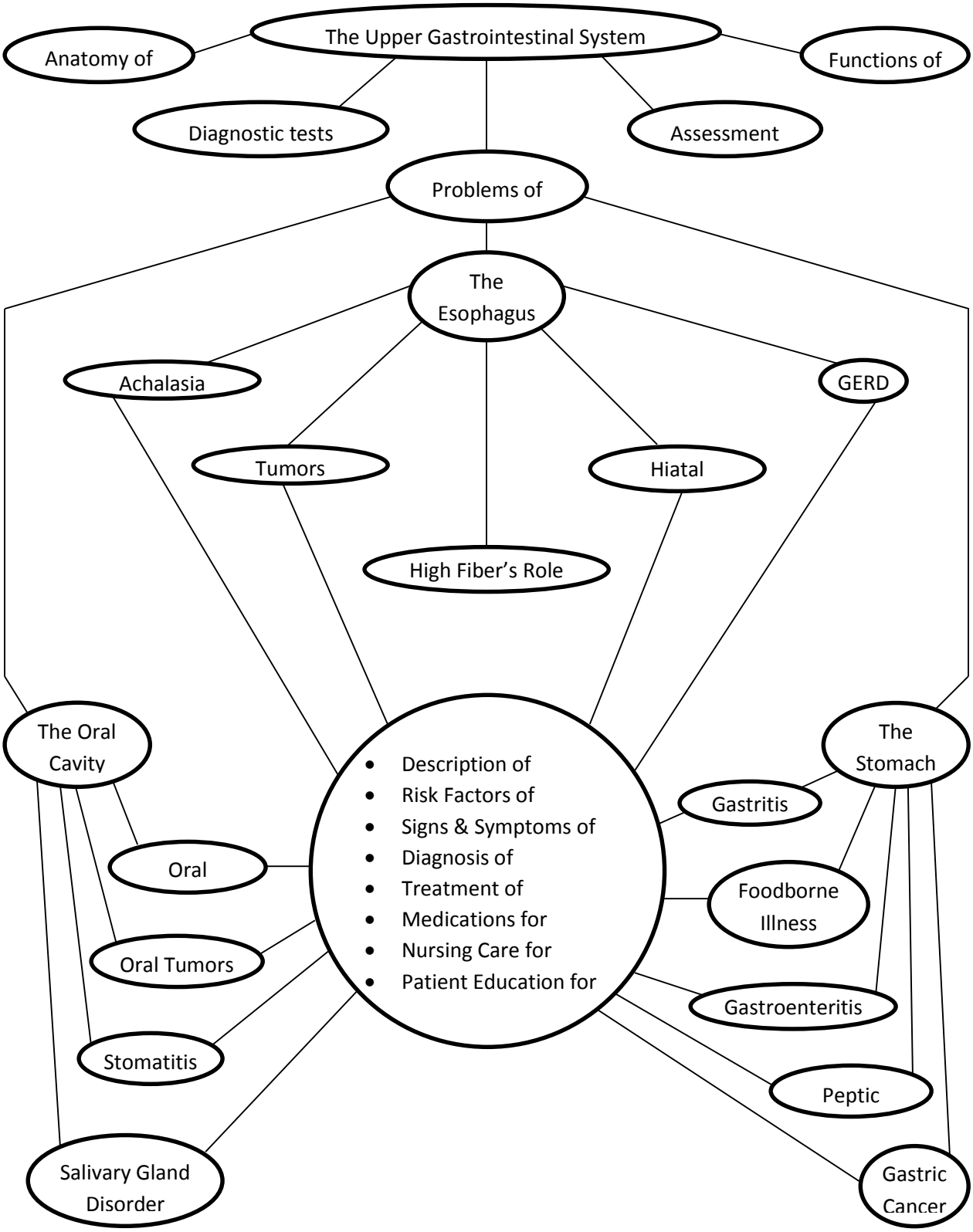
Analysis Phase

Instructional Intent for the Endocrine System



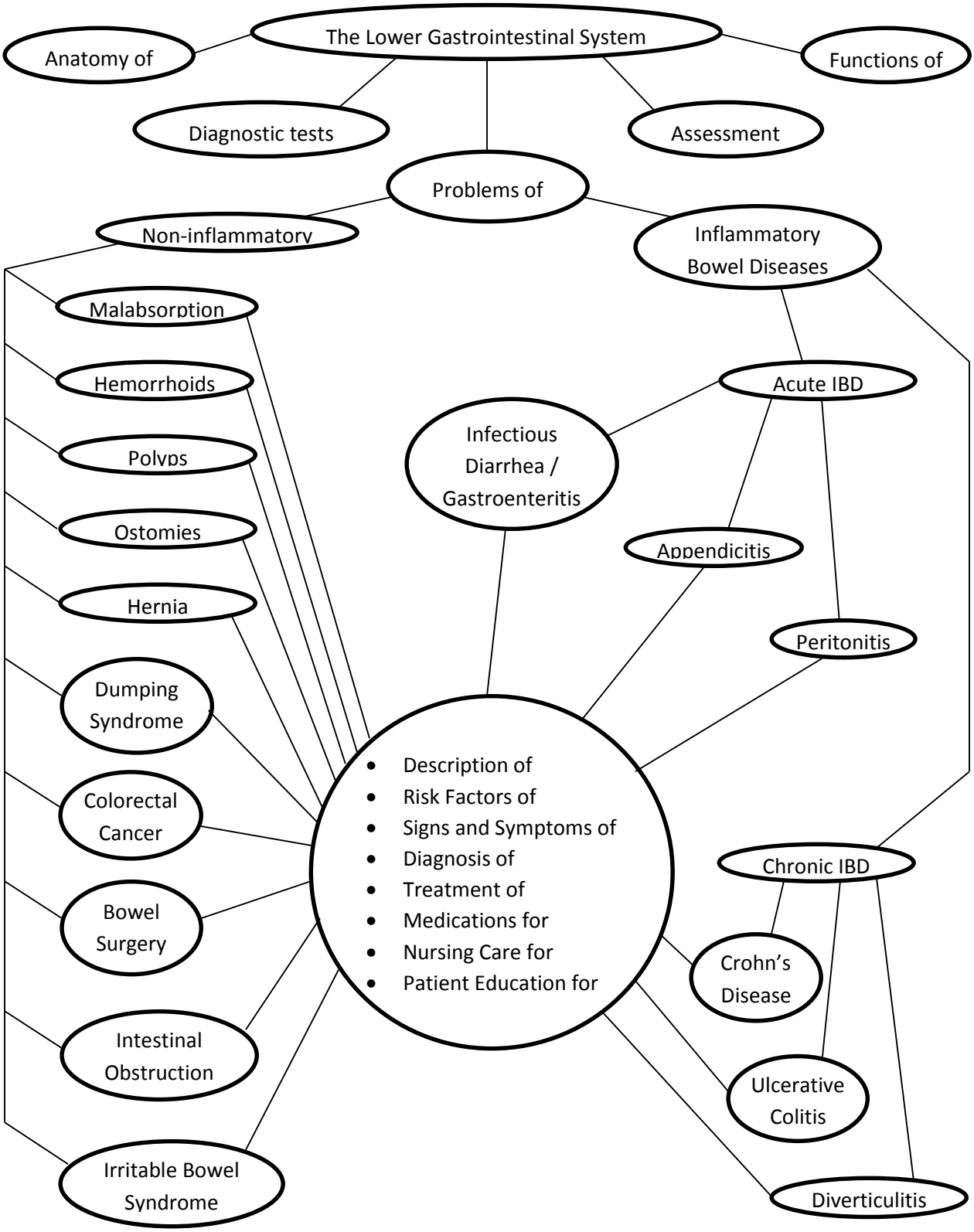
Analysis Phase

Instructional Intent for the Upper Gastrointestinal System



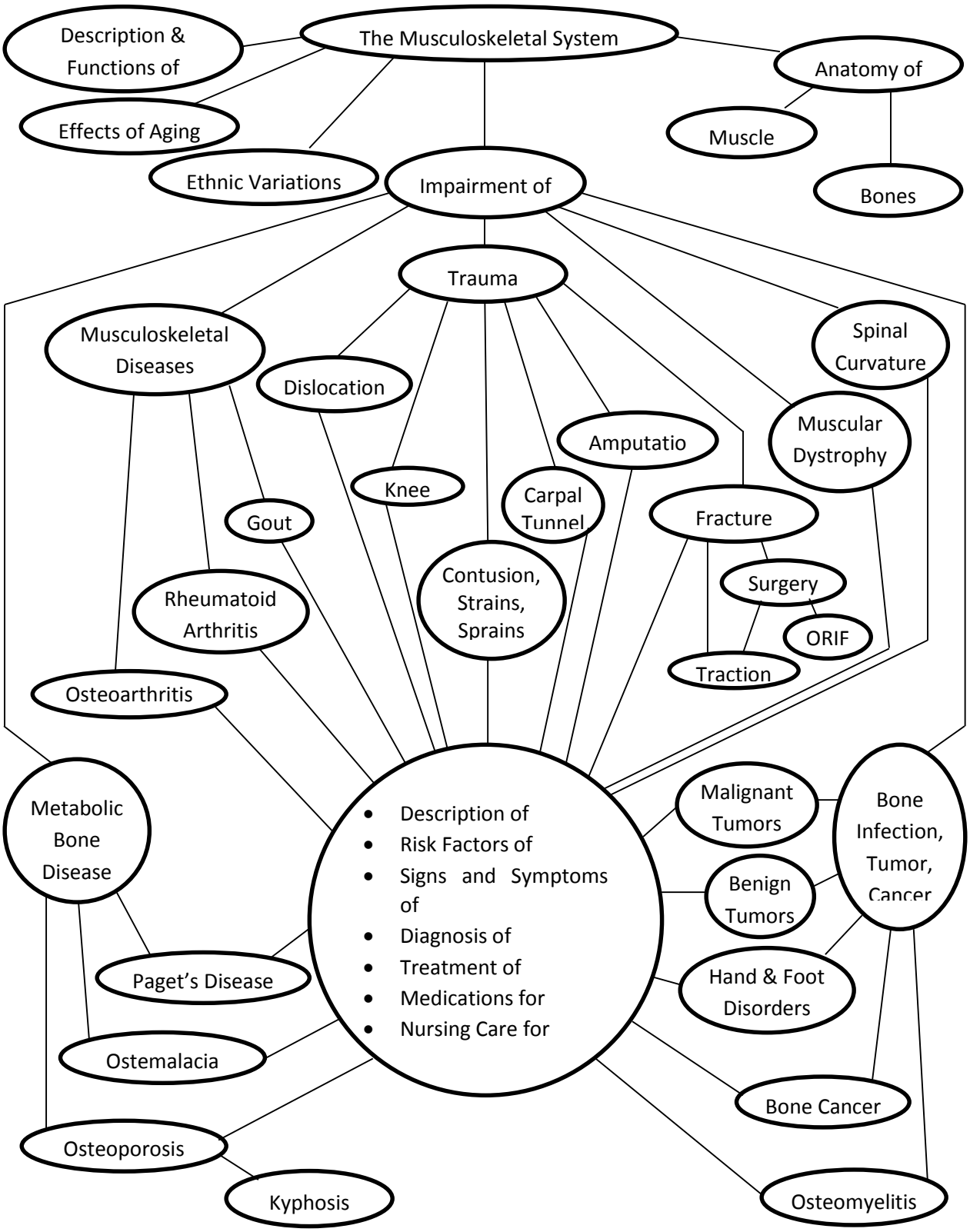
Analysis Phase

Instructional Intent for the Lower Gastrointestinal System



Analysis Phase

Instructional Intent for the Musculoskeletal System



APPENDIX A – 6

Validation of Instructional Intent

Analysis Phase

Validation of Instructional Intent for the Endocrine System

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The concepts portrayed in the concept map constitute an adequate review of the endocrine system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective; Apply knowledge of normal anatomy, physiology and assessments of the endocrine glands when providing nursing care for patients with endocrine disorders.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Compare and contrast the manifestations of disorders that result from hyperfunction and hypofunction of the endocrine glands.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Describe the nursing implications for medications prescribed to treat disorders of the endocrine glands.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor				X	

The instructional intent is likely to meet this learning objective: Know how to provide appropriate nursing care for the patient before and after surgeries for abnormalities of the pituitary, thyroid, and adrenals.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Use knowledge of the nursing process as the basis for providing care to patients with disorders of the endocrine system.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

Comments

Past Instructor Comments	Response
(Are there concepts that should be added to the concept map?) You may wish to add a concept entitled "Structure and Function" (or something similar) connected the "Endocrine System". Besides the gland, aging effect, hormones, and nurse's role, there is a certain amount of teaching done on how they are regulated from the hypothalamus to the pituitary to the specific glands.	The concepts of "Structure and Function" were added. The effects of the hypothalamus and pituitaries on glands and hormones were added.
(Are there concepts that should be removed from the concept map?) No, this is very well done. It's complex, as is the endocrine system.	
(Other comments?) I wonder if adding "Lifestyle implications" might be an additional instructional intent that could be placed in the largest oval. Although it is a part of the patient education, it is, in a sense, a category of its own.	"Lifestyle implications" was added.

Present Instructor Comments	Response
(Are there concepts that should be added to the concept map?) No this concept map is put together well.	
(Are there concepts that should be removed from the concept map?) Not at this time.	
(Other comments?) No this map is a good overall projection of what will be covered.	

Analysis Phase

Validation of Instructional Intent for the Upper Gastrointestinal System

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The concepts portrayed in the concept map constitute an adequate review of the upper gastrointestinal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Describe the pathophysiology of common disorders of the mouth, esophagus, and stomach.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Relate manifestations and diagnostic tests to the pathophysiologic processes involved in the upper gastrointestinal problems.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Explain interdisciplinary care for patients with upper gastrointestinal disorders.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Describe the role of the nurse in interdisciplinary care of patients with upper gastrointestinal problems.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

Comments

Past Instructor Comments	Response
(Are there concepts that should be added to the concept map?) We may wish to consider lifestyle implications (i.e., smoking and the relationship to oral cancer; lack of hand washing related to gastroenteritis or other stomach "flu"; eating indiscretions related to many GI problems).	These effects are included in the "Risk Factors."
(Are there concepts that should be removed?) No.	
(Other comments) Looks good.	

Present Instructor Comments	Response
(Are there concepts that should be added to the concept map?) No.	
(Are there concepts that should be removed from the concept map?) No.	
(Other comments) Again, I thought this concept map was well put together	

Analysis Phase

Validation of Instructional Intent for the Lower Gastrointestinal System

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The concepts portrayed in the concept map constitute an adequate review of the lower gastrointestinal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Explain the pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of patients with bowel motility disorders, acute or chronic inflammatory bowel disorders, non-inflammatory bowel disorders, neoplastic disorders, and structural and obstructive bowel disorders.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Discuss the purposes, nursing implications, and health education for the patient and family related to the medications used to treat bowel disorders.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Explain the rationale for using selected diets that are low-residue, gluten-free, and high-fiber, including diets for diarrhea and constipation.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Describe selected surgical procedures of the bowel, including colostomy, colectomy, and ileostomy.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

Comments

Past Instructor Comments	Response
(Are there concepts that should be added to the concept map?) No, these are well-covered.	
(Are there concepts that should be removed?) These are well-covered, and well-organized.	
(Other comments) The upper and lower GI have the same descriptions, except Upper GI has "Parts of" and Lower GI has "Anatomy of". Probably "anatomy" is a better word for both.	Changed from “Parts of” to “Anatomy of.”

Present Instructor Comments	Response
(Are there concepts that should be added to the concept map?) No.	
(Are there concepts that should be removed?) No.	
(Other comments) Looks good. No, this is a good outline of what will be covered.	

Analysis Phase

Validation of Instructional Intent for the Musculoskeletal System

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The concepts portrayed in the concept map constitute an adequate review of the musculoskeletal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Describe the functions of the musculoskeletal system.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Identify manifestations of impairment of the musculoskeletal system.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Explain the etiology, pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of musculoskeletal disorders.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

The instructional intent is likely to meet this learning objective: Discuss the purposes, the nursing implications, and health education for the patient and family related to the prevention and treatment of specific musculoskeletal disorders.	**SD**	**D**	**N**	**A**	**SA**
Past Instructor					X
Current Instructor					X

Comments

Past Instructor Comments	Response
(Are there concepts that should be added to the concept map?) *No answer*	
(Are there concepts that should be removed?) You could consider removing Bones and Muscle, particularly if you changed "Description of" to read "Anatomy of". Then, Bones, and Muscles would fit in as part of the anatomy of the musculoskeletal system.	"Anatomy of" was added with reference to bones and muscle.
(Other comments) Scoliosis, Kyphosis, and Lordosis are spinal curvature disorders. They can be related to osteoporosis because they osteoporosis weakens the spine, leading to curvature. It may be better to create a category for spinal curvatures.	Spinal curvature concept was added.

Present Instructor Comments	Response
(Are there concepts that should be added to the concept map?) No.	
(Are there concepts that should be removed?) No.	
(Other comments) Well put together, this map outlines the major issues we cover in class.	

APPENDIX B

Design Phase

APPENDIX B – 1

Task Analysis

Design Phase

Task Analysis

Task	Knowledge Type			Prerequisite	Time (minutes)	Difficulty	Domain		
	Declarative	Procedural	Structural				Cognitive	Motor	Affective
1. Review the anatomy and physiology of the system*	X			Y	7	L	X		
2. Demonstrate an understanding of the system through an activity or assessment	X			Y	3	L	X		
3. Learn about each disorder** related to system	X			Y	5	M	X		
4. Demonstrate understanding of each disorder through an activity or assessment	X			Y	3	M	X		
5. Learn about the manifestation (signs and symptoms) of each disorder	X			Y	2	M	X		
6. Learn about the prevention, treatment, surgery and/or medication for each disorder	X			Y	4	M	X		
7. Learn how to care for the patient before, after, or during diagnostic tests, treatment, surgery, or medication related to each disorder			X	N	5	M	X		
8. Demonstrate how to care for the patient through an activity or assessment			X	N	3	M	X		
9. Learn to recognize complications that arise and know how to respond, including when to contact the health care provider			X	N	4	H	X		
10. Demonstrate recognition of and correct response to complications through an activity or assessment			X	N	3	H	X		
11. Learn how to teach patients about their disorders, answer their questions, and provide instructions on how to take care of themselves	X			N	4	M	X		
12. Demonstrate teaching patients through an activity or assessment	X			N	2	L	X		

* The system refers to the endocrine, upper gastrointestinal, lower gastrointestinal, or musculoskeletal system

** Each system has the following disorders: (1) endocrine: hyperpituitarism, hypopituitarism, hyperthyroidism, hypothyroidism, hyperparathyroidism, hypoparathyroidism, hyper and hypo adrenal function; (2) upper gastrointestinal: oral cancer, oral tumor, stomatitis, salivary gland disorder, gastritis, foodborne illness, gastroenteritis, peptic ulcer, gastric cancer, GERD, hiatal hernia, esophageal tumor, achalasia; (3) lower gastrointestinal: malabsorption, hemorrhoids, polyps, ostomies, hernia, dumping syndrome, colorectal cancer, bowel surgery, intestinal obstruction, irritable bowel syndrome, infectious diarrhea, appendicitis, peritonitis, Crohn's disease, ulcerative colitis, diverticulitis; and, (4) musculoskeletal: gout, rheumatoid arthritis, osteoarthritis, Paget's disease, ostemalacia, osteoporosis, dislocation, amputation contusion, strain, sprain, fracture, malignant bone tumor, benign bone tumor, bone cancer, osteomyelitis, carpal tunnel, joint surgery

APPENDIX B – 2

Design of Nursing Scenarios

Design Phase

Design of Nursing Scenarios

1. Introduce the Patient
    a. In story form, setup a realistic situation
    b. Provide general information, such as age and gender
    c. Describe signs and symptoms (pain, difficulty performing daily tasks, etc.)
    d. Have the student identify pertinent clues and risk factors and explain the rationale
2. Provide Medical History
    a. Risk factors for diseases (smoking, alcohol usage, age, ethnicity, etc.)
    b. Current diseases or conditions
    c. Current medications
    d. Previous conditions, hospitalizations, surgeries
    e. Family history of diseases
    f. Have the student identify additional pertinent clues and risk factors and explain the rationale
3. Provide Specific Patient Information
    a. Provide vital statistics (temperature, blood pressure, respiration, pulse, oxygen)
    b. Have the student identify what vital signs are clinically significant and explain the rationale
    c. Provide nursing assessment

i. General appearance (resting comfortably; appears to be in no apparent distress)
ii. Respiratory (denies SOB. Breath sounds equal and with good aeration bilaterally)
iii. Cardiac (pulses 3+ throughout. No edema in extremities. Heart rate regular-S1S2)
iv. Neurologic (alert and oriented x4)
v. Abdomen/GI (abdomen soft, non-tender with active bowel sounds; no guarding or point tenderness present)
vi. Genitourinary (urine clear and yellow)
vii. Extremities/skin (skin is warm and dry-normal for color of skin)

d. Have the student identify any assessment data that is clinically relevant and explain the rationale

4. Provide the Diagnosis
    a. Provide the student with access to information about the disease
    b. The student may be led to the correct diagnosis through formative assessment
5. Provide the Treatment
    a. Provide the student with access to information about treatment options
    b. The student may be asked about preferred treatment options
    c. Provide medication prescription
        i. The student may calculate the correct dosage
        ii. The student may learn more about medication through formative assessment

iii. The student may explain to the patient what this drug does, how to take it, and any side effects

6. Nursing Care
    a. Provide the student with access to information about nursing care options
    b. Have the student identify nursing care for the patient (immediate and on-going)
7. Patient Education
    a. Provide the student with access to information about patient education
    b. Have the student explain what the patient needs to know in layman's terms
        i. Physical therapy, counseling, exercise, diet, assisted living, risks, etc.
    c. Have the student explain how they can determine that the patient understands
8. Optionally Continue the Story
    a. The patient may return later with a further complication related to the original condition (repeat the steps above)

APPENDIX B – 3

Identification of Needed Scenarios

Design Phase

Identification of Needed Scenarios -- Endocrine

System (Topic)	Major Disorder	Specific Disorder	Scenario
Endocrine	Pituitary (hyper)	Gigantism	A teenager boy who has an identical twin brother begins to experience changes (the effects of gigantism) making him drastically different from his brother.
		Acromegaly	
	Pituitary (hypo)	Dwarfism	
	Thyroid	Goiter	
	Thyroid (hyper)	Hyper	A woman develops hyperthyroidism caused by Grave's disease. After a thyroidectomy she is diagnosed with hypothyroidism and begins treatment.
		Grave's disease	
	Thyroid (hypo)	Hypo	
		Hashimoto's disease	
	Parathyroid (hyper)	Hyper	To be described
	Parathyroid (hypo)	Hypo	To be described
	Adrenal	Pheochromo-cytoma	
	Adrenal (hyper)	Hyper	
		Cushing's disease	To be described
	Adrenal (hypo)	Hypo	
		Addison's disease	To be described

Design Phase

Identification of Needed Scenarios – Upper Gastrointestinal

Upper Gastro-intestinal	Esophagus	Achalasia	
		Tumors	
		Hiatal hernia	
		GERD	Middle-aged man who smokes and drinks
	Oral Cavity	Oral cancer	Teenage male who chews tobacco
		Oral tumors	
		Stomatitis	
		Salivary gland	
	Stomach	Gastritis	
		Foodborne illness	
		Gastro-enteritis	
		Peptic ulcer	High-stressed man
		Gastric cancer	

Design Phase

Identification of Needed Scenarios – Lower Gastrointestinal

Lower Gastro-intestinal	Non-inflam-matory	Mal-absorbtion	
		Hemorrhoids	
		Polyps	
		Ostomies	Partially covered in the Elizabeth scenario below.
		Hernia	
		Dumping syndrome	
		Colorectal cancer	
		Bowel surgery	Partially covered in the Elizabeth scenario below.
		Intestinal obstruction	
		Irritable bowel syndrome	
	Inflam-matory acute IBD	Infectious diarrhea (gastro-enteritis)	
		Appendicitis	A girl, Elizabeth, has appendicitis and runs into complications leading to peritonitis.
		Peritonitis	
	Inflam-matory chronic IBD	Crohn's disease	A scenario that highlights the differences between Crohn's and ulcerative colitis.
		Ulcerative colitis	
		Diverticulitis	

Design Phase

Identification of Needed Scenarios -- Musculoskeletal

System (Topic)	Major Disorder	Specific Disorder	Scenario
Musculo-skeletal	Diseases	Osteoarthritis	Kelly, a man who has been very active all his life, begins to experience osteoarthritis.
		Rheumatoid arthritis	
		Gout	
	Trauma	Dislocation	A young man, Jared, is injured with a fractured arm and a sprained ankle. He later develops complications of compartment syndrome and infection.
		Contusion, sprains, strains	
		Fracture	
		Amputation	
		Carpal tunnel	
	Infection / tumor	Bone cancer	Meghan, a young woman, is diagnosed with bone cancer.
		Malignant tumors	
		Benign tumors	
		Osteomyelitis	
		Hand and foot disorders	
	Metabolic Bone Disease	Paget's disease	An elderly woman, Jane, begins to experience osteoporosis, brought to light by a compression fracture in her spine.
		Ostemalacia	
		Osteoporosis	
		Kyphosis	

APPENDIX B – 4

A Sample Nursing Scenario

Design Phase

Musculoskeletal Scenario about Osteoporosis

General Information about Jane

Jane is a 58 y.o. female who presents to the doctor's office with complaints of back pain after her 50# grandchild jumped on her back 2 days ago. Pain is presently sharp, rating 6/10 at rest and 8/10 with movement. Any movement creates searing, uncontrollable pain. Jane has been taking ibuprofen 600mg every 6 hours alternated with acetaminophen 1000mg every 6 hours providing moderate relief. However, she has not been pain free since the incident. Neither heat nor ice have improved the pain. Jane is post menopausal x 2 years with no replacement hormone therapy. She takes multivitamins daily and intermittently takes calcium supplements recommended by her gynecologist. She has no known drug allergies (NKDA). Jane drinks 2 cups of coffee in the morning followed by 3-4 diet sodas throughout the day. Until 2 years ago, Jane smoked cigarettes, 1 pack per day (ppd). She is married and has one child. Jane has been active all her life; running and swimming competitively through college and has continue to run as an adult. Past medical and surgical history are positive for tonsillectomy & adenoidectomy as a child and several fractures as an adult. Eighteen months ago, Jane fractured her left wrist and 2 ribs after a fall. The wrist fracture required surgery (ORIF). Jane reports it "took a long time for my bone to heal." Family history includes hypertension and hip fractures in both her mother and maternal grandmother.

Health Care Examination

Examination today reveals multiple bruises (reddish purple) over her right shoulder, flank and hip. Palpation of the injured area (L2-L3) elicits searing pain. Jane reports "the pain takes my breath away sometimes." Her lungs are clear bilaterally with equal and even respirations. She is alert, oriented x 4. Heart is regular with no murmur, bowel sounds are hyperactive and joints are free of swelling. All neuro checks are positive. There is a healed scar on her left wrist.

X-Ray Procedure

Jane's physician suspects a fracture, and orders an x-ray. Check all of the following that need to be done before Jane's x-ray.

- [x] Notify Jane that she must lie still during the procedure
- [x] Help position Jane on the x-ray table
- [x] Take oral pain medication prior to x-ray if not previously taken
- [ ] Instruct Jane not to eat or drink 4 hours before x-ray

After her x-ray, Jane complains that her lower back pain has increased from a 6/10 to a 8/10. The physician prescribes Norco 1-2 tabs q 6 hours prn for pain. He also prescribes a stool softener. What category drug is Norco? (Opioid/ narcotic). What is the generic name for Norco? (Hydrocodone + APAP). Why would the physician prescribe a stool softener as well? (Constipation is a normal side effect of Norco, a stool softener will help reduce this side effect.)

Diagnosis

Jane's X-ray shows a Lumbar Compression Fracture. Which of the following bone diseases put patients at a higher risk for fractures?

- [x] Osteomalacia
- [x] Paget's
- [x] Osteoporosis
- [ ] Osteoarthritis

Considering Jane's history and the results of her X-ray, what bone disease would her doctor most likely diagnose? Find out more about the diseases before deciding by clicking on the buttons to the right.

- [ ] Osteomalacia
- [ ] Paget's
- [x] Osteoporosis

Learn more about diagnostic tests for Osteoporosis, Paget's disease, and Osteomalacia by clicking on the button and then try to answer this question. Drag and drop the diagnostic tests to match it with the correct bone disease.

	Liver function, CBC, and urine calcium tests	Blood and urine test, bone biopsy	Blood test for serum alkaline phosphate levels
Osteoporosis	◉	○	○
Paget's Disease	○	○	◉
Osteomalacia	○	◉	○

The physician diagnoses Jane with lumbar compression fracture and osteoporosis. Explain Jane's condition in simple terms.

A compression fracture commonly occurs in patients with osteoporosis because of their low bone density. A compression fracture is a fracture in a vertebral bone that decreases its height. Osteoporosis occurs as a result of an imbalance in osteoblast and osteoclast activity. As we get older, our bone resorption exceeds bone formation. Bone density decreases rapidly during the postmenopausal period as estrogen levels decrease.

Patient Education

The physician leaves the room to complete Jane’s prescriptions. Jane asks you how she got osteoporosis. Find out more about patient education by clicking on the button and then answer the question. What are the factors from Jane’s medical and social history that most likely caused osteoporosis? What are the factors from her Medical and Social History that most likely caused osteoporosis?

The major factors are age, history of smoking, postmenopausal (lower estrogen levels) and caffeine intake from coffee and diet soda.

Jane explains that she has a friend with osteoporosis, and her spine is curved so that she leans forward when walking. What is this condition called? Could this happen to Jane?

Kyphosis. Since Jane has osteoporosis, she is very susceptible to forming kyphosis. Kyphosis usually occurs as a result of osteoporotic fractures, typically spinal compression fractures.

Treatment

Which of the following would the physician most likely prescribe FIRST? *

- Traction
- Vertebroplasty
- Prescribe Actonel
- Prescribe Vitamin D
- Send her to a nutritionist to learn about proper nutrition and exercise

The physician refers Jane to a neurosurgeon for a vertebroplasty. The next available appointment with the surgeon is in three days. Would it be beneficial for her physician to prescribe bed rest until her appointment with the surgeon? What are the advantages and disadvantages of bed rest?

Bed rest may help with acute pain, but it can also lead to further bone loss and worsening osteoporosis, which raises the risk for future compression fractures. Doctors may recommend a short period of bed rest for no more than a few days. However, prolonged inactivity should be avoided.

Vertebroplasty

Jane schedules visits with a neurosurgeon to first discuss, then perform her vertebroplasty. You will do pre-operative teaching and answer any questions Jane might have. You will then care for Jane post-operatively, as well as do discharge teaching.Jane doesn't understand exactly what Vertebroplasty is, and is very frightened of anesthesia. Explain what Vertebroplasty is so that Jane will understand. Include when she will start to feel pain relief. Also include why it is important to have this surgery and what could result if it is not performed.

Vertebroplasty is a minimally invasive surgery that places cement in fractures vertebrae through small incisions using x-ray guidance. Reassure the patient that vertebroplasty will provide IMMEDIATE relief the majority of the time.

The vertebroplasty is an outpatient surgery. In the first few days after Jane goes home, which of the following is Jane at a high risk for? (Check all that apply)

- [ ] Allergy
- [x] Infection
- [x] Falls
- [ ] Shortness of breath

Prescribing Osteoporosis Treatments

Before being discharged, Jane's physician prescribed treatment for her osteoporosis. Which of the following could be prescribed to Jane for her osteoporosis?

- [x] Actonel (Risedronate)
- [x] Fosamax (Alendronate)
- [ ] Adderall (Amphetamine)
- [x] Boniva (Ibandronate

What does Jane need to know regarding the taking of bisphosphonates?

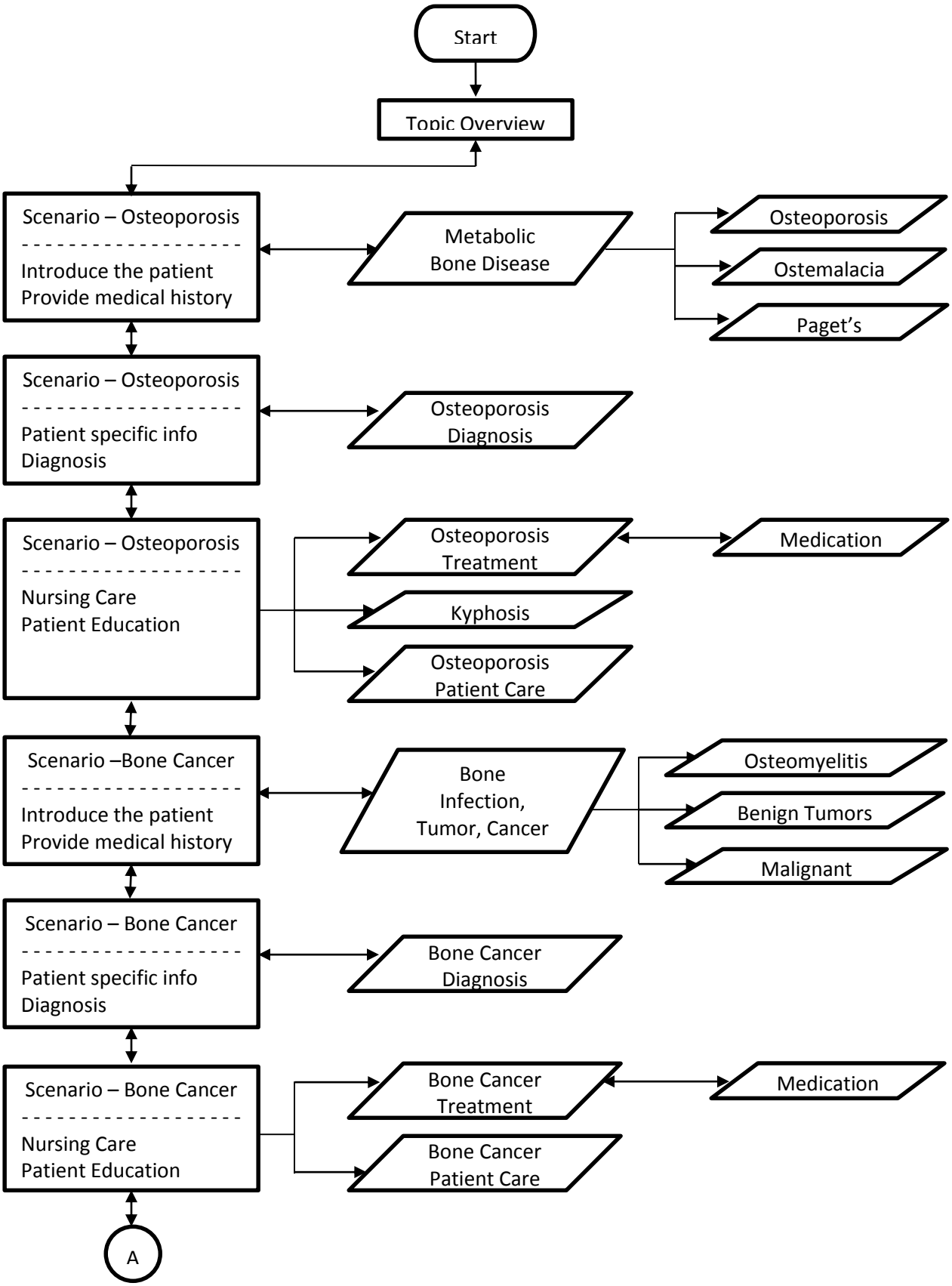
For the best results and to reduce the risk of irritation to your esophagus, if taking bisphosphonates by mouth, these medicines should be taken in the morning with a full glass of water at least 30 minutes before eating a meal, drinking a beverage, or taking any other medicine. Sit or stand (don't lie down) for at least 30 minutes after taking a bisphosphonate. This helps prevent heartburn. Do not take a bisphosphonate late in the day if you forgot to take it in the morning.

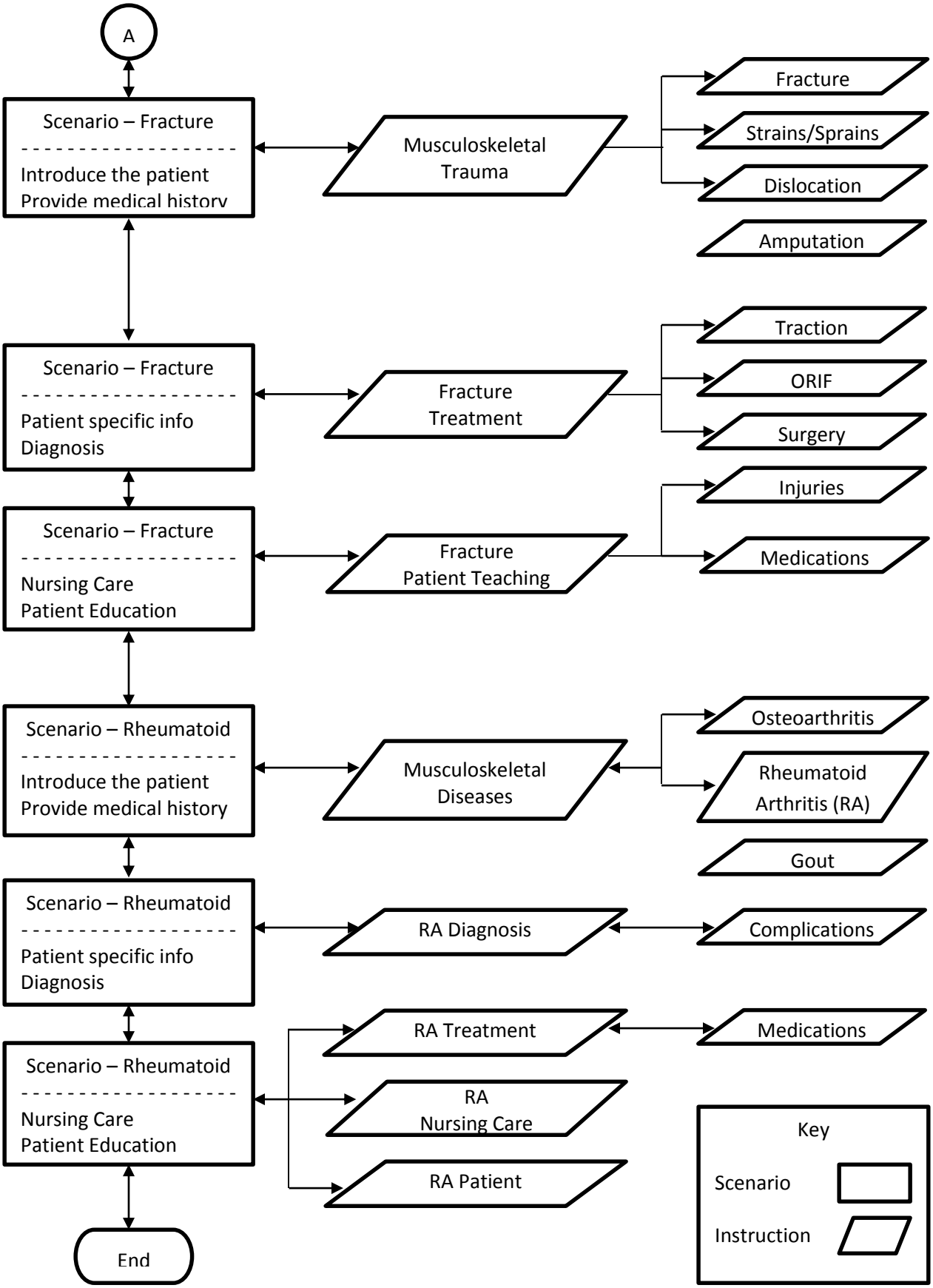
APPENDIX B – 5

Sample Module Flowchart

Design Phase

Sample Instruction Flowchart - The Musculoskeletal System




A
Scenario – Fracture
Introduce the patient
Provide medical history
Musculoskeletal Trauma
Fracture
Strains/Sprains
Dislocation
Amputation
Scenario – Fracture
Patient specific info
Diagnosis
Fracture Treatment
Traction
ORIF
Surgery
Scenario – Fracture
Nursing Care
Patient Education
Fracture Patient Teaching
Injuries
Medications
Scenario – Rheumatoid
Introduce the patient
Provide medical history
Musculoskeletal Diseases
Osteoarthritis
Rheumatoid Arthritis (RA)
Gout
Scenario – Rheumatoid
Patient specific info
Diagnosis
RA Diagnosis
Complications
Scenario – Rheumatoid
Nursing Care
Patient Education
RA Treatment
Medications
RA Nursing Care
RA Patient
End
Key
Scenario
Instruction

APPENDIX B – 5

Sample Storyboard

Design Phase

Musculoskeletal Osteoporosis Sample Storyboard

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 1 of 15	Date: July 17, 2014
Jane is a 58 y.o. female who presents to the doctor's office with complaints of back pain after her 50# grandchild jumped on her back 2 days ago. Pain is presently sharp, rating 6/10 at rest and 8/10 with movement. Any movement creates searing, uncontrollable pain. Jane has been taking ibuprofen 600mg every 6 hours alternated with acetaminophen 1000mg every 6 hours providing moderate relief. However, she has not been pain free since the incident. Neither heat nor ice have improved the pain. Jane is post menopausal x 2 years with no replacement hormone therapy. She takes multivitamins daily and intermittently takes calcium supplements recommended by her gynecologist. She has no known drug allergies (NKDA). Jane drinks 2 cups of coffee in the morning followed by 3-4 diet sodas throughout the day. Until 2 years ago, Jane smoked cigarettes, 1 pack per day (ppd). She is married and has one child. Jane has been active all her life; running and swimming competitively through college and has continue to run as an adult. Past medical and surgical history are positive for tonsillectomy & adenoidectomy as a child and several fractures as an adult. Eighteen months ago, Jane fractured her left wrist and 2 ribs after a fall. The wrist fracture required surgery (ORIF). Jane reports it "took a long time for my bone to heal." Family history includes hypertension and hip fractures in both her mother and maternal grandmother.		Navigation Info Menu entry: Meet Jane Next button Media Information Picture of 58 year old female, Jane, in pain at a health care setting
Notes: Use common nursing abbreviations, but highlight the abbreviation and allow the user to click on abbreviation for an expansion of the meaning of the abbreviation (later refer to this as define upon request).		

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 2 of 15	Date: July 17, 2014

Examination today reveals multiple bruises (reddish purple) over her right shoulder, flank and hip. Palpation of the injured area (L2-L3) elicits searing pain. Jane reports "the pain takes my breath away sometimes." Her lungs are clear bilaterally with equal and even respirations. She is alert, oriented x 4. Heart is regular with no murmur, bowel sounds are hyperactive and joints are free of swelling. All neuro checks are positive. There is a healed scar on her left wrist.

Navigation Info

Menu entry: Examination

Next button

Previous button

Media Information

Picture of health care provider examination of Jane

Notes: Define upon request "oriented x 4" (oriented to self, time, place, and situation). Define upon request "neuro checks" (orientation, alert, mentally intact, no tremors, not compromised).

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 3 of 15	Date: July 17, 2014

Jane's physician suspects a vertebral fracture, and orders complete spine x-rays within the clinic. Check all of the following that need to be done prior to obtain x-rays.

- **Notify Jane that she must lie still during the procedure**
- **Help position Jane on the x-ray table**
- **Provide oral pain medication prior to x-ray if not previously taken**
- Instruct Jane not to eat or drink 4 hours before x-ray

Navigation Info

Menu entry: X-ray

Submit button
- Correct answer continue
- Retry
- Wrong answer continue

Previous button

Next button

Media Information

Picture of x-ray machine

Notes: Multiple choice question with two retries with feedback. Correct answer: Yes. Help Jane be as comfortable as possible and correctly positioned, which will help her lie still during the procedure. Retry: No. Please try again. Wrong answer: No. You should help Jane be as comfortable as possible, including pain medication if appropriate, which will help her lie still during the procedure, and help position her. Jane does not need to fast prior to the x-ray.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 4 of 15	Date: July 17, 2014

After her x-ray, Jane complains that her lower back pain has increased from a 6/10 to a 8/10. The physician prescribes Norco 1-2 tabs q 6 hours prn for pain. He also prescribes a stool softener.

What category drug is Norco?

Enter answer

Check Answer

Opioid/ narcotic

What is the generic name for Norco?

Enter answer

Check Answer

Hydrocodone + APAP (acetaminophen)

Why would the physician prescribe a stool softener as well?

Enter answer

Check Answer

Constipation is a normal side effect of Norco; a stool softener will help reduce this side effect

Navigation Info

Menu entry: Norco

Next button

Previous button

3 correct answer buttons

Media Information

None

Notes: Use an input box for user to type answers. Provide a button for the user to find the correct answer. Define upon request q (every), prn (as needed), Hydrocodone + APAP (acetaminophen).

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 5 of 15	Date: July 17, 2014

Jane's X-ray shows a Lumbar Compression Fracture. Which of the following bone diseases put patients at a higher risk for fractures? (check all that apply)

- **Osteomalacia**
- **Paget's disease**
- **Osteoporosis**
- Gout

Navigation Info

Menu entry: Diagnosis

Next button

Previous button

Media Information

None

Notes: Multiple choice question with 2 retries and feedback. Correct answer: Yes. Retry: Please retry. Incorrect answer: No. Osteomalacia, Paget's disease, Osteoporosis are all bone disease that put patients at a higher risk for fractures.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 6 of 15	Date: July 17, 2014

Considering Jane's history and the results of her X-ray, what bone disease would her doctor most likely diagnose? Find out more about the diseases before deciding by clicking on the buttons to the right.

- **Osteoporosis**
- Osteomalacia
- Paget's disease

Navigation Info

Menu entry: Diagnosis

Next button

Previous button

Learn more about buttons
- Osteoporosis
- Ostemalacia
- Paget's disease

Media Information

Picture of Jane

Notes: Multiple choice question with 2 retries and feedback. Correct answer: Yes, but if you haven't learned more about all these diseases, please do so. Retry: No. Please find out more about the diseases before trying again. Incorrect answer: No. The doctor will most likely diagnose Osteoporosis. Make sure you understand these disease before moving on.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 7 of 15	Date: July 17, 2014

Learn more about diagnostic tests for Osteoporosis, Paget's disease, and Osteomalacia by clicking on the button and then try to answer this question. Drag and drop the diagnostic test to match it with the correct bone disease.

Osteoporosis	Liver function, CBC, and urine calcium tests
Paget's disease	Blood test for serum alkaline phosphate levels
Osteomalacia	Blood and urine test; bone biopsy

Navigation Info

Menu entry: Diagnostic Tests

Next button

Previous button

Learn more about button on Diagnostic Tests

Media Information

Generic picture of bone disease

Notes: Drag and drop matching question with 3 retries.

Project name: Musculoskeletal – Osteoporosis Scenario | Screen: 8 of 15 | Date: July 17, 2014

The physician diagnoses Jane with lumbar compression fracture and osteoporosis. Explain Jane's condition in simple terms.

Enter answer

Check Answer

A compression fracture commonly occurs in patients with osteoporosis because of their low bone density. A compression fracture is a fracture in a vertebral bone that decreases its height. Osteoporosis occurs as a result of an imbalance in osteoblast and osteoclast activity. As we get older, our bone resorption exceeds bone formation. Bone density decreases rapidly during the postmenopausal period as estrogen levels decrease.

Navigation Info

Menu entry: Physician Diagnosis

Next button

Previous button

Media Information

Picture of Jane with Doctor

Notes: Question followed by data entry and check for correct answer.

Project name: Musculoskeletal – Osteoporosis Scenario | Screen: 9 of 15 | Date: July 17, 2014

The physician leaves the room to complete Jane's prescriptions. Jane asks you how she got osteoporosis. Find out more about patient education by clicking on the button and then answer the question. What are the factors from Jane's medical and social history that most likely caused osteoporosis?

Enter answer

Check Answer

The major factors are age, history of smoking, postmenopausal (lower estrogen levels) and caffeine intake from coffee and diet soda.

Navigation Info

Menu entry: Patient Education

Next button

Previous button

More information button on patient education

Media Information

Jane with nurse

Notes: Question followed by data entry and check for correct answer.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 10 of 15	Date: July 17, 2014

Jane explains that she has a friend with osteoporosis, and her spine is curved so that she leans forward when walking. Find out more about osteoporosis complications by clicking on the button and then answer this question. What is this condition called? Could this happen to Jane?

Enter answer

Check Answer

Kyphosis. Since Jane has osteoporosis, she is very susceptible to forming kyphosis. Kyphosis usually occurs as a result of osteoporotic fractures, typically spinal compression fractures.

Navigation Info

Menu entry: Patient Education

Next button

Previous button

More information button on Kypohosis

Media Information

Jane with nurse

Notes: Question followed by data entry and check for correct answer.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 11 of 15	Date: July 17, 2014

Find out more about the treatment of osteoporosis by clicking on the button and then answer the question. Which of the following would the physician most likely prescribe FIRST?

- Traction
- **Vertebroplasty**
- Prescribe Actonel
- Prescribe Vitamin D
- Send her to a nutritionist to learn about proper nutrition and exercise

Navigation Info

Menu entry: Treatment

Next button

Previous button

More information button on treatment

Media Information

Generic picture

Notes: Multiple choice question with 1 retry and feedback. Correct answer: Yes. Retry: No. Try one more time. Remember this is the FIRST thing that would be prescribed. Incorrect answer: No. The first thing would be a vertebroplasty. More long term measures would follow.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 12 of 15	Date: July 17, 2014

Jane schedules visits with a neurosurgeon to first discuss, then perform her vertebroplasty. You will do pre-operative teaching and answer any questions Jane might have. You will then care for Jane post-operatively, as well as do discharge teaching. Jane doesn't understand exactly what vertebroplasty is, and is very frightened of anesthesia. Explain what vertebroplasty is so that Jane will understand. Include when she will start to feel pain relief. Also include why it is important to have this surgery and what could result if it is not performed.

Enter answer

Check Answer

Vertebroplasty is a minimally invasive surgery that places cement in fractures vertebrae through small incisions using x-ray guidance. Reassure the patient that vertebroplasty will provide IMMEDIATE relief the majority of the time.

Navigation Info

Menu entry: Patient Education

Next button

Previous button

More information button on vertebroplasty

Media Information

Picture of vertebroplasty

Notes: Question followed by data entry and check for correct answer.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 13 of 15	Date: July 17, 2014

The vertebroplasty is an outpatient surgery. In the first few days after Jane goes home, which of the following is Jane at a high risk for? (Check all that apply)

- Allergy
- **Infection**
- **Falls**
- **Shortness of breath**

Navigation Info

Menu entry: Patient Care

Next button

Previous button

Media Information

Generic picture

Notes: Multiple choice question with 1 retry and feedback. Correct answer: Yes. Retry: No. Try one more time. Incorrect answer: No. She is at high risk of infection and falls. Shortness of breath is consistent with a pulmonary embolism. Any time a patient is inactive, there is concern for venous stasis (pooling of the blood). This can create a clot and send it to the lungs. That is why they put those stockings on legs which inflate/deflate.

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 14 of 15	Date: July 17, 2014

Before being discharged, Jane's physician prescribed treatment for her osteoporosis. Which of the following could be prescribed to Jane for her osteoporosis? (check all that apply)

- **Actonel (Risedronate)**
- **Fosamax (Alendronate)**
- Adderall (Amphetamine)
- **Boniva (Ibandronate)**

Navigation Info

Menu entry: Medication

Next button

Previous button

More information button link to WebMD for bisphosphonates medicine

Media Information

Bisphosphates picture

Notes: Multiple choice question with 1 retry and feedback. Correct answer: Yes. Retry: No. Try one more time. Incorrect answer: No. Medication website at http://www.webmd.com/osteoporosis/bisphosphonates-for-osteoporosis .

Project name: Musculoskeletal – Osteoporosis Scenario	Screen: 15 of 15	Date: July 17, 2014

What does Jane need to know regarding the taking of bisphosphonates?

Enter answer

Check Answer

For the best results and to reduce the risk of irritation to your esophagus, if taking bisphosphonates by mouth, these medicines should be taken in the morning with a full glass of water at least 30 minutes before eating a meal, drinking a beverage, or taking any other medicine. Sit or stand (don't lie down) for at least 30 minutes after taking a bisphosphonate. This helps prevent heartburn. Do not take a bisphosphonate late in the day if you forgot to take it in the morning.

Navigation Info

Menu entry: Patient Education

Next button

Previous button

More information button link to WebMD for bisphosphonates medicine

Media Information

Picture of Jane taking medicine

Notes: Question followed by data entry and check for correct answer. Medication website at http://www.webmd.com/osteoporosis/bisphosphonates-for-osteoporosis .

APPENDIX C

Validation of Instruction

Development Phase

Validation of Instruction for Endocrine System – Scenario-based e-Tutorial

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the endocrine system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Apply knowledge of normal anatomy, physiology and assessments of the endocrine glands when providing nursing care for patients with endocrine disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Compare and contrast the manifestations of disorders that result from hyper-function and hypo-function of the endocrine glands.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe the nursing implications for medications prescribed to treat disorders of the endocrine glands.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Know how to provide appropriate nursing care for the patient before and after surgeries for abnormalities of the pituitary, thyroid, and adrenals.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Use knowledge of the nursing process as the basis for providing care to patients with disorders of the endocrine system.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial allows the learner to be more actively involved in his/her learning. (Interactivity refers to clicking the mouse, hovering the mouse over an object, mouse drag-and-drop, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3	(no response to question)				

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3	(no response to question)				

The scenario-based mode of instruction used in the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3	(no response to question)				

Comments

Subject matter expert #1	Response
I found difficulty in locating the pancreas with the drop button. I know where it is located in the body, the computer told me "no."	Fixed
I liked the voice in the first section. There is noticeable change to another female voice that sounds grainy, as if the recording process was done with a different microphone set up.	Future enhancement
I love the case studies, the multiple choice answers and study questions. The graphics are well done.	

Subject matter expert #2	Response
I liked the upgraded version.	
I liked how you brought into the course real people with the diseases. I think this brought it down to a nurse/patient level that we are striving to achieve with students.	

Subject matter expert #3 (JOANN)	Response
(Is anything missing?) All good.	
Some of the speakers have an echoing to her voice, like being in an empty room, because of this echo, just needs to be more clear.	Future enhancement
Love the personal experiences.	

Development Phase

Validation of Instruction for Upper Gastrointestinal System – Scenario-based e-Tutorial

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the upper gastrointestinal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe the pathophysiology of common disorders of the mouth, esophagus, and stomach.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Relate manifestations and diagnostic tests to the pathophysiologic processes involved in the upper gastrointestinal problems.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain interdisciplinary care for patients with upper gastrointestinal disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe the role of the nurse in interdisciplinary care of patients with upper gastrointestinal problems.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1				X	
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Videos in the tutorial adequately do one or more of the following: demonstrate something; help the learner apply what he/she is learning; show the reality of something; or is interesting and relevant.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Comments

Subject matter expert #1 (ROD)	Response
Perhaps a separate section for medications.	Future enhancements
I really enjoy these tutorials. I particularly enjoyed the video presentations of survivors at the end. I also like that there are several voices. The female voice recording is soft and sounds as a lesser quality than the male voice.	

Subject matter expert #2 (SAM)	Response
(Missing instruction?) Not at this time, this was again very well done in my opinion. I really liked the new content presented here. I really think it will help engage the student in the learning process.	
(Suggested improvement to instruction?) Not at this time	
(Other comments?) I liked how the new content took a patient through the disorders and surgery so the students followed it and could see the whole process. I also liked how there was new content and pictures/visuals of the conditions.	

Subject matter expert #3 (JOANN)	Response
Need to correct the info on the Gastritis slide to say B12....it now just says B 2.	Corrected
I might have missed this but was there mention of Herpes Simplex 1 of the oral cavity?	Instruction on type 1 herpes simplex virus (HSV-1) was strengthened and two questions added in both scenario and direct instruction
Loved the stories and use of Roberts condition throughout ....also of the women with oral cancer and Dr. Oz dentist's information.	

Development Phase

Validation of Instruction for Lower GI System – Scenario-based e-Tutorial

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the lower gastrointestinal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain the pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of patients with bowel motility disorders, acute or chronic inflammatory bowel disorders, non-inflammatory bowel disorders, neoplastic disorders, and structural and obstructive bowel disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

The tutorial meets this learning objective: Discuss the purposes, nursing implications, and health education for the patient and family related to the medications used to treat bowel disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain the rationale for using selected diets that are low-residue, gluten-free, and high-fiber, including diets for diarrhea and constipation.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe selected surgical procedures of the bowel, including colostomy, colectomy, and ileostomy.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3				X	

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Videos in the tutorial adequately do one or more of the following: demonstrate something; help the learner apply what he/she is learning; show the reality of something; or is interesting and relevant.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial allows the learner to be more actively involved in his/her learning. (Interactivity refers to clicking the mouse, hovering the mouse over an object, mouse drag-and-drop, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X

Subject Matter Expert #3			X		

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The scenario-based mode of instruction used in the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Comments

Subject matter expert #1 (ROD)	Response
The female voice quality is poor.	Future enhancements
I liked this presentation for it's ability to walk me through at my pace. Nice job.	

Subject matter expert #2 (SAM)	Response
I enjoyed again how you brought real patients, Andrew and Adam, into the discussion to tie it home.	

Subject matter expert #3 (JOANN)	Response
(Is there anything missing from the instruction that you think should be there?) 1. I would include the "transmural" and the cobblestone" appearance of Crohn's disease. 2. you may look at the Ostomate blog, it seemed some of the verbage was inappropriate.... 3. I would include that diverticulitis has "blood- streaked diarrhea" 4. need to add that if someone has ulcerative colitis for 10 years or more, a complete colectomy is recommended due to 100% cancer causing. 5. Some videos did not work: IBS, hernias, appendix, UC, Crohn's, 6. With the interventions on Appendicitis, head of bed up and add "knees up" 7. add info about surgery for hemorrhoids and nursing care	Future enhancements
(Do you have any suggestions to improve the instruction?) 1. some of the words are pronounced different than I have heard	Future enhancements

them pronounced. 2. the picture on the Polyps covers the last few words....make pic smaller	
(Other comments) I liked the research tools and articles to clarify the material. Videos are always good. Scenarios very good.	

Development Phase

Validation of Instruction for Musculoskeletal System – Scenario-based e-Tutorial

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

The tutorial is an adequate review of the musculoskeletal system in preparation for in-class discussion and activities.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Describe the functions of the musculoskeletal system.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Identify manifestations of impairment of the musculoskeletal system.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Explain the etiology, pathophysiology, manifestations, complications, interdisciplinary care, and nursing care of musculoskeletal disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The tutorial meets this learning objective: Discuss the purposes, the nursing implications, and health education for the patient and family related to the prevention and treatment of specific musculoskeletal disorders.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Pictures in the tutorial adequately do one of more of the following: is relevant and interesting; promotes greater understanding; gains the learner's attention.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Illustrations in the tutorial promote greater understanding.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial allows the learner to be more actively involved in his/her learning. (Interactivity refers to clicking the mouse, hovering the mouse over an object, mouse drag-and-drop, etc.)	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The interactivity within the tutorial adequately does one or more of the following: allows for practice; allows for formative assessment; is interesting, gains learner's attention, or motivates the learner.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

The formative assessments found throughout the tutorial help students learn.	**SD**	**D**	**N**	**A**	**SA**
Subject Matter Expert #1					X
Subject Matter Expert #2					X
Subject Matter Expert #3					X

Comments

Subject matter expert #1 (ROD)	Response
(Missing instruction?) No	
(Improvements to instruction?) No	
(Other comments?) None	

Subject matter expert #2 (SAM)	Response
I really like the how the students have to be interactive, good job.	

Subject matter expert #3 (JOANN)	Response
On the nursing care after post surgery ...the speaker skipped over the: monitor elimination bullet point.	Future enhancement
In the Additional Conditions section: forgot to cover information on the Care bullet point.	Future enhancement
I did not see anything about Casts??? or Traction??? these are important for nursing care.	Cast and traction are covered in the Jared scenario
Liked the Medline Plus internet links,...phalon and tinel sign good to demonstrate for students..	

APPENDIX D

Links to e-Tutorials

Links to e-Tutorials

Direct instruction e-tutorials	
Endocrine system CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=52d7bcc1-3db5-4f3c-8b3d-a65d1d792bcd http://bit.ly/DIendocrine
Upper gastrointestinal system CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=3ea0c0e1-e7c6-4c75-825c-0df444c2de6c http://bit.ly/DIupperGI
Lower gastrointestinal system CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=f1c1a4ba-d748-4437-a4be-d681477a4684 http://bit.ly/DIlowerGI
Musculoskeletal CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=62afbed5-b94c-43d7-a71e-828274eef783 http://bit.ly/DImusculo
Scenario-based e-tutorials	
Endocrine system CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=b0486cc9-8bee-46bf-b2f9-bbe9e8c7af3e http://bit.ly/SBendocrine
Upper gastrointestinal system CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=60b82ea9-5c67-4d8e-b355-a10dabc380fd http://bit.ly/SBupperGI
Lower gastrointestinal system CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=8dd4b7d4-b0d5-4015-b1b8-bd6e774dfe66 http://bit.ly/SBlowerGI
Musculoskeletal CMS link or bitly link	https://content.byui.edu/items/a8a37042-b28c-442f-bde6-40e05306b4a3/1/?.vi=file&attachment.uuid=b7f7cc69-6fb9-4a99-b384-574cb018c053 http://bit.ly/SBmusculo

APPENDIX E

Assessment Questions

APPENDIX E – 1

Categorization of Tutorial Quiz Questions

Assessment questions from the tutorial quizzes have been categorized as low or high order cognitive questions. Low order questions require the student to remember a fact or understand a concept. High order questions require the student to apply a procedure, analyze parts of something, evaluate according to criteria, or create something new (Anderson et al., 2001).

Categorization of Endocrine Tutorial Quiz Questions

Tutorial Quiz – Endocrine		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Understand what the endocrine system does and does not
Question 2	Low	Understand the functions of glucocorticoids
Question 3	Low	Remember another name for vasopressin
Question 4	Low	Remember that hypo cortisol secretion is associated with Addison's disease
Question 5	High	Apply understanding of the endocrine system and evaluate the symptom that would prompt a more detailed assessment
*Question 6	High	Apply understanding of assessment of the thyroid gland in order to select the correct response
*Question 7	Low	Remember which organ is the target tissue for ADH
*Question 8	High	Apply understanding of the diagnosis of hyperthyroidism in order to choose the correct assessment finding
*Question 9	High	Apply understanding of aldosteronism in order to select the correct clinical manifestation
*Question 10	High	Apply understanding of acute adrenal insufficiency in order to select the correct treatment response

* This question was created and added by the instructor to bring the number of questions up to 10 and to achieve the correct mix of high and low order questions. The question was validated by another instructor who taught the course in the past.

Categorization of Upper Gastrointestinal Tutorial Quiz Questions

Tutorial Quiz – Upper Gastrointestinal		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Remember what the correct description of GERD
*Question 2	High	Apply understanding of GERD in order to select the discharge teaching
Question 3	Low	Understand the most likely cause of gastritis
Question 4	Low	Remember a common symptom of hiatal hernia
Question 5	Low	Remember an intervention for stomatitis
Question 6	Low	Remember a risk factor for oral cancer
*Question 7	High	Apply understanding of EGD in order choose the most important thing to observe following the procedure
*Question 8	High	Apply understanding of esophageal varices in order to select the sign of potential hypovoemia
*Question 9	High	Apply understanding of upper GI bleeding in order to select the appropriate diet during the first 24 hours after admission
*Question 10	High	Apply understanding of peptic ulcer disease in order to select the priority physical examination

* This question was created and added by the instructor to bring the number of questions up to 10 and to achieve the correct mix of high and low order questions. The question was validated by another instructor who taught the course in the past.

Categorization of Lower Gastrointestinal Tutorial Quiz Questions

Tutorial Quiz – Lower Gastrointestinal		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Remember a sign of a ruptured appendix
*Question 2	High	Apply understanding of diverticulosis in order to choose the food consumed by the patient that indicates lack of understanding
*Question 3	High	Apply understanding of peritonitis in order to choose the sign that most strongly indicates the condition
Question 4	Low	Understand that intestinal perforation is a cause of peritonitis
Question 5	Low	Remember a self-limiting GI disorder
*Question 6	High	Analyze three symptoms and evaluate five disorders and select intestinal obstruction as the life-threatening disorder
*Question 7	High	Apply understanding of ulcerative colitis in order to choose the correct teaching to provide the patient
*Question 8	High	Apply understanding of the Jackson Pratt drain in order to select the action to take following an appendectomy
Question 9	Low	Remember the expected laboratory finding for a patient with diverticulitis
Question 10	Low	Understand the position that provides comfort to a patient with appendicitis

* This question was created and added by the instructor to bring the number of questions up to 10 and to achieve the correct mix of high and low order questions. The question was validated by another instructor who taught the course in the past.

Categorization of Musculoskeletal Tutorial Quiz Questions

Tutorial Quiz – Musculoskeletal		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Understand which symptom correlates best with Paget's disease
Question 2	Low	Understand the concept of phantom limb pain and the best response
Question 3	Low	Understand compartment syndrome related to a fracture
Question 4	Low	Understand pin care as the appropriate nursing intervention
Question 5	High	Analyze medication history of rheumatoid arthritis patient and select the most important question to ask
Question 6	Low	Understand high-seat commode as the equipment that would help a client with a total hip replacement
*Question 7	High	Apply understanding of the fractures caused by an accident
*Question 8	High	Apply understanding of fractured hip in order to select recognize the most critical change after a neuro assessment
*Question 9	High	Apply understanding pedal pulse palpitation in order to identify the best intervention
*Question 10	High	Apply understanding of osteoporosis in order to select the best patient teaching

* This question was created and added by the instructor to bring the number of questions up to 10 and to achieve the correct mix of high and low order questions. The question was validated by another instructor who taught the course in the past.

APPENDIX E – 2

Categorization of Content Exam Questions

Assessment questions from the content exams have been categorized as low or high order cognitive questions. Low order questions require the student to remember a fact or understand a concept. High order questions require the student to apply a procedure, analyze parts of something, evaluate according to criteria, or create something new (Anderson et al., 2001).

Categorization of Endocrine Content Exam Questions

Content Exam – Endocrine		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Understanding the purpose of palpating the thyroid gland during a physical exam
Question 2	Low	Analyze the effect of hypothyroidism on an infant and the select the possible consequence
Question 3	Low	Recognize a symptom of hypothyroidism
Question 4	Low	Know what to medication would be best for patient diagnosed with hypothyroidism
Question 5	Low	Understand how long a patient diagnosed with hypothyroidism will have to take their medication
Question 6	High	Apply understanding of hypothyroidism in order to know which assessment indicates effective treatment
Question 7	Low	Recognize a symptom of myxedema
Question 8	Low	Understand which teaching of patient with hyperthyroidism is most appropriate
Question 9	High	Analyze Grave's disease situation and take the appropriate action
Question 10	Low	Recognize symptoms of Grave's disease
Question 11	Low	Analyze thyrotoxicosis situation and take the appropriate action
Question 12	Low	Understand what to monitor on a patient after a thyroidectomy
Question 13	High	Analyze several situations and assign the most experienced nurse to a particular patient
Question 14	High	Analyze a complication after a thyroidectomy and select the priority intervention
Question 15	High	Apply understanding of parathyroid glands in orders to recognize a statement that indicates need for further teaching
Question 16	Low	Recognize the need for further teaching for the patient
Question 17	Low	Recognize a life threatening complication in a parathyroidectomy patient
Question 18	Low	Recognize the most likely cause of osteoporosis in a 60 year old patient

Question 19	High	Apply understanding of growth hormone deficiency in order to select the statement by the patient that may have contributed
Question 20	High	Apply understanding of hyperpituitarism in order to tell patient how long to take testosterone hormone replacement therapy
Question 21	Low	Know what pituitary hormone is related to androgens, estrogens, and progesterone
Question 22	High	Know what to ask a middle-aged woman who has very little axillary hair
Question 23	Low	Know when acromegaly is most frequently diagnosed
Question 24	High	Apply understanding of hypophysectomy in order to choose what clarification is needed for the patient regarding treatment
Question 25	High	Apply understanding of transphenoidal hypophysectomy in order know what statement by patient indicates adequate understanding
Question 26	Low	Understand the action of cortisol
Question 27	High	Know what to tell a patient with severe inflammation about why they need to continue taking corticosteroids
Question 28	Low	Recognize which condition is caused by long-term exposure to cortisol
Question 29	Low	Recognize which condition is caused by a deficiency of hormones produced in the adrenal cortex
Question 30	Low	Understand which medical emergency may occur with Addison's disease, secondary to hypoadrenocorticism
Question 31	High	Apply understanding of Cushing's disease in order to recognize which disorder is commonly seen with a patient experiencing water and sodium retention
Question 32	Low	Recognize what condition may result from remove of one of the adrenal glands due to Cushing's syndrome
Question 33	Low	Recognize the most common sign in a pheochromocytoma patient
Question 34	High	Analyze a patient who had a hypophysectomy for hyperpituitarism and select the post-operative finding that requires immediate intervention
Question 35	High	Apply understanding of endocrine disorders in order to recognize which finding should be reported immediately.

Categorization of Upper Gastrointestinal Content Exam Questions

Content Exam – Upper Gastrointestinal		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Understand effect of steroid therapy on stomatitis
Question 2	Low	Understand most relevant complaint of a patient that uses oral tobacco
Question 3	Low	Understand how to instruct a patient who has stomatitis.
Question 4	Low	Understand correct outcome for a patient with aphthous stomatitis
Question 5	Low	Understand the best description of patient's response to a diagnosis of oral cancer
Question 6	Low	Understand what to teach a GERD patient about handling symptoms
Question 7	High	Understand the statement of a patient that indicates they understand discharge instructions following an EGD
Question 8	High	Understand dietary restriction for patient with lower esophageal sphincter dysfunction
Question 9	High	Know the medication most likely to be prescribed for GERD
Question 10	High	Analyze several possible lab results and evaluate which would warrants notifying the health care provider for a patient scheduled for GERD surgery
Question 11	High	Analyze four patients' conditions and evaluate which should be assigned the most experienced nurse
Question 12	High	Understand which statement by a patient indicates the patient has GERD
Question 13	High	Understand which symptom indicates GERD
Question 14	Low	Understand which disease a patient with GERD is at greater risk for developing
Question 15	Low	Understand the assessment data that indicates a diagnosis of gastric ulcer
Question 16	Low	Remember which test confirms a diagnosis of peptic ulcer disease
Question 17	Low	Understand what data should be obtained from a patient suspected of having peptic ulcer disease
Question 18	Low	Understand the data that indicate that peptic ulcer medicines are being effective

Question 19	Low	Understand the correct intervention for a patient experiencing abdominal cramping and diarrhea for two days
Question 20	Low	Understand which intervention would prevent gastroenteritis from Clostridium botulism
Question 21	High	Understand what data would warrant immediate intervention for a patient with gastroenteritis
Question 22	High	Understand the assessment data that indicates the condition of a patient with peritonitis is improving
Question 23	High	Understand the most appropriate question to ask an 84 year old woman complaining of right lower abdominal pain
Question 24	High	Understand the expected order for a patient complaining of pyrosis
Question 25	Low	Understand which statement by a patient with hiatal hernia indicates effective teaching by the nurse
Question 26	Low	Understand which statement by a patient with mouth ulcers indicates effective teaching by the nurse
Question 27	Low	Understand which question to ask a patient who has been taking Naprosyn for several months
Question 28	Low	Understand what instruction to give to a patient who just completed an upper GI radiographic series
Question 29	Low	Understand which statement by a patient with a sliding hiatal hernia indicates understanding of how to manage his or her condition
Question 30	Low	Remember which factor places a patient at risk for esophageal cancer
Question 31	High	Understand what priority action to take for a patient vomiting copious amounts of bright red blood
Question 32	High	Know the best response to give a patient who asks why a proton pump inhibitor is prescribed
Question 33	Low	Know what instruction to give a patient with gastroesophageal reflux disease
Question 34	Low	Identify a symptom of gastric cancer
Question 35	High	Identify which complication of cirrhosis is most serious and potentially life-threatening

Categorization of Lower Gastrointestinal Content Exam Questions

Content Exam – Lower Gastrointestinal		
Question	Cognitive Level	Basis of Categorization
Question 1	Low	Identify the task that can be delegated to a nursing assistant when preparing a patient for a colonoscopy
Question 2	High	Identify which menu selection indicates a client with irritable bowel syndrome has a good understanding of dietary teaching
Question 3	Low	Understand what condition is indicated by a bulge in a patient's groin when standing but not when lying down
Question 4	Low	Identify which symptom a client with colon cancer is most likely to exhibit
Question 5	Low	Understand what instruction to give a patient who will receive a fecal occult blood test
Question 6	High	Analyze condition of a patient who wishes to cancel a colonoscopy and evaluate the proper response
Question 7	High	Identify the best response to the request of a colostomy patient
Question 8	High	Identify the priority teaching for a patient who had a colon resection surgery with creation of a new colostomy
Question 9	High	Identify the best self-care measures for a client who has hemorhoids
Question 10	Low	Understand what finding indicates appendicitis
Question 11	High	Analyze several symptoms of patient with severe RLQ abdominal pain and evaluate the lab value to bring to the attention of the HCP
Question 12	Low	Understand the priority action to take for a client with Salmonella food poisoning
Question 13	Low	Remember the instruction to give a patient who has acute viral gastroenteritis
Question 14	High	Understand what statement by a patient with perineal excoriation indicates the need for additional teaching about perineal care
Question 15	High	Remember what assessment of a patient with Crohn's disease requires immediate consultation with the HCP
Question 16	High	Understand the priority assessment for a client who may have food poisoning by Clostridium botulinum infection

Question 17	Low	Remember what statement by a patient with diverticulitis indicates the need for addition teaching
Question 18	Low	Understand what to say to a patient who wonders if she should lose weight
Question 19	Low	Remember what to say to an older patient who wants to know how to prevent constipation
Question 20	High	Identify most appropriate intervention when patient with NG tube reports feeling nauseated following surgery for a ruptured appendix
Question 21	High	Identify priority diagnosis of patient with ulcerative colitis who reports abdominal pain prior to defecation
Question 22	Low	Identify the most likely cause of hemorrhoids in a female patient with three children
Question 23	Low	Identify most likely complication thought to be the most common cause of appendicitis
Question 24	Low	Identify the micro-organism thought to cause peptic ulcer disease
Question 25	High	Recognize that further teaching is necessary for a patient with colorectal cancer based upon their statement
Question 26	High	Identify the finding that is normal in a patient following abdominal surgery
Question 27	Low	Choose the procedure that must be performed to identify bulging, distention, and peristaltic waves
Question 28	Low	Know what organ is affected when the patient verbalizes pain in the right iliac region
Question 29	Low	Identify the test that would yield good visualization of the peptic ulcer
Question 30	Low	Identify several causes of diarrhea
Question 31	Low	Identify what is causing an exacerbation of ulcerative colitis in a patient
Question 32	Low	Identify the diet implicated in the development of diverticulosis
Question 33	High	Analyze the assessment of a patient diagnosed with colorectal cancer and evaluate a condition that is developing
Question 34	Low	Identify the primary purpose of NG tube insertion
Question 35	Low	Identify which finding in a patient with appendicitis best alerts the nurse to a ruptured appendix

Categorization of Musculoskeletal Content Exam Questions

Content Exam – Musculoskeletal		
Question	Cognitive Level	Basis of Categorization
Question 1	High	Recognize which order to clarify with the surgeon before discharging a patient who had arthroscopic surgery
Question 2	High	Recognize what question to ask a patient with severe knee pain
Question 3	High	Recognize which patient to assess first at the beginning of a shift
Question 4	Low	Recognize the most common finding in an older client related to musculoskeletal
Question 5	Low	Recognize what instruction to give to a discharged patient with osteoporosis
Question 6	Low	Recognize how to prevent transfer for an organism from the wound of a patient with osteomyelitis
Question 7	Low	Recognize the exercise to recommend to a patient at risk for osteoporosis
Question 8	Low	Recognize what statement by a patient with Paget's disease indicates understanding of causative factors
Question 9	Low	Recognize what statement by a patient prescribed with Fosamax understands teaching about this drug
Question 10	Low	Recognize what to assess for a patient diagnosed with osteomalacia
Question 11	Low	Recognize what health history finding may have contributed to a patient's diagnosis of acute osteomyelitis
Question 12	High	Recognize what should be considered first for a patient with a total hip replacement that is experiencing redness at the surgical site
Question 13	Low	Recognize the assessment finding that indicates a risk for osteoporosis
Question 14	Low	Recognize which patient could not be tested using Phalen's test
Question 15	Low	Recognize Kyphosis during an assessment of a 68 year-old female patient
Question 16	Low	Recognize the best thing to say to a patient that is concerned about decreased height of 1 inch in the past year
Question 17	Low	Identify the best assessment test to determine if a patient is experiencing carpal tunnel syndrome
Question 18	High	Recognize what is likely to occur to a patient who is ordered to be on bed rest for two months

Question 19	Low	Recognize what is likely to occur to a patient with chronic low blood calcium
Question 20	Low	Recognize what type of muscle is needed to recover from orthopedic surgery
Question 21	Low	Recognize what to teach a patient about an electromyelogram
Question 22	Low	Recognize the correct name for a procedure that uses endoscopic examination of the interior surfaces of a joint
Question 23	Low	Recognize how to prepare a patient for a standard x-ray of the arm
Question 24	Low	Recognize what condition is most likely suspected when a bone scan is ordered
Question 25	Low	Recognize what condition is most likely suspected when a DEXA exam is ordered
Question 26	Low	Recognize what order to expect for a patient with pain in the left wrist
Question 27	High	Choose what to counsel an older patient about ways to prevent fractures
Question 28	High	Identify the highest priority order to carry out for a patient with ankle swelling and severe pain
Question 29	High	Know what to answer a patient who questions when their cast can be removed
Question 30	High	Know how to access for pressure areas on a patient in Buck's traction
Question 31	High	Identify the priority action to take when a patient arrives after an accident with leg-swelling and bruising on the chest
Question 32	High	Identify the nursing priority diagnosis when developing a care plan for a patient with an ORIF
Question 33	High	Identify the most important assessment data to report to the HCP for a patient with orders for bed rest after an open-book pelvic fracture
Question 34	High	Identify what postoperative care to expect for a patient that has undergone left-knee arthroplasty
Question 35	High	Identify what action to take first when a patient who has been hospitalize for three days with a hip fracture and Buck's traction suddenly says, "I feel like I am going to die!"

APPENDIX F

Levene's Test

Levene's Test of Equality of Error Variances

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Endocrine Quiz High	.823	3	80	.485
Endocrine Quiz Low	.970	3	80	.411
Endocrine Exam High	.760	3	80	.520
Endocrine Exam Low	2.720	3	80	.050
Upper GI Quiz High	1.660	3	80	.182
Upper GI Quiz Low	2.108	3	80	.106
Upper GI Exam High	2.190	3	80	.096
Upper GI Exam Low	.022	3	80	.996
Lower GI Quiz High	.824	3	80	.484
Lower GI Quiz Low	.907	3	80	.442
Lower GI Exam High	.563	3	80	.641
Lower GI Exam Low	.792	3	80	.502
Musculoskeletal Quiz High	.923	3	80	.434
Musculoskeletal Quiz Low	2.366	3	80	.077
Musculoskeletal Exam High	1.800	3	80	.154
Musculoskeletal Exam Low	.532	3	80	.662

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Condition + GPA + Pretest + GenderCode
Within Subjects Design: Topics + AssessTypes + QuestionTypes