

Developing a Multimedia Courseware Using Cognitive Load Theory

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Abstract

This study describes the application of cognitive learning theory in the development of a multimedia courseware to enrich the clinical experience of nursing students in a distance learning environment. The objectives of the study include: (1) describing the nature and organization of tasks needed by students to demonstrate the performance of selected competencies in an adult health nursing specialty course; and (2) identifying strategies and approaches in addressing the intrinsic, extraneous and germane cognitive load in the development of the multimedia material.

Content experts, instructional designers, and multimedia specialists were involved in key informant interview, focus group discussion and roundtable discussion to develop the multimedia courseware guided by the cognitive load theory. Students were likewise consulted by soliciting their comments on the content, learning activities and design elements of the courseware.

Cognitive load theory was shown to help guide in the development of a multimedia courseware involving complex learning; such as in the clinical practicum of nursing students. By addressing the intrinsic, extraneous and germane cognitive load in developing a multimedia courseware, course developers help students: (1) manage tasks more effectively, (2) reduce the time spent on unnecessary steps in understanding concepts; and (3) focus on learning and demonstrating the competencies needed by the course. This framework forces the content experts, instructional designer, and multimedia specialist to work together to achieve a well-balanced and interesting course that will address directly the needs of the students and at the same time achieve the objectives of the course.

Keywords: *cognitive load theory, multimedia courseware, virtual clinical practicum, distance education, nursing*

Introduction

Distance education has gained popularity among nursing students since it offers the convenience of getting formal education without the need to leave jobs or be separated from families, provides opportunities for immediate application of learning to work, and allows potential savings in time and money. However, some see distance education as a break with the education's traditions of teaching; thus, faces certain challenges (Chaffin & Maddux, 2004). This is even more so in a discipline like nursing, where personal qualities and technical skills are considered learned mostly through face-to-face interaction.

Studies have shown that there are certain issues that need to be addressed in delivering nursing program through distance education. There is a need for students in distance education to be taught competencies on new learning methods, computer-assisted learning, and technology in education (Bonnel, Wambach, & Connors, 2005; Cooper, Taft, & Thelen, 2004). There is a need to provide for development of a professional technical language, which was seen lacking in nursing students in distance education program (Fredskild, 2004). There is also a need to provide continuous interaction to replace the kind of intellectual discourse usually happening in the classroom

(Sit, Chung, Chow, & Wong, 2005). Ledwell, Andrusyszyn, and Iwasiw (2006) emphasized the need for face-to-face options and availability of technical and information support at all times.

This study focuses on the challenges of putting together a multimedia courseware that will enrich the clinical experience of students in a distance-learning environment. It provides opportunities for nursing students to maximize the learning potentials during clinical practicum by empowering them through new learning methods, computer-assisted learning, and education technologies. This will minimize over-reliance to clinical preceptors to gain something from the clinical experience. In distance education settings, the availability of qualified clinical preceptors in local settings where the students are likewise located can be a challenge to the quality of learning experience. By providing students with self-instructional multimedia materials and engaging them in online communication technologies, it is hoped that the standards of clinical practicum experience will be achieved.

Putting together a distance education course is not a simple process, especially when complex learning is involved. Complex learning aims at the integration of knowledge, skills, and attitudes; the coordination of qualitatively different constituent skills; and the transfer of what is learned to daily life or work settings (Van Merriënboer, Kirschner, & Kester 2003). The clinical nursing practicum requires complex learning since this is the time for integrating and applying concepts learned. The use of authentic learning tasks based on real-life tasks becomes the driving force for such complex learning. This, in turn, leads to the challenge of optimizing cognitive load for such complex tasks. The application of cognitive load theory in putting together a multimedia courseware is the focus of this study.

Objectives

This study aims to describe the application of the cognitive load theory in the process of putting together a multimedia courseware that involves complex learning in a virtual clinical practicum setting.

The specific objectives of the study include:

1. Describe the nature and organization of the tasks needed by nursing students in the virtual clinical practicum;
2. Identify strategies for addressing the inherent complexity of the tasks involved in clinical nursing practice;
3. Determine ways of reducing the extraneous cognitive load in a multimedia environment;
4. Select instructional activities that will re-focus learners to the subject matter; and
5. Summarize how the manipulation of the three types of cognitive load can help improve the process of teaching and learning in a multimedia environment.

Conceptual/Theoretical Framework

Cognitive load theory is a major theory providing a framework for investigations into cognitive processes and instructional design (Paas, Renkl, & Sweller 2003). It originated in the 1980s, underwent substantial development in 1990s, and gained global recognition and application in the

2000s. It helps instructional designers control the learning environment, which in this case is the multimedia courseware.

There are three categories of cognitive load: (1) intrinsic, (2) extraneous, and (3) germane as first explained by Chandler and Sweller (1991). Intrinsic cognitive load is the inherent level of difficulty associated with the instructional material. Extraneous cognitive load is generated by the manner in which information is presented to learners and is under the control of instructional designers. Germane cognitive load refers to the processing, construction and automation of schemas or mental representation of a class of objects, events, or practices.

The intrinsic cognitive load cannot be altered by the instructor; however, it can be broken into individual subschemas and taught in isolation, to be later brought back together and described as a combined whole (Kirschner, Sweller, & Clark, 2006). The extraneous and germane can be manipulated by the instructional designer by reducing extraneous cognitive load by removing the unnecessary in the format of instructional material, and redirect learners' attention to cognitive processes that are directly relevant to the construction of schemas (Sweller, Van Merriënboer, & Paas, 1998).

Methodology

The conduct of this study was done in stages involving different methods and participants. These stages are: (1) convening content experts in key informant interviews and focus group discussion, (2) roundtable discussion between content experts, instructional designers and multimedia specialists, and (3) pilot review of multimedia material by content experts and students.

The key informant interview and focus group discussion among content experts (n=12) were on the issue of selecting tasks needed by nurses in the clinical practicum setting. Some guide questions were formulated, such as: (1) what are the tasks needed by nurses in the adult health nursing specialty courses for the clinical practicum based on the list of competencies identified for the course; (2) what are the nature of these tasks and how are they organized; (3) how can these tasks be simplified into more manageable tasks; and (4) what learning activities can be suggested in a multimedia environment that will help address the inherent complexity of the tasks.

The roundtable discussion among content experts (n=6), instructional designer (n=1) and multimedia specialist (n=1) revolved around the areas of finding out design elements that can help reduce the extraneous cognitive load of the multimedia courseware and redirect the learners attention to the process of acquiring the needed skills, knowledge and attitude, without removing the good-design elements of the courseware that helps motivate and engage learners.

The pilot review of the courseware involved students (n=10) who were asked about the following: (1) content, in terms of presentation, relevance, level of interest, clarity, and readability; (2) learning activities, in terms of relevance, appropriateness, and presentation of variety of tasks; and (3) design, in terms of organization, navigation, good mix of multimedia elements, and overall aesthetics.

Results and Discussions

The development of the multimedia courseware using Cognitive Load Theory could be summarized in four steps, namely: (1) selecting tasks needed by nurses in the clinical practicum, (2) simplifying complexity of tasks, (3) reducing extraneous cognitive load, and (4) refocusing learners to the subject matter.

Selecting Tasks Needed by Nurses in the Clinical Practicum

The interviews and discussions yielded the following competencies needed by nurses in the clinical practicum: (1) utilizing the nursing process in care of patients; (2) conducting complete and well-organized documentation; and (3) providing comprehensive care based on bioethical principles.

The tasks involved in demonstrating the above competencies include: (1) obtaining a complete, accurate, and appropriate health history, (2) performing systematic physical examination, (3) analyzing assessment findings to derive nursing diagnoses, (4) formulating a therapeutic nursing care plan, (5) implementing the nursing care plan, (6) evaluating the nursing care plan, (7) documenting care, and (8) applying bioethical principles in providing care.

During the design phase, learning tasks are ordered sequentially according to task difficulty and then learning scaffolds are added to support the learning process. The learning method consists of completing procedures that match authentic set of tasks performed by the learners in simulated environments in the courseware.

Simplifying Complexity of Tasks

Task complexity has been shown to increase as learners progress through the course. This multimedia courseware allows learners to navigate the increasingly complex learning environment by providing learning scaffolds and being supported by additional resources, tools, and templates.

The identified tasks showed varying degrees of complexities. Some strategies that were recommended to simplify them into manageable tasks were the following: (1) sequencing of the sub-tasks, (2) giving students scaffolding or guides and steps on how to perform each task, and (3) providing templates on how to accomplish them.

The strategies used in the courseware was supported by Van Merriënboer, Clark, & de Crock's study (as cited in Paas, Renkl, & Sweller, 2003) who suggested two forms of scaffolding, namely: (1) sequencing tasks from simple to complex, and (2) providing examples from partial to full problems.

In the same study (Van Merriënboer, Clark, & de Crock, 2002) the timing of essential information presented to students was identified as also critical from a cognitive load perspective. This underscores the value of giving students an overview of the tasks needed for them to be able to appreciate the process; and only giving them specific details at particular points when they are required.

Reducing Extraneous Cognitive Load

Discussions between the context experts, instructional designer, and multimedia specialist resulted to a courseware environment that was mindful of the needed learning activities for the achievement of the learning objectives.

The multimedia environment was kept similar to the real setting, from the structure of the hospital unit, arrangement of rooms, and look-and-feel of the nurses' station and patient rooms. Inter-activity elements in the rooms were kept to a minimum so as not to distract the learners from the intended activities in the virtual clinical environment.

The case studies were rendered in video formats that were “chunked” into short video clips corresponding to each identified tasks and sub-tasks to help students process the complexity of conducting a clinical practicum. The short videos were made realistic taken in the vernacular language but with English subtitles.

The learning activities identified for the multimedia environment include providing case studies featuring different patients with different health and social concerns.

Figure 1. The Courseware's Homepage

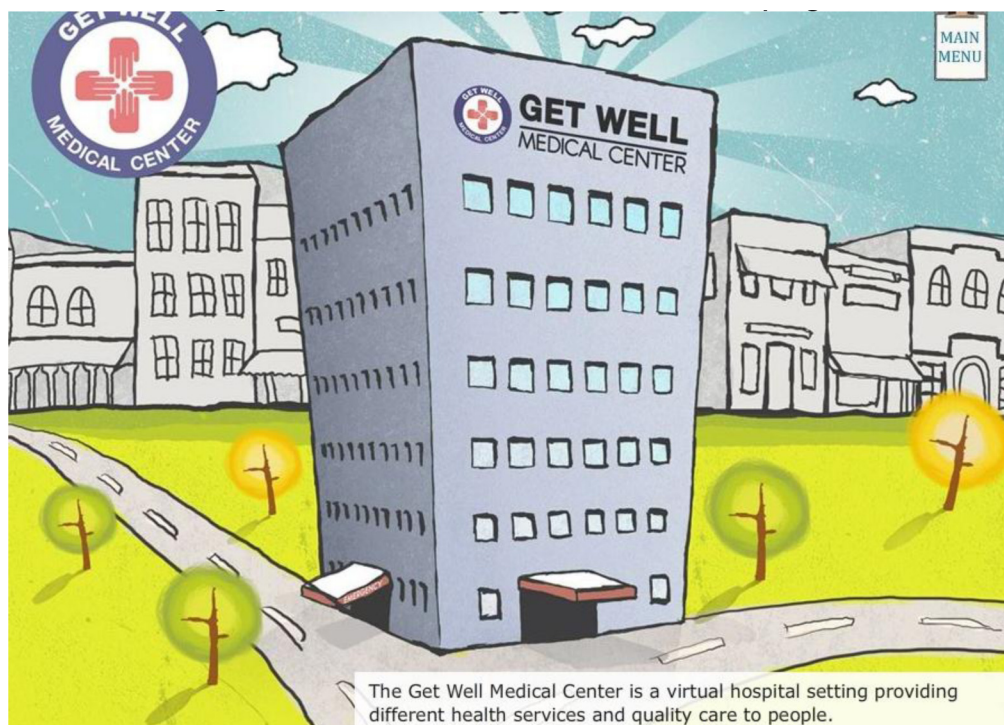


Figure 2. The Nurses' Station

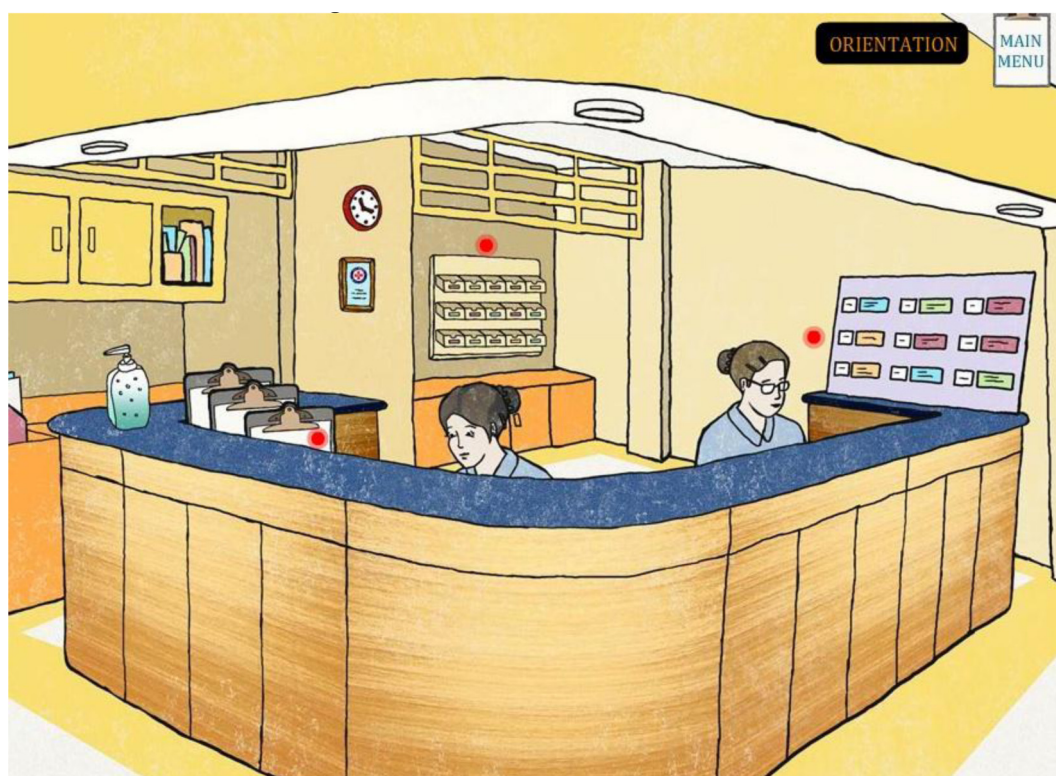


Figure 3. The Patient's Room

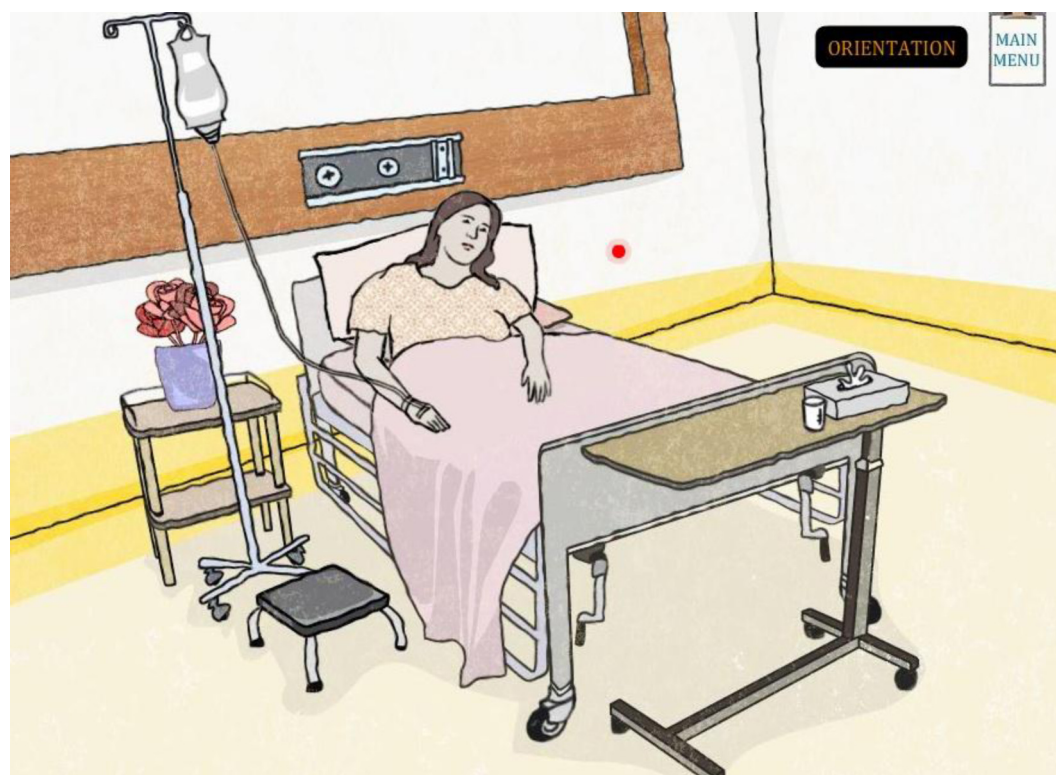
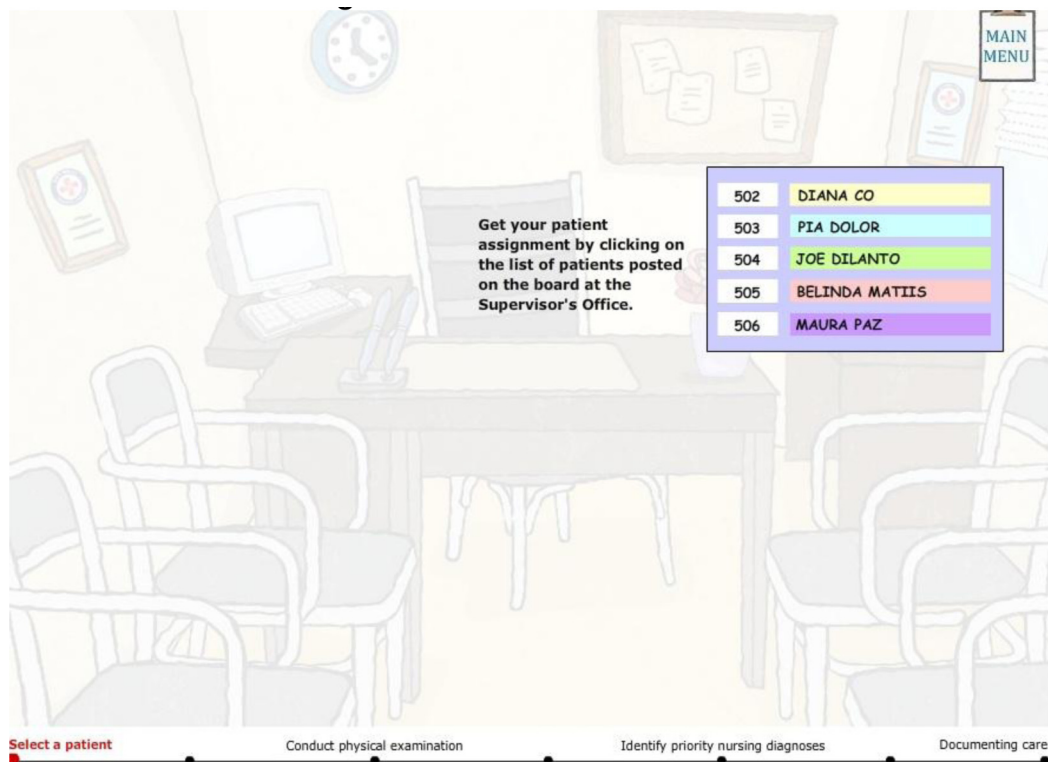


Figure 4. The Case Studies



Refocusing Learners to the Subject Matter

Other learning activities that were included to increase the learners' interest and focus them on the achievement of the learning objectives include: short lessons, self-assessment questions, hyperlinks to glossaries and references, and forms/templates. The short lessons contain the key concepts essential to attain the learning objectives of the course. The self assessment questions help in formative evaluation and were available both in interactive and offline formats. Hyperlinks were also provided for easy access to glossaries, references, and forms/ templates needed in the course. These materials help learners focus on what are essential to achieve the learning outcomes and maximize the use of the multimedia courseware.

Integrating the Key Components of Instructional Design in Multimedia Courseware

Using the cognitive load theory to improve the design of the courseware requires the integration of four key elements in the instructional plan of the complex multimedia courseware. These four key components include: (1) learning tasks, (2) supportive information, (3) just-in-time information, and (4) part-task practice.

Learning tasks involve instructional methods primarily aimed at induction, that is, constructing an instructional plan through mindful abstraction which include design steps such as sequencing task practice and setting performance objectives.

Supportive information aids the learning and performance of non-recurrent aspects of learning tasks. It provides the bridge between learners' prior knowledge and the learning tasks. Instructional methods primarily aim at elaboration to add to what learners already know.

Just-in-time information is about providing learners with specific information that is needed at a particular time. For example, more information on specific lessons can be provided as optional materials.

Part-task practice includes practice items that are provided to learners in order to promote rule automation for selected recurrent aspects of the whole complex skill. Instructional methods primarily aim at rule automation, including compilation and subsequent strengthening to reach a very high level of automatically.

Pilot Review of the Courseware

The initial review of the courseware showed positive responses to the courseware in terms of content, learning activities, and design. Students rated the courseware as very good in terms of presentation, relevance, level of interest generated, clarity, readability, appropriateness, and good mix of multimedia elements and design. There were some comments on how to improve navigation of the course. Some students also asked for a basic tutorial guide on the features of the courseware as well as a study guide in print form.

Conclusions and Recommendations

Cognitive load theory has been shown to help as a guide in the development of a multimedia courseware involving complex learning such as in the clinical practicum of nursing students. Complex learning, which is needed in clinical practicum, whether real or virtual, forces students to deal with a learning environment that requires understanding an enormous number of interacting knowledge structures and constituent skills to be able to perform a task.

By addressing the intrinsic, extraneous, and germane cognitive load in developing a multimedia courseware, course developers help students: (1) manage tasks more effectively, (2) reduce the time spent on unnecessary steps in understanding concepts; and (3) focus on learning and demonstrating the competencies needed by the course.

The use of cognitive load theory in the process of developing the multimedia courseware forced the different stakeholders: content experts, instructional designers, and multimedia specialist to work together. The synergy in the interaction between them created a more enriched product because the issues on cognitive loading were discussed from different perspectives. In future studies, students may also be included as part of the development process in the early stage of conceptualization. Future studies should also focus on measuring the effectiveness of this multimedia courseware in terms of achieving the course goals and evaluating student performance.

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