Chapter 13

Development and Evaluation of Neuroscience Computer–Based Modules for Medical Students:
Instructional Design Principles and Effectiveness

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ABSTRACT

Interactive neuropathology computer-based teaching modules and other neuroscience computer-based resources were developed to provide individualized self-paced content information accompanied by images and self-assessment questions with feedback, along with problem-solving cases to facilitate application of neuroanatomy, neurology, and neuropathology concepts to patient cases. Initial implementation occurred in three curricula for second-year medical students. Evaluation of the modules was conducted using quantitative and qualitative methods to determine features of the modules that were important for students. This chapter will describe the instructional design principles that evaluation results identified as important and effective for student learning, and compare those to current principles for effective multimedia instructional design identified in a variety of research. Especially important principles applied in the neuroscience modules included cognitive load theory, retrieval practice and self-assessment, feedback, and learner control.

INTRODUCTION

Interactive computer-based teaching modules covering neuropathology content for second-year medical students were first developed by the author when interactive computer programs (e.g. Hypercard) and videodiscs with randomly accessible images became available (images from the second edition of Slice of Life videodisc, coordinated by Suzanne Stensaas, Ph.D., were utilized; most of the neuropathology images were provided by Margaret Z. Jones, M.D.). These factors were ideal for pathology content where

gross and microscopic images are essential to the learning process. The goal of the modules was to provide individualized self-paced content information accompanied by images and self-testing questions with feedback, along with problem-solving cases to facilitate application of neuroanatomy, neurology, and neuropathology concepts to patient cases.

The development process included consideration of instructional design principles, production of initial topics (neoplastic disorders and cerebrovascular disorders), use-testing to determine student perceptions of technical and instructional effectiveness, and revisions based on student input. All images and diagrams were open source (Creative Commons or similar licensing). The interactive modules have been used continuously in the Colleges of Human Medicine and Osteopathic Medicine at Michigan State University since 1988, and repeated evaluations have demonstrated student support for the effectiveness of the instructional design principles. Periodic changes have been made based on changes in software and hardware, and access to additional images, and additional neuroscience units have been created for specific teaching goals.

The objectives of this chapter are to describe the development and structure of the neuropathology teaching modules and other units, including the instructional design principles utilized; to summarize results of evaluation of the modules by students; and to compare features of the modules with instructional design principles based on theories of learning and experimental evidence from other research.

BACKGROUND

Initial Structure and Implementation of Neuropathology Modules

Two neuropathology topics (neoplastic disorders and cerebrovascular disorders) were selected for initial module development and use-testing by students before additional topic modules were generated. The initial computer-based modules consisted of:

- Pre-test.
- Lesson utilizing text, diagrams and images (both normal and abnormal) with descriptions.
- Post-test (with immediate feedback for correct and incorrect answers).
- Clinical simulation emphasizing reinforcement of concepts in the lesson.
- Glossary.

A randomly accessible table of contents was available to permit learner control over lesson sequencing. The content of the units were based on paper modules with images provided in 35mm slide carousels developed previously by Dr. Margaret Z. Jones. Images in the modules were from the second edition of Slice of Life videodisc, coordinated by Suzanne Stensaas, Ph.D., University of Utah); most of the neuropathology images used were provided by Margaret Z. Jones, M.D., Michigan State University).

Hodgins & Lovell (1988) described the implementation of the initial two units in three curricular formats in the Colleges of Human Medicine and Osteopathic Medicine at Michigan State University (systems curriculum, discipline-based courses, problem-based independent study curriculum). The modules were designed to be usable by students in any order at any time, and could be used individually or in groups, and were required or optional for different sets of students. A log-in system and data

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