

Application of Several Multimedia Approaches to the Teaching of CNS Pharmacology: Parkinson's Disease and Antiparkinsonism Drugs¹

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PROLOGUE

Computer and multimedia-based technologies have been incorporated into a course in Central Nervous System Pathology and Pharmacology in order to facilitate learning in this area and to address multiple student learning styles. During the 1994-1995 year, multimedia classroom presentations annotated with appropriate pictures, graphics, animation, and sound were developed for the entire course. In 1995-1996, "Parkinson's Disease and Antiparkinson Drugs" (PD) were chosen as a focal area for the incorporation of additional multimedia approaches. A web page for PD was developed which was linked to related home pages and to outside WWW sites, and the showing and discussion of the movie "Awakenings" was used in recitation sections. Assessment of the methodology included a questionnaire of student acceptance of the individual components and a comparison of examination questions on PD over a three year period. Students found the multimedia classroom presentations and "Awakenings" very useful, but very few students used the web material. A comparison of PD examination results failed to show a difference over the three years. This may denote the failure of typical examination questions to assess the impact of the methodology rather than a failure of the methodology itself. Since the time of assessment, an interactive animated movie on the action of drugs in PD has been added. Improvement of multimedia presentations and the development of web pages for other subject areas are currently under way. Incorporation of these components into distance learning modules is also planned.

INTRODUCTION

The advancement of computer technology is affecting pharmacy education, and higher education in general, in a profound and multifaceted manner. Presentation graphics programs now allow slide quality presentation of lecture and discussion material annotated with pictures, graphics, sound, animation and video clips. Interactive programs can be purchased or easily produced by faculty for use both in and out of the classroom. These and other course materials can now be made readily available on the World Wide Web. And a wealth of additional material is also available on the web from other sites. Students can easily communicate with faculty and each other by electronic mail (E-mail). Indeed,

The combination of web material, E-mail, and telecommunications introduce methodology which makes distance learning more effective and practical. The university educator now has the tools available to greatly improve the quality of education. In addition, the greater computer and media sophistication of the college student places greater expectations on the professor to adopt such methodology.

Efforts have been made to incorporate computer and multimedia-based technology into a course in Central Nervous System (CNS) Pathology and Pharmacology at Ohio Northern University over the past two years. Multimedia presentations were introduced in all classroom sessions during the 1994-95 academic year. For 1995-96, Parkinson's Disease (PD) was chosen as a model for the introduction of a number of additional computer-based approaches to education. This paper describes the computer-based methodology incorporated over the past two years in the course with specific emphasis being placed on the PD section. Assessment of the innovations consisted of determining student acceptance of the various components and comparing test results on questions pertaining to PD over a three year period.

DESCRIPTION OF TEACHING METHODOLOGY

The course in CNS Pathology and Pharmacology is a required, 4.0 quarter hour course which integrates the pathophysiology of CNS disorders and the pharmacology of the drugs which primarily affect the CNS. Students regularly take this course in the winter quarter of their fourth year of the 0-5 year program. The students have completed the Biochemistry and Physiology sequences as well as introductory courses in Pharmacokinetics, Pathology, and Pharmacology. Most students will have also completed Cardiovascular Pathology/Pharmacology, and be currently enrolled in Endocrine Pathology/ Pharmacology. The course is followed by a Therapeutics course which develops applications in the CNS as well as other areas. Class size over the three years in question ranged from 142-170 students. The entire class attends four hours per week of lecture/ discussion over the 10 week quarter, and meets again in one of six recitation sections each week. Recitations are arranged in a consortium with Endocrine Pathology/Pharmacology and Chemotherapy such that individual recitation sections of 20-30 students can meet one hour per week or three recitation sections can meet concurrently for three hours.

Because the innovations to be discussed were phased in over a two year period, and some have been developed since

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Table I. Chronological summary of multimedia utilized in teaching PD

1993-1994	1994-1995	1995-1996	Summer 1996 (post-assessment)
Lecture Outlines	Lecture Outlines Multimedia Presentation “Awakenings”	Lecture Outlines Multimedia Presentation “Awakenings”/Discussion Internet & World Wide Web Evaluation	Lecture Outlines Multimedia Presentation “Awakenings”/Discussion Internet & World Wide Web Interactive Animated Movie

the formal assessment. Table I is presented as a time table. The following discussion then addresses each of the innovations chronologically.

Lecture Outlines

Lecture outlines have been used for all lectures in this course for the past 19 years. These have evolved over this time to be progressively more comprehensive and to include more graphics. The outline along with the text book, marginal notes, and informal discussions, constituted the primary educational resources prior to the innovations begun in 1994-95.

Multimedia Classroom Presentations

Beginning with the 1994-95 quarter, all lectures in the course used a multimedia format (Freelance Graphics, Lotus Development Corp.®). Topical outlines which followed the lecture outlines were annotated with appropriate pictures, video, graphics, animation and sound. Most animation was produced using AddImpact (Gold Disk®) or page by page building of motion. The PD presentation is typical of presentations used throughout the course. The PD presentation was only slightly upgraded for 1995-96 with additional pictures and a video clip. Sample pages can be found in Figure 1. The bottom figure is an example of a “build” graphic whereby elements of the pathway are added in successive presentation pages.

Classroom Use of the Movie “Awakenings”

During the 1994-95 quarter, one of the three hour recitation sections was used to show the popular movie “Awakenings(1)”. This is an excellent film in demonstrating the symptomatology and progression of post-encephalitic Parkinsonism, and the introduction of l-dopa into therapy. The movie also depicts a dose response curve for l-dopa which allows for discussion of such things as a narrow therapeutic window and the “on-off” phenomenon. The film also depicts the interactive role between physicians, nurses and pharmacist. For the course in 1995-96, this approach was modified by the introduction of discussion questions which were completed by the students and discussed in class. A copy of the discussion questions can be found in Table II.

Internet and World Wide Web Applications

The beginning of the 1995-96 quarter saw the introduction of a CNS Pathology/Pharmacology World Wide Web home page. Initially, the syllabus was introduced along with a page on the neurophysiology of acetylcholine and dopamine which included introductory pathology and pharmacology applications. Each recitation section was given a one hour introduction on the use of the page and the World Wide Web in general via a networked classroom computer.

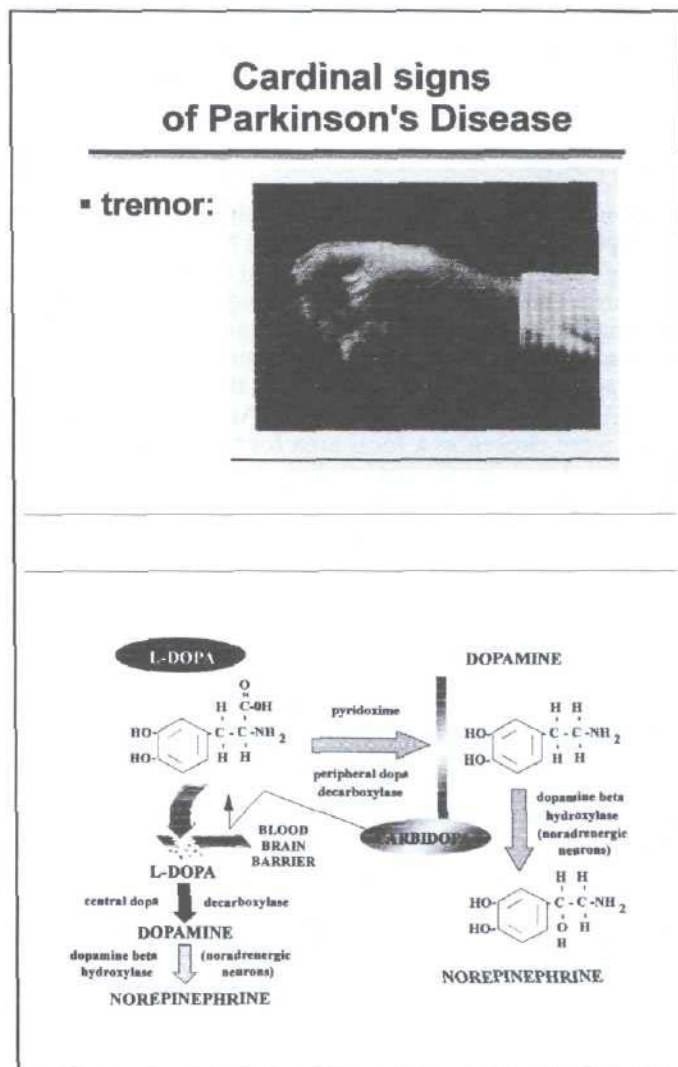


Fig. 1. Sample pages of multimedia classroom presentations.

Students were also given the E-mail address of the instructor and encouraged to use it anytime that questions arose.

Later in the quarter (subsequent to the PD presentations), a web page on PD and its treatment was introduced. The PD web page consists of approximately two type-written pages of text and several resident graphics designed to offer an overview of the disease and the drugs used to treat it. Individual words in the text are hyperlinked to either the resident graphics, the neurotransmitter page, or a glossary. Hyperlinks are also provided to outside PD pages, and the “Director” animation discussed below can be downloaded from the page. The links from the PD page are illustrated in Figure 2. As a final application towards the end

Table II: Discussion questions^a for the movie "Awakenings"

1. What is the pathophysiology of Parkinsonism?
2. What is the mode of action of levodopa? Since, the time of Dr. Oliver Sack's original observations in 1969, what has been done to improve the therapeutic utility of levodopa?
3. What are the common signs/symptoms of Parkinson's disease?
4. To design a drug study or any study, the researcher should start from a hypothesis. What is the hypothesis underlying Dr. Sack's experiment?
5. The movie describes the way the experiment was conducted; how might you change the design of the study?
6. In Awakenings, there is a chronological description of the dose response curve of favorable and adverse effects. Describe them. Are you familiar with any other drugs for which the therapeutic and toxic effects closely overlap?
7. What are the adverse reactions common to levodopa therapy?
8. Imagine that the year is 1969 and you are serving on the Institutional Research Ethics Committee that has to approve Dr. Sacks' protocol. Assuming that this is a double-blind, placebo-controlled study, what would you like to know to formulate your view?
9. What is the overall common mechanism of the current agents used in the treatment of Parkinson's disease? Name some of these agents.

^aModified from reference 2.

of the quarter, a page of sample examination questions was included on the web. These questions covered not only PD, but other areas as well. All World Wide Web material can be accessed through the internet at <http://www.onu.edu/user/FS/tFaulkner/parkinso.html>.

Student Performance and Material Evaluation

Following the final examination in the course, students were asked to complete a questionnaire concerning their perceptions of the various components of the computer and media applications. Included were examination questions on PD, some of which had been on the final examination and others which had not. Prior to the administration of the questionnaire, the students were totally unaware that a questionnaire was to be given, or that there was a reason for any perceived focus on PD. Student perceptions were analyzed and are discussed below. Success in answering the PD questions was compared to the results on final examinations from the previous two years.

Interactive Animated Movie: "The Effects of Dopaminergic Drugs in Parkinson's Disease"

An animation movie, using Macromedia's "Director," was prepared to demonstrate the effects of dopaminergic drugs in PD. The movie begins with a description and illustration of the relevance of striatal dopamine in PD. An animation of dopaminergic function is then presented using the classical synaptic model. By clicking on buttons labeled "l-dopa," "amantadine," "ergolines," or "selegiline," the effects of each drug on dopaminergic function is demonstrated. Pop-up textual descriptions of the drug effects, the graphic metaphors, and the use of the program add to the interactivity. Sample still frames extracted from the animation are shown in Figure 3. As noted above, the movie can be downloaded from the PD web page.

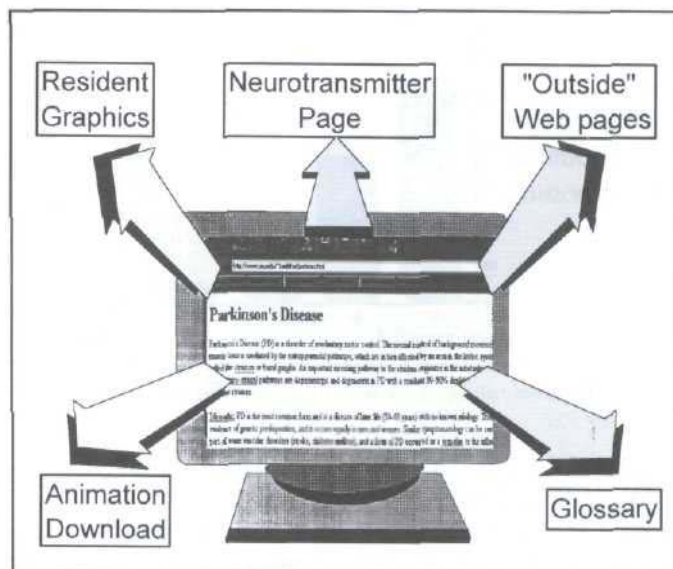


Fig. 2. Internet and world wide web page. These pages can be accessed through the Internet at <http://www.onu.edu/user/FS/tFaulkner/parkinso.html>.

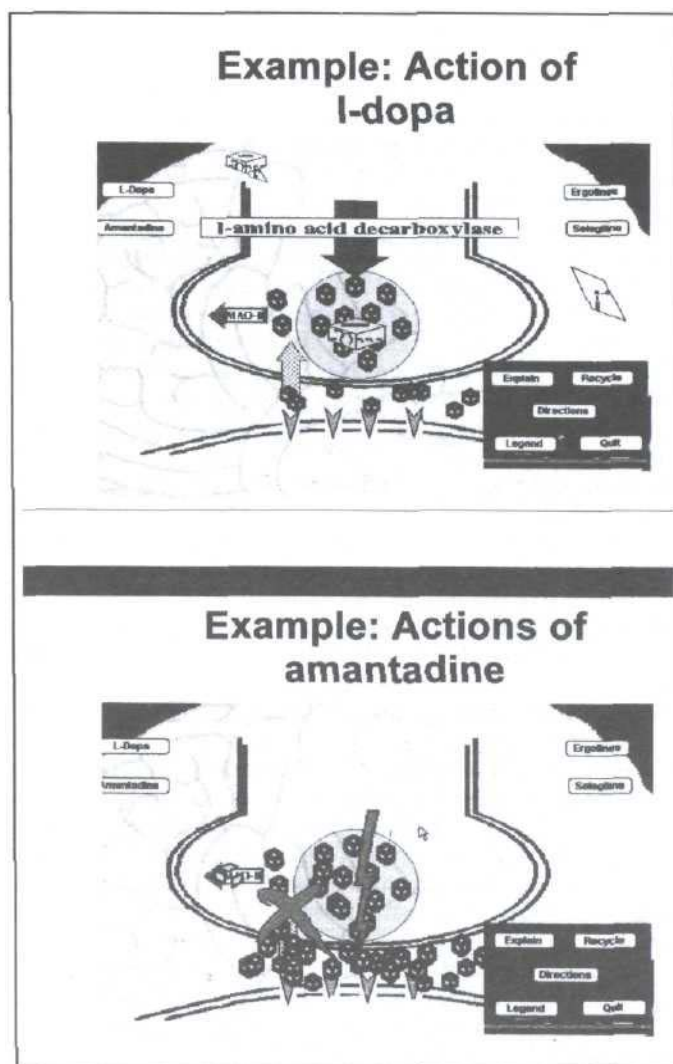


Fig. 3. Interactive animation movie: "The effects of dopaminergic drugs in Parkinson's disease."

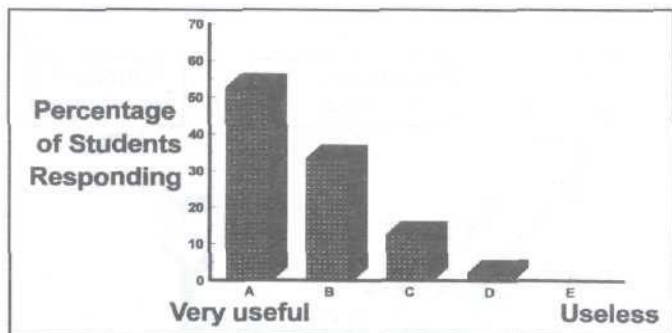


Fig. 4. Approval rating of the use of multimedia classroom presentation for PD.

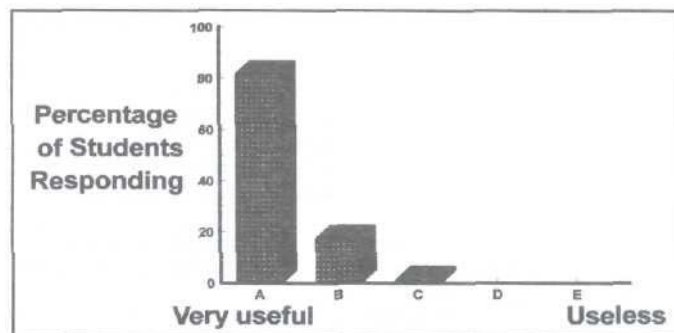


Fig. 5. Approval rating of the movie "Awakenings" for the teaching of PD.

EVIDENCE OF STUDENT LEARNING AND OTHER EVALUATIVE DATA

A total of 162 (100 percent) students completed the questionnaire; 150 of these also completed the supplemental examination questions. As part of the questionnaire, the students were asked to give their overall grade point average (GPA). Analysis of the data based on GPA did not yield significant differences from the pooled results. Therefore, only the pooled results are included.

The students reported attending class on an average of 82 percent of the time. However, 92 percent of the students reported attending the lectures on PD. The high attendance for the PD lectures does show that a vast majority of students had a basis for evaluating the PD multimedia presentations.

The use of multimedia classroom presentations for PD received an overall high approval rate of 85 percent (total of top two ratings) by the students (see Figure 4). This approval rating is greater than that for multimedia presentations in general (66 percent). Because there were no appreciable differences in the nature of the PD presentations vs. other subjects, this probably reflects a greater appreciation of the subject matter *per se*. Only a few students rated the multimedia presentations as useless. Seventy-two percent of the students said that they would like to see more use of multimedia presentations in other courses. These results indicate that students in general perceive this approach as helpful, or at least enjoy lectures utilizing multimedia.

The use of the movie "Awakenings" received the highest approval rating (98 percent), and 91 percent of the students said that they would like to see techniques like this used in other courses (see Figure 5). Koren (2) also reported on the success of using this movie for medical students.

Students did not report much use of the web material. The greatest number (31 percent) reported using it to access the sample test questions. Most students already have access to old examinations, but few (0.6 percent) confess to using these as a primary study source. The Director movie had not been available at the time the questionnaire was completed. Student response following a small (12 students) summer school class did, however, suggest high acceptance.

Lecture handouts were the primary method for studying the PD section for the final examination (88 percent). This is not surprising because few students used the web material, and multimedia presentations and the movie are really not able to be studied as such. The lecture handouts received a high acceptance rate (80 percent), but several comments suggested that the comprehensives of the handouts encouraged absenteeism and a lack of attentiveness in

class because fewer notes needed to be taken.

Student performance on PD examination questions did not significantly differ over the three years studied (see Figure 6). Therefore, no educational impact was demonstrated as having resulted from the introduction of multimedia presentations, the use of popular video, or web applications. A comparison of yearly examination results is subject to many other variables, some of which are discussed below.

DISCUSSION AND FUTURE DEVELOPMENT

The various multimedia components described above were introduced to facilitate the learning of material traditionally taught in the course, rather than to add new material. Therefore, lecture outlines, presentations, web material, and interactive animations addressed the basic pathophysiology and the drugs used to treat PD using consistent organization, terminology, and graphic metaphors. Indeed, these are consistent throughout the course as well as between the components of the PD material.

The educational value of approaching the same material through different methods is based on addressing different learning styles. The "Visual" learner is the most obvious beneficiary of the graphics, animation, and video contained in all components. The "global" learner now has various methods to gain understanding of the "big picture". "Reflective" learners should benefit from the self-paced processes of "web browsing" and interactive animation. "Active" learners may find particular benefit in the "Awakenings" approach because there is ample time to discuss material and relate it "to the real world." "Verbal" and "sequential" learners retain the traditional written and verbal, linear approach to the material.

Although the primary intent is to provide several avenues to address the same material, exposure to new material also occurs. The use of "Awakenings" certainly exposes the student to additional psycho-social, historical, and scientific aspects of Parkinsonism. The hyperlinks to other World Wide Web sites provide the student the opportunity to go beyond the material provided in the course *per se*.

There were many rewarding but several disappointing aspects in conducting this project. Most disappointing, obviously, was the inability to demonstrate improved test performance concurrent with what should be improved teaching methodology. There are obviously other factors involved in comparing yearly examination results including different students, different class sizes, different examination times, varying difficulty of the questions, etc. These are, for the most part, uncontrollable. Other factors however, deserve consideration. This was an almost totally new approach to

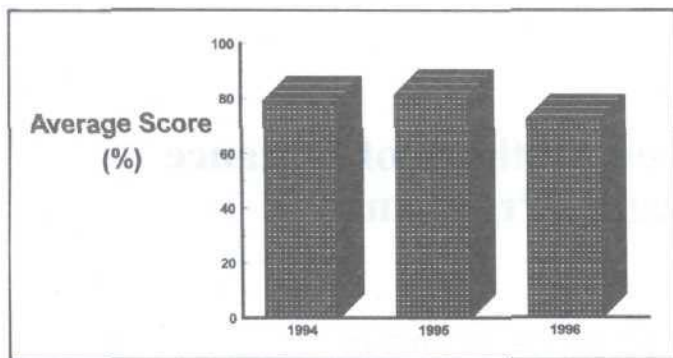


Fig. 6. Three year examination results comparisons for PD. ANOVA analysis with Student Newman Kuels post hoc test indicates no significant differences over the three-year test period.

learning for most students, and students may be expected to exhibit a certain degree of comfort in relying on “tried and true” methods for examination preparation. Indeed, the results of the questionnaire indicated very little use of the web material except for old test questions. Possibly, the typical multiple choice examination questions do not measure the broader, or the long term retention values of the present teaching approach. In any case, these results certainly do not indicate that the use of multimedia should be abandoned.

Most rewarding was the student appreciation of the methodology. The large majority of students apparently perceive that they benefited from the multimedia presentations, and the use of “Awakenings.” Unfortunately, only a few students used the web material. However, this may be partially explained by the fact that the PD page was introduced relatively late in the quarter, and PD was only one of many subjects covered on the final examination. Perhaps many students felt using this method for only one subject was not worth the effort. Some individual comments on the questionnaire, also suggest that the majority of the class is not yet comfortable using the web. For example, one student said “... keep in mind some people are still intimidated by computers. I think that as years pass the response will get even better.” Informal “polling” of the class during the web introduction recitation period indicated that few students had used the internet in previous courses. Because use of the

web was optional, the vast majority of students apparently declined to use this source of information.

The completion of the interactive animated movie on the action of dopaminergic drugs will complement the other multimedia based material on PD. Because the interactive animated movie was not available to the last class, it will be evaluated in the future. The authors feel that this may prove to be one of the most valuable components to this multimedia approach

The combination of multimedia approaches to PD will provide the basis for upgrading all subjects in the CNS pathology/pharmacology course, and probably other courses in the college. Because multimedia lecture presentations are available for all lectures in this course, upgrading these with additional graphics, animation, and video clips will be relatively easy. The development of web pages and hyperlinks to other World Wide Web sites for other subjects discussed in the course are currently under construction. Finally, the Director movie animation for PD can be easily modified to produce other movies which can demonstrate the mechanism of action of other CNS active agents.

The production of the materials presented here and in the future has application beyond use in this course. The web material and animation are easy sources of review for students in higher level courses both on and off campus. The use of the web can also provide a source for Pharmacy continuing education. Combined with teleconferencing, videotape, and CD-ROM resources, these materials form modules for the offering of formal courses which can be taken at distant sites. The development of such modules is fundamental to the projected demand for classes aimed at the non-traditional Doctor of Pharmacy degree.

The incorporation of computer-based and multimedia technology is still in its infancy, but is in a state of rapid development. Pharmacy educators cannot ignore the tools which are now at their disposal.

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References

- (1) *Awakenings*. Columbia Pictures, Los Angeles CA (1990).
- (2) Koren, G., “Awakenings: Using a popular movie to teach clinical pharmacology.” *Clin. Pharmacol. Ther.* **53**,3-5(1993).