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THE IMPACT OF MULTIMEDIA ON TEACHING TROPICAL MEDICINE

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ABSTRACT. This study evaluated the impact of multimedia in the information transfer of subjects specific to Tropical Diseases - Tetanus and Snake Envenoming. We evaluated the autonomous learning process of 76 fourth-year medical students at Botucatu School of Medicine of UNESP, using printed matter, video, and CD-ROM. The students were submitted to a specific test, which was repeated approximately one week later. They were divided into groups and received a kit containing a textbook, a video, and a CD-ROM. These materials were used for out-of-class study. Before the second test, the students gave a seminar, where they discussed and resolved their doubts with their professor. The results of the first test showed averages between 4.27±1.41 and 6.41±1.61. The second test, given after the seminar, presented averages that increased to 8.41±0.76 and 9.52±0.42, significance $\alpha = 5\%$. At the end of the course, the students answered a questionnaire, which evaluated the material quality and acquired knowledge. The students concluded that multimedia was a more efficient and quick means for knowledge building than traditional teaching materials. They said that the active participation and interactivity with the CD-ROM were the major differences. The authors continue to study the associated use of printed matter, video, and CD-ROM as a faster alternative to the traditional method of information transfer, which may be of help in the knowledge building process in medical education.

KEY WORDS: Medical education; tropical diseases; multimedia; video; printed matter.

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INTRODUCTION

"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change". This was immortalized by Charles Darwin (8), one of the most brilliant scientists of the 19th century. Great challenge for medical schools is to be able to change to complete their program.

These statements are related to human evolution. Thus, in relation to knowledge growth, approximately 9,000 scientific articles were published worldwide in 1900; 90,000 in 1950; and 900,000 in 2000, that is, an exponential growth of approximately 10 times every 50 years (11).

In this context, the time available for medical school teaching staff to transfer a larger quantity of information has been the same since 1950, that is, six years. The quantity of medical knowledge has increased significantly; therefore, the amount of knowledge the physician needs for a good education does not fit within the current curricular limits. There are, however, some alternatives to address this challenge: increase the duration of some undergraduate courses; eliminate some disciplines; or develop faster systems for construction of knowledge. Which of these alternatives would be less traumatic and more productive?

Studies have shown that people learn and memorize 20% of what they hear, 40% of what they see and hear, and 75 % of what they see, hear, and do. It is well known that they learn faster, understand better, and memorize more when the senses are stimulated together (12,14).

Based on these considerations, since 1995 we have studied alternative methods for information transfer to make the medical knowledge building process faster (1). A little later, we began developing systems with multimedia linked to traditional media. Today, several systems are being used by medical students (2-4,6,7,9,10). Two of these systems – Tetanus and Snake Envenoming – are the subject of this study (2,3).

The following questions remain unanswered: what is the best way to make these systems available? Do they really help construct knowledge more quickly? Do these new methods motivate the students?

This study attempted to answer these questions by evaluating medical students studying in this manner.

MATERIALS AND METHODS

Sample characterization

The course on Infectious and Parasitic Diseases of the Department of Tropical Diseases and Imaging Diagnosis at Botucatu School of Medicine of UNESP is offered annually to fourth-year medical students. It consists of lectures, seminars, directed study, and clinical case discussion of patients hospitalized in the Tropical Diseases Clinic.

In 2001, the students were divided into three groups of 30, Groups A, B, and C, respectively. These students attended the course on Infectious and Parasitic Diseases at different times. Fourteen students (15.5%) completed the course and took the tests, but chose not to answer the end-of-course questionnaire. The other 76 students (84.5%) were evaluated; 45 were female (59.2%) and 31 (40.8%) male aged between 20 and 28 years; most (69.8%) were between 22 and 23 years.

Teaching Material and evaluations

In this study, 30 students were subdivided into six groups of five each.

One week before the Tetanus and/or Snake Envenoming seminars, each Group was given a kit containing a textbook, a video, and a CD-ROM. These kits were used by the students out of the class. Before receiving the kit, the students were given a surprise test on Tetanus and/or Snake Envenoming on different days.

The seminars were delivered approximately one week after receiving the kits and lasted from 40 to 60 minutes; all doubts, at least theoretically, were resolved by the professor. The second evaluation was at the end of the seminar presentation.

This study analyzed evaluation results of Groups A and B.

Description of the Materials

These included a textbook, a video, and a CD-ROM.

Textbook: The 70-page textbook comes with a video or CD-ROM.

Video: The 15 to 20-minute duration videotape was professionally produced. It did not include filmed classes, professor's explanations, but it had images and animations.

CD-ROM*:* It was hierarchically developed, with no need for installation. When the CD-ROM is placed in the computer drive, the system is started, taking the student to the initial navigation screen; this has the following buttons: start, support, help, and exit. The start button takes the user directly to the CD technical content; the support button presents the sponsors; the help button shows a five-minute mini-video, teaching the user about the available navigation systems; and the exit button exits the system.

The start button takes the student to the general navigation system, containing the history, etiology, epidemiology, pathogenesis, clinical picture, diagnosis, treatment, and prophylaxis. Each content from history to prophylaxis consists of approximately 10 static screens. Navigation is linear with interactive buttons opening explanation windows, sounds, videos, and animations. The last screen has buttons leading to bibliographic references, evaluation system, and author selected Internet pages.

The evaluation system includes yes/no and multiple-choice questions, with or without images. If the student scores more than 70%, he can access the comments.

The CD-ROM has data retrieval tools such as content, index, and find. These allow the user to search all CD-ROM content and move to the subject of his choice by clicking the mouse.

The especially selected Internet pages can be visited without exiting the CD-ROM structure.

Evaluation questionnaire

After the second test, all students were invited to answer the following questionnaire:

Teaching material evaluation

1-Age: _____years
2-□ Female □ Male
3-Do you have a computer with multimedia? □ yes □ no
4-Are you accustomed to using a computer for your medical papers, research on the Internet, and research in the library? □ yes □ no
5-Have you read the textbook?
□ yes □ once □ 2 twice □ three times or more □ no

6-Have you watched the video?
□ yes □ once □ twice □ three times or more □ no
7-Have you explored the CD-ROM?
□ yes □ once □ twice □ three times or more □ no
8-Have you used the index to explore the CD-ROM? □ yes □ no
9-Which computer have you used to explore the CD-ROM?
□ yours □ a friend's □ the university's
10-Have you completed the CD-ROM exercises?
□1chapter □2 chapters □3 chapters □4 chapters □5 chapters □6 chapters □7 chapters □ 8chapters □ no

Specific evaluation of the CD-ROM development

11-Number of audio narrations:
□ excessive □ good □ insufficient
11A-Quality of audio narrations (clarity, speed, diction):
□ excellent □ very good □ good □ bad □ very bad
11B-Combination of audio narrations with background music:
□ pleasing □ unpleasant □ inadequate
11C-Intensity and quality of sounds:
□ excessively loud □ loud □ low □ very low
11D-Quantity of images:
□ excessive □ good □ insufficient
11E-Quality of images:
□ excellent □ very good □ good □ bad □ very bad
11F-Quality of background textures:
□ excellent □ very good □ good □ bad □ very bad
11G-Quantity of mini-videos:
□ excessive □ good □ insufficient
11H-Quality of mini-videos:
□ excellent □ very good □ good □ bad □ very bad
11I-Quantity of animations:
□ excessive □ good □ insufficient
11J-Quality of animations:
□ excellent □ very good □ good □ bad □ very bad
11K-Font size:
□ excellent □ very good □ good □ bad □ very bad
11L-Evaluation system:
□ excellent □ very good □ good □ bad □ very bad
11M-Quality of evaluation tests:
□ very difficult □ difficult □ adequate □ easy □ very easy
11N-Teaching methodology on the CD-ROM:
□ excellent □ very good □ good □ bad □ very bad
11O-Technical scientific information on the CD-ROM:
□ excellent □ very good □ good □ bad □ very bad

Knowledge building process:

12-Did you need help from the professor during seminar presentation?
□ yes □ no
13-In your opinion, which media most contributed to your learning?
□ video □ textbook □ CD-ROM □ all of them
14-Have searched for complementary information in other places?
□ traditional books □ scientific journals □ Internet □ others
15-If you had to take a test now would you:
□ Be prepared to answer the questions?
□ Need more time to study?

16-What do you think of taking a test at the end of each seminar?
□ I feel prepared
□ The information is sufficient
□ I need more time to study at home
17-What kind of teaching material did you expect to find on the CD-ROM?
18-Make a brief analysis of the textbook, video, and CD-ROM.
19-Do you have any comments on any of the chapters?

Grade Criteria

Excellent/up-to-date:	9 &10	Very difficult:	9 & 10
Very good:	7 & 8	Difficult:	7 & 8
Good:	5 & 6	Adequate:	5 & 6
Bad:	3 & 4	Easy:	3 & 4
Very bad:	0, 1, & 2	Very easy:	0, 1, & 2

RESULTS

Use of teaching materials

Of the 76 students, 44 (57.9%) used the computer to study; 30 (39.5%) owned computer; 58 (76.31%) watched the video; 75 (98.7%) read the textbook; and 68 (89.5%) used the CD-ROM. Thirty-six (47.4%) students read the textbook more than once; and 24 (31.6%) students used the CD-ROM more than once.

The CD-ROM data retrieval system, mainly the index, was consulted by 55 (72.36%) students. The evaluation tests were completed by 44 students (57.9%); 16 (21.05%) did not take the test; and 16 (21.05%) did not complete all the tests.

Aspects of the CD-ROM development

In this study, we assessed the methodology, content, audio narration, images, mini-videos, animations, fonts, and evaluation system, with the following results:

- methodology: 71 students (93.42%) said it was of good quality;

- content: 70 students (92.1%) said it was up-to-date;

- audio narrations: 57 students (75%) said the quantity was adequate and 52 (68.43%) excellent. Background music: 56 students (73.7%) said it was pleasing;

- images: 63 students (82.9%) said the quantity was adequate, and 67 (88.15%) said the quality was good and excellent. Background: 67 (88.15%) students said it was adequate;

- mini-videos: 56 students (73.7%) said the quantity was sufficient and 20 (26.3%) insufficient; 68 (89.47%) said they were of good and excellent quality;

- animations: 66 students (86.85%) said they were sufficient and 70 (92.1%) of good and excellent quality;

- evaluation system: 65 students (85.5%) said it was good; 65 students (85.52%) said questions were adequate, 2 (2.63%) said they were easy, and 9 (11.85%) said they were difficult.

Aspects related to knowledge building

The students were asked about the need for complementation by the professor after the study; 44 (57.9%) answered that it was be necessary and 32 (42.1%) unnecessary.

In relation to knowledge building, 35 (46.05%) answered that the CD-ROM was the media that contributed the most; 21 (27.63%) said the combination of the textbook, video, and CD-ROM was the most important. The textbook and e the video were the most important for 10 students (13.15%).

Fifty-seven students (75%) considered unnecessary to search for complementary information in other places.

The evaluation after the seminar showed that 55 students (72.36%) were prepared to answer the questions. The students considered interesting to take an evaluation at the end of each seminar, and unnecessary to take an evaluation at the end of the course. This proposal was considered ideal for 62 students (81.58%).

Results of the evaluations

Table 1 shows evaluation results after the seminars.

Data in Table 1 show that before the Tetanus seminar, Groups A and B had averages of 5.72 and 6.41, respectively; after the seminar, these were 9.10 and 8.59 respectively.

In relation to Snake Envenoming, Table 1 shows averages of 4.27 and 4.35 for Groups A e B, respectively; after the seminar, these were 9.52 and 8.41, respectively.

Table 1. Results of Groups A and B evaluations before receiving the materials and immediately after the seminar.

Subject	*Groups*	*Before (B)* $X \pm s$	*After (A)* $X \pm s$	*Calculated t Test* $\alpha = 5\%$	*Critical t Test* $\alpha = 5\%$	*Comments Before x After*
Tetanus	A, n=25	5.72±1.14	9.10±0.59	-14.09	-1.71	B < A
	B, n=27	6.41±1.61	8.59±1.47	-4.75	-1.76	B < A
Snake envenoming	A, n=22	4.27±1.41	9.52±0.42	-17.86	-1.72	B < A
	B, n=27	4.35±1.46	8.41±0.76	-12.09	-1.70	B < A

Statistical analysis revealed 5% significance level in the comparison of before x after values for all samples.

DISCUSSION

Candidates intending to follow a medical career should be aware of the need to attend the best schools and prepare themselves well for the entrance examinations. This should include courses on computer science. The good schools and pre-exam preparation courses give the student the opportunity to use new technological tools, mainly the Internet, which will help search for information, contributing to knowledge building. Everything the student learns at this time should be used when he enters the university, but this does not happen; he is faced with a traditional classroom and a professor giving four-hour classes, using blackboard, chalk, and slides. It may seem absurd, but this is what happens in most Brazilian medical schools.

Young students apparently enter the university aware of the importance of autonomous learning and the need to be up-to-date and informed. They are, by nature, interested, curious, and active towards recent advances. For them, research on a certain subject is a dynamic and active process, which improves and helps knowledge construction (13). They are part of a more participative and integrated learning process, aware of their role in the knowledge building process. This generation knows that knowledge is not transmitted, but constructed.

They know that they will have to be partners of their professors in their career construction!

This is all very beautiful in theory, but in practice, they soon realize that things are not quite the way they imagined; this is reflected in the passive attitude they begin to assume. This generates disinterest, and they only fulfill the minimum requirements laid down by the university. How can this be changed?

Construction of knowledge without the professor's presence is for this new generation a less stressing alternative, as the student can leave the class and study at more convenient times (5,15,16).

Distance teaching has become one of the major challenges of these days. We have studied this subject since 1995 when we noticed the students' disinterest in class and decided to innovate by associating different media in content presentation. Paper is the oldest medium used in information transfer, beginning in the 15th century when Gutenberg invented the press (1,5,16).

The development of information technology has introduced new media to traditional teaching, such as radio, television, and more recently, the computer; these have and still play a major role in this area.

The computer has revolutionized the teaching/learning process with the inclusion of sounds, images, texts, videos, animations, and interaction with Internet pages (15).

Today, the major question that still remains for those who teach using the new technologies is if the multimedia really helps knowledge building more quickly.

Concerned with this answer, multimedia systems have been developed as complementary material for use in medical teaching (2-4,6,7,9,10). In this study, the students received a kit consisting of a textbook, a video, and a CD-ROM and were submitted to two evaluations. At the end of the course, they answered an evaluation questionnaire.

The students were asked about the kit, and most answered that they had read the textbook. This shows that printed matter is still important for today's youngsters, as it still is the most practical and safe means for transferring information.

Approximately 90% of students used the CD-ROM; 31,6% used it more than once, which indicates that it is familiar to them and arouses their curiosity.

Recording a CD-ROM is a technology available to those who own a computer with a CD-ROM recorder. Thus, some people believe they are able to develop a CD-ROM. However, the development of a multimedia system, which allows a student to acquire knowledge, is not that simple. We have already developed six CD-ROM's and each has its own peculiarities and new tools. The CD-ROM evaluation has shown that 72.36% of the students used the data retrieval system in search of information. This is fundamental in the structure of any CD-ROM. The software we used to develop the Tetanus and Snake Envenoming CD-ROM's allows the user to search for key words and authors, using an index and a data retrieval system. This is an indispensable tool for distance teaching.

Evaluation by yes/no and multiple-choice questions or with images is another essential tool for the students; they should be strategically placed at the end of each chapter. Commented evaluations help assimilate the subject more quickly. In this study, 21% of the students did not do the exercises because they might not know their importance in autonomous learning.

CD-ROM's should include the possibility of interaction with the Internet. The systems used by the students allow navigation to pre-selected Internet pages without exiting the CD-ROM structure.

In relation to access to information for knowledge construction, the students were asked about the need for complementary guidance by the professor and 57.9% answered that it was important. They said the CD-ROM was the medium that contributed the most; for 27.63% the combination of the three media was more appropriate than the use of each one separately.

The evaluations made before the study showed a variation between 42.7% and 64.1% and after between 84.1% and 95.2%, which suggests that the students learned.

What is the best way to make these systems available? Do they really help construct knowledge more quickly? Do these new methods motivate the students? With regard to these unanswered questions, we still do not know the best way to develop these systems; but we do know that the CD-ROM should contain simple language, linear navigation, images, videos, and animations.

The students answered that these systems allow quicker knowledge construction than the traditional methods. It took them about five hours to read the textbook, explore the CD-ROM,

and answer the evaluation questions. Images, videos, and animations seem to permit a quicker and more permanent assimilation of content.

The new idea seems to be familiar to the students, stimulating their autonomous learning. Out-of-class study generates doubts and reflections, requiring at some time, student/professor interaction, even at a distance. Maia (13) believes that this new generation knows what they want and are not satisfied with "the chalk and dust" of traditional classes. They want more because they are aware that they know they have more to offer to society.

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