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The disease game: Enhancing test selection and diagnosis and treatment skills by use of computer simulations

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The disease game: Enhancing test selection and diagnosis and treatment skills by use of computer simulations

Abstract
Computers are being used frequently in educational environments these days. The Disease Game is a computerized game that tests one's knowledge of diagnosing and treating ocular diseases. Ten subjects (5 fourth year and 5 third year optometry students) were chosen to play this game and rate the game in terms of its accessibility, effectiveness, and enjoyment versus other conventional methods used. It was concluded that the Disease Game could be a valuable supplement to existing teaching methods in the classroom.

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THE DISEASE GAME: 
ENHANCING TEST SELECTION AND DIAGNOSES 
AND TREATMENT SKILLS BY USE OF 
COMPUTER SIMULATIONS 

By 

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A Thesis submitted to the faculty of the 
College of Optometry 
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MEET THE AUTHORS

Derrick Abe:
Attended the University of Hawaii for 3 years. During these 3 years Derrick was intrigued by the science field. He then went on to Pacific University to attend the College of Optometry. While at Pacific University, Derrick received a Visual Science degree. He also participated in two fraternities, the Beta Sigma Kappa (BSK), and Phi Theta Upsilon (PTU).
Derrick plans to work for a practicing Optometrist in Hawaii for a few years before practicing on his own.

Douglas Egbert:
Attended the University of Miami in Ohio for 3 years. Doug then attended Pacific University College of Optometry. While at Pacific University, he received a Visual Science degree. He also was a member of the PTU fraternity.
After Doug graduates he plans to practice with his dad in Ohio. His dad is the owner of several well established practices.

Dirk Fujii:
Graduated from the University of Hawaii in the spring of 1991 with a Bachelor of Arts degree in Psychology. Dirk then attended the Pacific University College of Optometry in the fall of that same year. While there he was a member of the PTU fraternity.
After graduation Dirk plans to practice with either an Optometrist, or an HMO program for a year. He will then open up a solo practice in Hawaii.

Neal Kubo:
First attended the University of Pacific for a year, then transferred to the University of Hawaii. After 4 years of undergraduate school, Neal was accepted into Pacific University’s College of Optometry. While there he was a member of BSK, and PTU.
Immediately after graduation Neal plans to open up a solo private practice on the Big Island of Hawaii.
ACKNOWLEDGMENTS

We would like to extend our most special thanks to our advisors; Dr. Diane Yolton, and Dr. Robert Yolton for their patience and helpfulness. We would also like to express our gratitude to the person who made everything possible, Dr. Alan Leroy. Alan not only wrote the program, but also provided that extra hand whenever we had computer trouble. Also at this moment, we would like to thank the 10 players that participated in our thesis for taking the time out to evaluate the Disease Game.
ABSTRACT

Computers are being used frequently in educational environments these days. The Disease Game is a computerized game that tests one's knowledge of diagnosing and treating ocular diseases. Ten subjects (5 fourth year and 5 third year optometry students) were chosen to play this game and rate the game in terms of its accessibility, effectiveness, and enjoyment versus other conventional methods used. It was concluded that the Disease Game could be a valuable supplement to existing teaching methods in the classroom.
INTRODUCTION

As we all know, computers are fast becoming a popular tool for education. Students use computers because it takes less time to type and correct academic material. There are many brands of computers available to the consumer; however, people usually buy brands that are the easiest to use. The Apple Macintosh is such a computer. The Macintosh is very user friendly and can be operated by the most novice person.

For our experiment we selected the Macintosh specifically for this reason. We attempted to allow each operator to get through the testing with the least amount of frustration. We thought that if we reduced frustration, learning would be more enjoyable, stimulating, and all together more worth while.

The purpose of this experiment was to determine how effective a computer program "The Disease Game" can be when it is used as a learning aid for students in optometry school. The "Disease Game" is a program written by Alan Leroy. He did a thesis report on a parallel program, "The Optometry Game" which, for those who are interested, contains an in-depth review about computers and some information dealing with programming. This research paper was submitted in the spring of 1993 at Pacific University College of Optometry. We also found that the information contained in the books "Macintosh Bible and The Computer Curmudgeon" were very helpful and enabled us to further understand the intricacies of the Macintosh computer systems.(5,6)

The "Disease Game" is an innovative and fun computer program which tests the basic knowledge necessary for proper diagnoses and treatment of various ocular diseases. The game personifies the term "user friendly" since basic computer understanding is all that is required to be successful in operating this program. Its pull down menu's illustrate all the possible tests available and the results of each depending upon the particular case being reviewed. The game even includes a portrait of each patient and important pictures pertaining to their specific disease.

This computer game was written to supplement a traditional ocular disease lecture course. It was written to simulate a routine exam that might take place between an optometrist and a patient. This case-based learning approach had several objectives. The first was to help the student select the most appropriate
tests using information revealed by previous testing. The second goal was to help the student learn how to develop a differential diagnosis. And third, this program was meant to be enjoyed and that solving these cases was a satisfying and enriching learning experience.

The objective of this thesis, then, was to evaluate the program using 3rd and 4th year optometry students to test its effectiveness as a teaching aid. Each of the students was given an instruction sheet which guided him/her through the experiment. After turning the computer on and loading the Disease Game program, 5 cases arranged in a specific order were presented to each student one case at a time. The student was timed on how long it took to complete each case and after finishing the game, the students were given an evaluation form.

**DIRECTIONS FOR THE GAME**

To begin playing the game, open "The Disease Game" file. You will see retinal pictures with "The Disease Game" written next to it. Click once on the mouse to continue. Type in your name in the appropriate space and press enter. Next, go to 'patient' on the menu and scroll down the list to select 'open patient'. You then open patient 1 and then open patient 1 data on the following screen. A computerized voice will announce "doctor, your patient has arrived" and a picture of your patient will appear on the computer screen. Click once on the mouse to begin playing the game.

During the game the student is asked to select the tests to be performed in order to diagnose the patient's problem. After each test is selected, the results of that test for that patient are shown. Just as during a real exam, the doctor makes decisions about which tests need to be done after receiving information from the previous tests, this interactive program also asks the student to select the next appropriate test using the information received from previous tests. Also, just like during a real exam, the doctor must maximize his/her time to make the most profit by selecting the most appropriate tests to lead to a diagnosis, during the game the student is also encouraged to make the best use of his/her time. Each test costs the doctor a certain amount of money proportional to the
time the doctor must take to complete the test. This amount is subtracted form
the initial $100 given to the doctor to complete the exam. The money remaining
after the diagnosis is made is the amount the doctor makes on this exam.
Some of the tests may have 'see picture' written in the results. To view the
picture, go to 'pictures' on the menu and scroll down to open the appropriate
picture.

Once you think you have come up with the correct diagnosis and severity, go
to 'patient' on the menu and scroll down to 'diagnosis and treatment'. A list of
different ocular conditions will appear. Select the appropriate diagnosis and
severity and then press enter. If you choose the correct condition and severity,
a voice will announce, "You must have gotten an A in disease class". If you
choose the incorrect diagnosis and severity, the voice will announce, "Another
wrong diagnosis, you must have missed class that day". The correct diagnosis
and severity will then immediately present itself so that the operator will know
exactly what it was that he/she got wrong. However, if a correct diagnosis was
chosen then you need to select the appropriate way to manage this patient by
choosing the best drug, concentration, form, dosage, any non-drug treatment, if
you are going to co-manage this patient, and when they need to come back for
a follow-up. If your treatment is correct a voice will announce "You must have
gotten an A in disease class". If your treatment is incorrect, the voice will
announce, "Do you really think that patient is going to get better with that
treatment, NOT!"

Once you have finished patient 1 you can proceed to the next case.

EVALUATION OF THE GAME

Five 3rd year students and five 4th year students were selected to play and
evaluate the game. The five cases that were evaluated were age related
macular degeneration (ARMD), acute bacterial conjunctivitis, diabetic
maculopathy, dry eye (keratoconjunctivitis sicca), and open angle glaucoma
(table 1). After each case, the evaluator filled out a questionnaire (appendix 1)
about the length of time it took to complete the case, whether or not the
diagnosis was correct, and his/her reaction to the game.
RESULTS

The evaluators of the Disease Game were asked to rate different aspects of the game. Specifically, they were asked to rate their general computer skill level, user friendliness, effectiveness, enjoyment, efficiency and practicality of the game (table 3). The response then to rating of general computer skill level was predominantly average to slightly less experienced in comparison to their classmates. Overall they found the relative ease of playing the game to be above average (the response of the 4th years being slightly higher than that of the 3rd years). Case presentations in class were evaluated as more effective, enjoyable and efficient over the use of the Disease Game by both the 3rd and 4th years. The only exception being that of the 4th years who ranked the Disease Game as more enjoyable. Reading journal articles was ranked last in the three categories with the exception of efficiency being rated slightly better than the disease game by the 4th year students. In terms of practicing and enhancing test selection and diagnosis determination skills versus that of the effort expended with real patients, the disease game was evaluated as above average, almost great. In response to the question, "Do you feel that use of the Disease Game with appropriate patients would be a valuable addition to courses in the College of Optometry?" 100% of the responses was "YES."

The representative comments made about the Disease Game was overwhelmingly positive (table 4). The students enjoyed the concept of intertwining computers and education. They found the interaction with the computer to be challenging yet fun. They especially liked the computer pictures and audio feedback.

The cases played by each evaluator was as follows: 1) Age Related Macular Degeneration 2) Acute Bacterial Conjunctivitis 3) Diabetic Maculopathy 4) Dry Eye (Keratoconjunctivitis sicca) 5) Open Angle Glaucoma. On the first patient (ARMD) both 3rd and 4th years took the longest time to complete. This was expected because the players were becoming familiar with the procedures of the game. Overall 4th years did better than 3rd years due in part to their increased knowledge base and clinic experience. Peculiarly, the 4th years required a longer amount of time to complete each patient verses the 3rd years. Interestingly the 3rd years all misdiagnosed dry eye while 60% of the 4th years diagnosed dry eye correctly.
All of the optometric students participating in the game have had previous exposure to the proper diagnosis and treatments of the diseases played. The cases were classic clinical cases, therefore we expected a higher percentage of correct responses for the diagnosis. We had anticipated a low percentage of correct treatments due to the vast number of treatment options available. In our cases we stuck to textbook treatments even though other treatments would have been valid. As expected, a major concern with all of the evaluators was that severity of diagnosis was somewhat subjective and failure to correctly choose the proper severity resulted in an incorrect diagnosis. Another concern of the evaluators was that there was only a limited amount of treatment options accepted by the computer. Many evaluators felt that their option was valid. Evaluators also complained about the Return to Clinic (RTC) date. For example, RTC date for some diseases or disorders can vary or in other words it is not set in stone. An incorrect RTC date would also result in an unacceptable diagnosis.

Although we felt some agreement with the evaluators that certain areas of the Disease Game may be a bit rigid, we felt the rigidity of the game increased its educational benefit. Almost without exception the only negative comments in evaluating the game revolved around the games rigidness. The Disease Game could be altered in the future to give a wider range of correct answers in order to increase enjoyment however it is our belief that a rigid game is more educational.

**DISCUSSION**

Overall the participants in this study felt the Disease Game would make a valuable addition to the classroom. They felt their knowledge about disease was tested in a relaxed unpressured stress free environment where they could move at their own pace. All of these factors plus the idea that mistakes are permissible in a computer simulation, but are devastating in real life contributed to the participants valued perception of the Disease Game.

The future of the Disease Game is limited only by the imagination of the programmer. The game could be used in testing situations, continuing education courses, study guides and lecture supplements. The game could be programmed to choose cases selectively in certain categories such as "Retinal Diseases," or could remain in a random order.
Computers are becoming an ever increasing fact of life and the full educational potential is just now being realized. In the future computers in the classroom will become the paper and pencil of today. With the advent of the information superhighway all Optometry schools could be linked and the Disease Game could be an ever increasing program of learning.
### TABLE 1

**CASES PLAYED BY THIRD AND FOURTH YEAR STUDENTS**

1. Age Related Macular Degeneration (ARMD)
2. Acute Bacterial Conjunctivitis
3. Diabetic Maculopathy
4. Dry Eye (Keratoconjunctivitis sicca)
5. Open Angle Glaucoma
### TABLE 2
**SUMMARY RESPONSES OF EVALUATORS TO SIMULATED PATIENTS**

**THIRD YEAR EVALUATORS**

<table>
<thead>
<tr>
<th>PATIENT</th>
<th>MEAN TIME TO PLAY PATIENT (in min.)</th>
<th>MEAN % OF CORRECT DIAGNOSIS ON FIRST TRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.2</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>7.2</td>
<td>60%</td>
</tr>
<tr>
<td>3</td>
<td>7.2</td>
<td>40%</td>
</tr>
<tr>
<td>4</td>
<td>9.4</td>
<td>0%</td>
</tr>
<tr>
<td>5</td>
<td>8.6</td>
<td>80%</td>
</tr>
</tbody>
</table>

**FOURTH YEAR EVALUATORS**

<table>
<thead>
<tr>
<th>PATIENT</th>
<th>MEAN TIME TO PLAY PATIENT (in min.)</th>
<th>MEAN % OF CORRECT DIAGNOSIS ON FIRST TRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15.0</td>
<td>40%</td>
</tr>
<tr>
<td>2</td>
<td>10.4</td>
<td>80%</td>
</tr>
<tr>
<td>3</td>
<td>14.0</td>
<td>40%</td>
</tr>
<tr>
<td>4</td>
<td>12.0</td>
<td>60%</td>
</tr>
<tr>
<td>5</td>
<td>9.8</td>
<td>60%</td>
</tr>
</tbody>
</table>
TABLE 3
SUMMARY OF RESPONSES OF EVALUATORS TO THE DISEASE GAME

1. Please rate your general computer skill level. (Data shown are the numbers of third and fourth year responses for each category.)

   - Less experienced than most of my classmates--Third=1 and Fourth=2.
   - Same as most of my classmates (average)--Third=4 and Fourth=2.
   - More experienced than most of my classmates--Third=0 and Fourth=1.

2. How hard was it to learn the Game's instructions and master the "computer aspects" of the Game, such as the pull-down menus, etc.? How user-friendly was the Game? Please rate this on a 1 to 10 scale with 1 being very difficult and 10 being very easy.

   - Mean rating for third year evaluators = 7.0
   - Mean rating for fourth year evaluators = 8.4

3. Please rank the following methods in terms of overall effectiveness as a teaching method, enjoyment, and efficient use of your time. Rank 1 as highest and 3 as lowest. Remember to consider only test selection and diagnosis determination skills.
Using the Disease Game Case
Presentations in Class
Reading Journal Articles

<table>
<thead>
<tr>
<th></th>
<th>Mean Ranks for Enjoyment</th>
<th>Mean Ranks for Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease Game</td>
<td>2.0/1.0</td>
<td>2.2/2.2</td>
</tr>
<tr>
<td>Case</td>
<td>1.6/2.4</td>
<td>1.6/1.8</td>
</tr>
<tr>
<td>Presentations</td>
<td>2.4/2.6</td>
<td>2.2/2.0</td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td></td>
<td></td>
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<tr>
<td>Journal</td>
<td></td>
<td></td>
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<tr>
<td>Articles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** (Data shown above are mean third year rankings/fourth year rankings.)

4. Assume that the effort you expend with real patients to practice and enhance the thinking skills associated with test selection and diagnosis determination has a value of 10. Considering only these skills, how would you rate the value of the Disease Game as a means of practicing and enhancing test selection and diagnosis determination skills?

- Mean rating by third year evaluators
- Mean rating by fourth year evaluators

---- O  X ----
Poor   Average  Great
X= third years
O= fourth years

5. Do you feel that use of the Disease Game with appropriate patients would be a valuable addition to courses in the College of Optometry? (Please answer yes or no.)

- Percentage of "Yes" responses from third year evaluators = 100%.
- Percentage of "Yes" responses from fourth year evaluators = 100%.
TABLE 4
REPRESENTATIVE COMMENTS ABOUT THE DISEASE GAME FROM PLAYERS

THIRD YEAR PLAYERS
- “This game makes you think.”
- “Good simulation of what could walk in the door!”
- “I liked the pictures and the wise cracks by the computer.”
- “I learned that I need to review disease and pharm notes!”
- “It really does make you think of supplemental test that can be done.”
- “It made me feel like a fool . . . but in a good way.”
- “It is a very interesting concept and I think it will be beneficial for future students.”
- “Excellent tool for learning.”
- “More practical vs. simply reading about a case or a specific disease.”
- “More enjoyable vs. just studying (memorizing) for a test.”

FOURTH YEAR PLAYERS
- “The Game is fun and this helps you learn. Also, you are competing against yourself.”
- “The Game allows you to move at your own pace and think as much as needed. You don’t feel pressured into making a decision which may cloud your judgments.”
- “The pictures were a great help.”
- “Really makes you think about the tests you run. Although you might run or not run necessary or reaffirming tests due to cost.”
- “It’s fun!”
- “You cannot do every single test on the patient because the money portion of the game moderates you (the doctor) to determine which of the tests is essential.”
Bibliography


Footnote

a The Disease Game program was written in Think C for use on Macintosh computers running 6x or 7.0 systems. The program is available on a non-exclusive site license basis for a nominal fee from Alan LeRoy, OD, 3607 9th Ave., Castlegar, BC, Canada, V1N 2Z6.