CaseBook: A problem-based learning online environment for high school microbiology

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ABSTRACT:

Problem-based learning (PBL) is an educational approach that allows students to improve problem solving and critical thinking skills while learning science. However, PBL requires significant teacher time and expertise to develop problems and facilitate small-group problem-solving sessions. With advances in technology, PBL can be used in today's classrooms in an effective and scalable manner.

CaseBook is an interactive computer system that allows for easy integration of PBL into the K-16 curriculum. Through a simple web-based interface, teachers enter and edit their case materials. As students work through cases, CaseBook guides them through a 3-stage process in which they analyze, learn and reflect. Students may work independently, or a small group of students may work together and share a Team Notebook, which is used to record facts, ideas, and issues about the case as they progress. Students assess their progress through self and group reflection and through teacher feedback.

In this poster, we report on the use of CaseBook for a microbiology case in a high school classroom. The results suggest that CaseBook is effective for both advanced and remedial students. As the technological capacity of students and classrooms increase, it is only appropriate to use this technology to implement novel methods of teaching that will provide students the skills they need post-graduation.

INTRODUCTION:

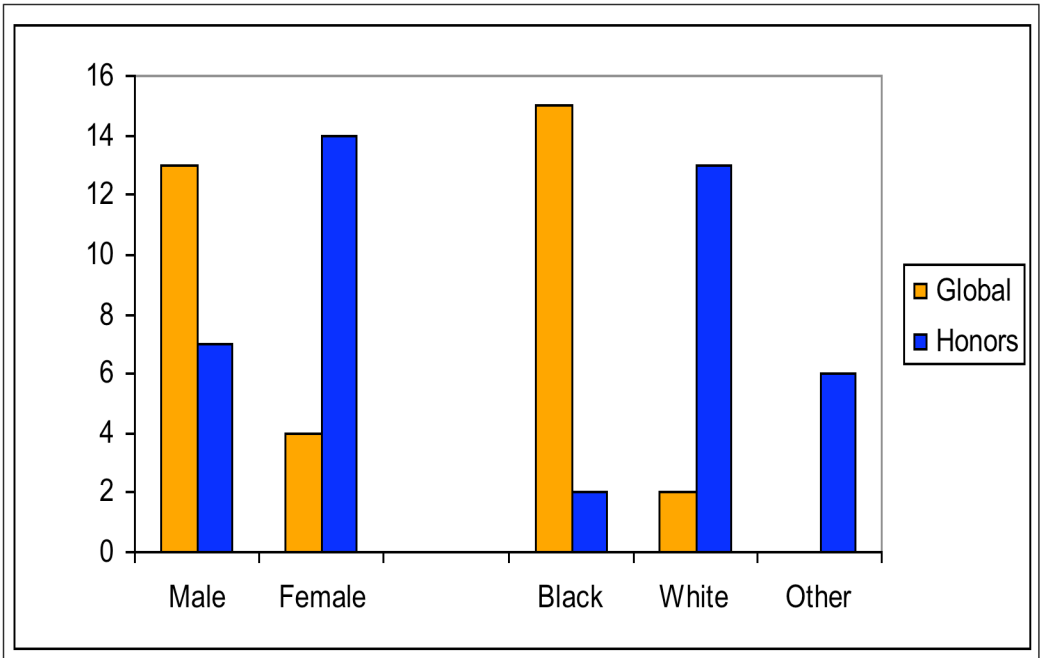
The benefits of the PBL approach to teaching are apparent and well-documented in research. Educators are exploring various other pedagogies to supplement or replace the more conventional lecture-dominated instruction in science in order to promote more active learning. The administrative problems of working with PBL in the classroom, such as time, facilitation, and number of students can be overcome using technology in the classroom. The goal of the Casebook program

is to allow teachers to develop PBL materials for use in their classrooms that allow students to work together through a web interface that fosters investigative learning. Large classes can be divided into smaller groups of students, making the job of facilitation much easier if there is only one teacher. Furthermore, students improve their research skills and their use of new technology enhances their learning experience.

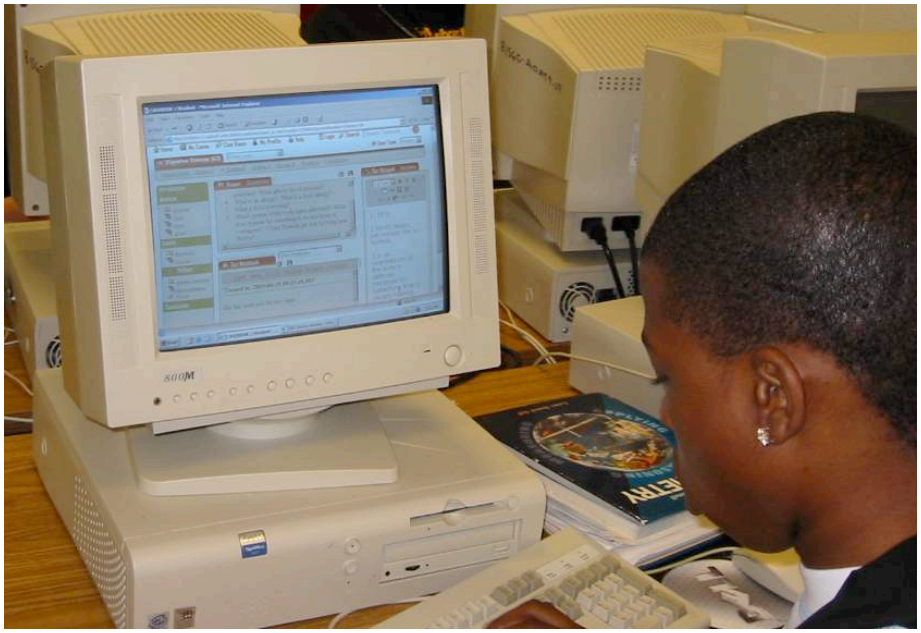
METHODS:

The high school trial of Casebook was performed at North Springs High School, located in North Fulton County, GA. Students from Global Studies (identified as lower level learners) and Honors Biology were given a case, 'Digestive Distress' to work either using the Casebook program, or using a traditional, pen and paper format. Each class of students was divided in half so that both methodologies were running simultaneously. Students were pre-tested before going through the case, and were post-tested using the same test upon completion of the case. 'Digestive Distress' followed the story of Shelby, a freshmen college student who has watery diarrhea. The students eventually learn that Shelby drank unfiltered stream water while on a hiking trip, and ultimately conclude the case by studying a particular water-borne pathogen.

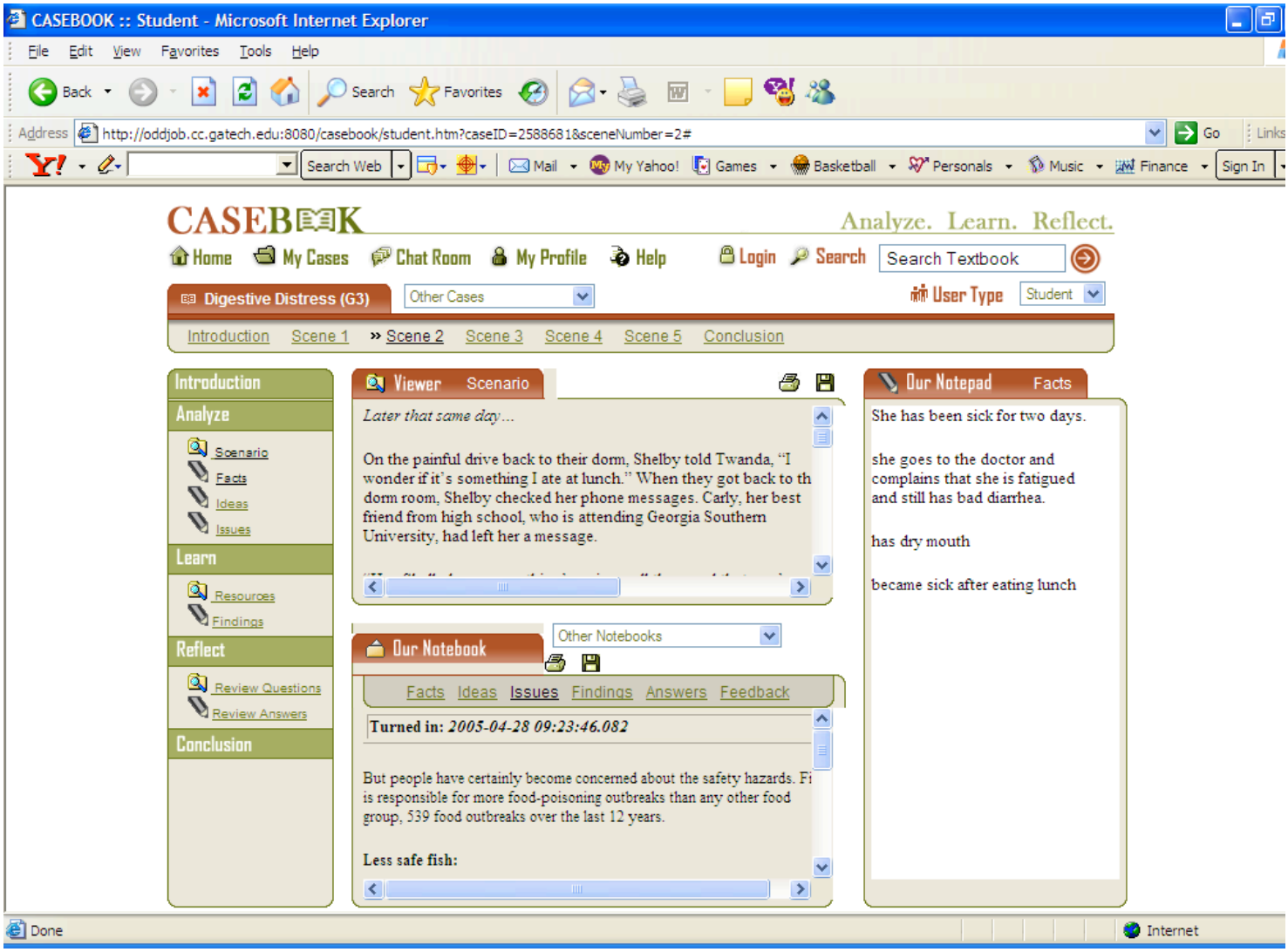
Honors Biology students at work on the paper version of the case.



<u>Figure 1:</u> Classroom Demographics. Gender and racial distribution of students from Global Studies and Honors Biology at North Springs High School. Note the differences in gender and race between the two classes. N = 18 for Global Studies; N = 21 for Honors Biology. 'Other' refers to students who identified as Hispanic, Asian, Multiracial, or who chose not to answer the question.



A Global Studies student working with Casebook.



(For more information on CaseBook: http://www.caseworks.org/casebook)

Figure 2: The Casebook Interface. Students log in to the program and are able to choose their case. They are then presented with the interface, where they progress through the scenes by reading the case, analyzing their data, learning through research, and reflecting by answering questions. Student answers are entered into the student notepad, and are subsequently turned in so that teachers may grade each section. Students can read teacher feedback to monitor their progress through the case. In addition to text, pictures and links can be inserted into the interface as well. Students are unable to advance to the next scene until they complete the previous scenes, allowing students to work outside the classroom at their own pace. Additionally, login ID's can be created for each student, or for students as part of a group.

Sample Test Questions: (multiple choice, true/false, and free response)

1. Bacteria are very limited in the type of environments they live in.
Circle one:

True False

2. How do bacteria reproduce? Circle one letter choice:
a. Binary fusion
b. Binary fission
c. Sexual reproduction
d. Mitosis

3. Name one type of bacteria and one type of virus.

4. What is a flagellum used for? Circle one letter choice:
a. Eating
b. Digesting
c. Moving
d. Fighting
e. Protection

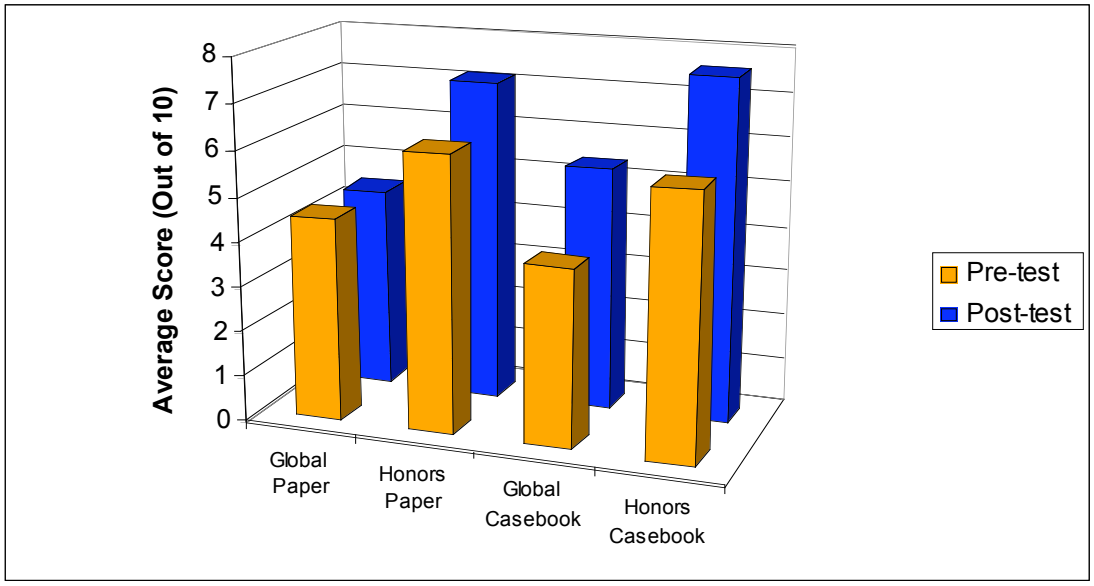


Figure 3: Pre and Post-Test Scores. Students were administered the same pre and post-tests, regardless of class or case version. While Global Studies students given the paper version of the case showed no change in their average score (4.5 pre and post), GS students using Casebook increased their score by 1.5 points. Honors Biology students shows an increase of 1.04 points using the paper case, and 1.78 points when working with Casebook.

CaseBook User Survey

Q1: If you have done problem-based learning with a case study before, do you prefer to work the cases on paper or online with Casebook?
1 = Prefer Paper, 3 = Either, 5 = Prefer Casebook

Q2: In general, do you prefer looking up information online or in printed materials (books, journals, and textbooks)?
1 = Prefer printed, 3 = Either, 5 = Prefer Online

For the next questions:
1 = Not at all, 3 = Somewhat, 5 = Very much

Q3: Did working the case on the computer make it easier to do research?
Q4: Did you use the resources that were provided in Casebook?
Q5: Did working the case on the computer make it easier to record your answers?
Q6: Do you think the automatic save feature works well?
Q7A: Were the instructions given on how to use Casebook clear and helpful?

Q9: What did you like best about Casebook?
1. “The ability to quickly access the information in one place” – Global Studies student
2. “How organized it was” – Honors Biology student
3. “I’d even work with it at home” – Honors Biology student

Q10: What did you like least about Casebook?
1. “Sometimes our work disappeared” – Honors Biology student
2. “It was somewhat confusing when it came to the turning it in section of the casebook” – Global Studies student
3. “All the writing” – Honors Biology student

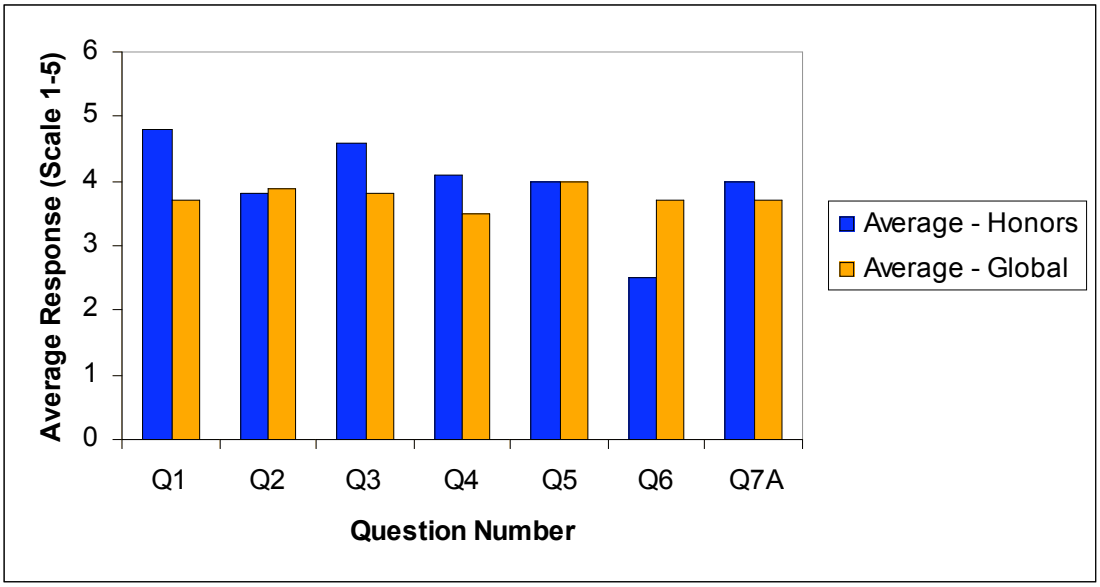
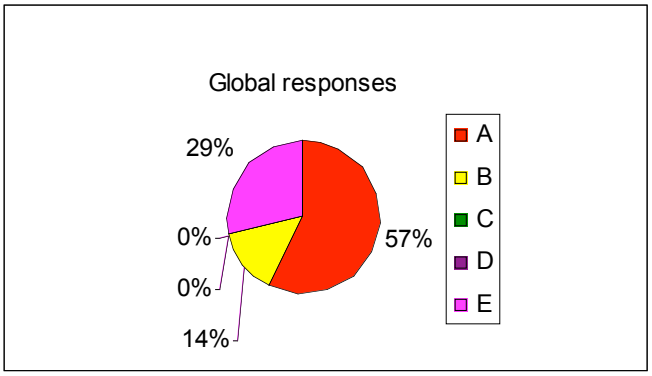


Figure 4: Casebook Evaluation. Students in each class were surveyed upon completion of the case to solicit their opinions about the Casebook program. Note the differences between the Global Studies students and the Honors Biology students for questions 1, 3, and 6.



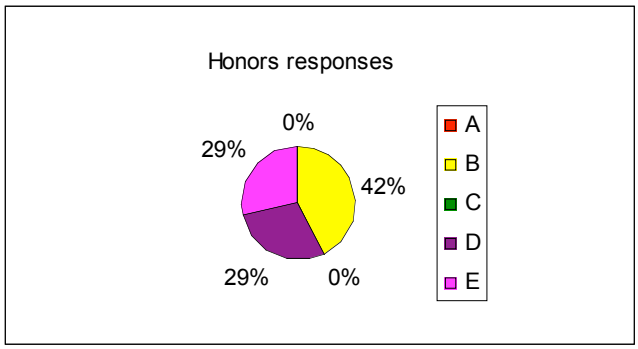


Figure 5: Question 8 responses. Global vs. Honors responses to Casebook survey Question 8, addressing their overall opinion of the Casebook program. Note the absence of responses for choices C and D in global Studies, and the absence of choices A and C in Honors. Identical percentages of students in both classes like the idea of Casebook, but think it needs improvement (E).

A = I don't like PBL cases, and I don't think Casebook made them any better.
B = If I had to do another PBL case, I would rather work with Casebook.
C = I liked PBL cases on paper, but I really didn't like using the website.
D = It was fun to use the computer to work on a PBL case.
E = I think Casebook is a good idea, but the website needs a lot of work.

CONCLUSIONS:

1. Preliminary data suggests that both advanced students and lower level learners achieve larger learning gains using Casebook.
2. Students enjoy using the Casebook program, even more than traditional, paper-based cases.

FUTURE DIRECTIONS:

1. Improve Casebook interface; resolve issues involving ease of use, automatic save feature
2. Test Casebook using other cases at both the high school and college level.
3. Collect data and publish results showing gains in problem-based learning exercises and general knowledge using Casebook.

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