Using a Critical Thinking Model to help Students Analyze Case Studies

Resource Type: Curriculum: Classroom

Publication Date: 8/25/2009

Authors

Janie Sigmon
York Technical College
Rock Hill, South Carolina
Email: JSigmon@YorkTech.com

Abstract

Case studies can be used to help students realize the real-life applications of the knowledge that they gain in the field of microbiology. Many students do not have an organized logical means of analyzing case studies, however. By using the critical thinking model developed by York Technical College and walking students through a case study, students have shown that they begin to develop critical thinking skills, the ability to analyze a case study, and a level of comfort in doing both. An animation of this analysis process is provided to help instructors.

Activity

Description: By using a simple critical thinking model, students can learn to analyze case studies in microbiology.

Pedagogy Keywords: Learn, Problem-Based Learning, Teach, Case Studies

Core Themes: Theme 3 (Microorganisms and humans), Theme 6 (Teaching and Learning)

Learning Discipline Keywords: Bacteriology, Microbiology

Microorganisms: N/A

Keywords: Bacteria, Case Studies, Clinical cases, Clinical Microbiology, Critical Thinking, Data Analysis/Interpretation, Disease, Gram stain, Identification, Medical, Risk, Symptoms, Teaching

Skills: Thinking: Analysis, Thinking: Cognitive processes

Intended Audience:
Microbiology/Biology majors
Allied health majors
Biotechnology majors
Science education majors
Nonmajors

Learning Time:
1 hour in class or take home

ACTIVITY

Learning Objectives.

Students will be able to apply a critical thinking model to the analysis of case studies.

Background.

Students should have had an introduction to microbes and should have a basic understanding of laboratory testing, particularly the Gram staining technique.

PROCEDURE

Materials.

Students need to have access to a computer or be in a classroom with a computer and projector system.

Student Version.

Pretest
Posttest

Instructor Version.

Instructors should review the critical thinking model used to familiarize themselves with the seven steps of the process:

identify, gather, examine, formulate, apply, evaluate, and reflect.

Students should be introduced to case studies then asked to read a copy of the case study that will be presented in the animation (see Case study). The students should then complete the pretest. The animation called "Using Critical Thinking Skills to Analyze Case Studies in Microbiology" should be shown to the students (see Animation). A posttest is then administered.

Safety Issues.

None

Suggestions for Determining Student Learning.

By using the pre- and posttests, student confidence about analyzing a case study and student understanding of the steps needed to properly analyze a case study can be assessed.

Field Testing.

This activity was field tested with 28 microbiology students (Biology 225), most of whom are planning careers in the allied health fields.

Results after the first presentation of the animation

Pretest questions
· Question 1 on student confidence in analyzing case studies: 93% either were unsure or did not know how to do this analysis.
· Question 2 on needing help with the analysis: 100% wanted help.
· Steps in analysis of case study: average number of steps identified was 1.25 out of 7 steps.

Posttest questions
· Question 1 on student confidence after watching animation: 75% could now analyze or use this step-by-step model to analyze a case study.
· Question 2 on use of the model: 100% thought that it would help them.
· Steps in analysis of case study: 5.8 out of 7 steps of the critical thinking model were correctly put in order.

Results after a second presentation of the animation with new case studies (31 students participated)
Using the grading rubric for critical thinking skills (advanced = 4, competent = 3, developing = 2, and elementary = 1), the average student score for each section of the critical thinking model was:

Identify	2.65
Gather	2.68
Examine	3.03
Formulate	3.17
Apply	3.03
Evaluate	3.28
Reflect	3.34

Not only could students identify the parts of the critical thinking model, they also had developed a level of competence in using the model to analyze new case studies.

Student Data.

Before the animation was shown, most students could only list "identify the problem" as a step in the analysis of a case study. Many steps were minimally filled out or went off on tangents that had nothing to do with the case itself. After the animation, most students expressed, through the posttest and by voice, that they felt more comfortable using the critical thinking model as a guide through this type of analysis.

SUPPLEMENTARY MATERIALS

Possible Modifications.

The pre- and posttests can be modified to accommodate any extra questions that an instructor would like to add. The animation could be made available to the students for review via a web-based course management system. Other case studies could be used to test the students' ability to analyze new case studies.

Links to other case studies from MicrobeLibrary:

Viral Mini-Case History Studies for Courses Involving Medical Microbiology,

http://archive.microbelibrary.org/Edzine/details.asp?id=496&Lang=

Bacterial Mini-Case History Studies for Courses Involving Medical Microbiology,

http://archive.microbelibrary.org/Edzine/details.asp?id=494&Lang=

Link to information about a book containing case studies:

Gilligan, P. H., M. L. Smiley, and D. S. Shapiro. 2002. Cases in medical microbiology and infectious diseases, 3rd ed. ASM Press, Washington, D.C.

Links to other case studies from the web:

Case studies in Science from State University of New York at Buffalo: case collection in Microbiology,

http://ublib.buffalo.edu/libraries/projects/cases/ubcase.htm#microbiology

References.

1. **Buxton, R.** 2007. Examination of Gram stains of urine. http://archive.microbelibrary.org/Gram%20Stain/details.asp?id=2415&Lang=English.

2. **Cundell, D.** 2000. Bacterial mini-case history studies for courses involving medical microbiology. http://archive.microbelibrary.org/Edzine/details.asp?id=494&Lang=English.

3. **Facione, P. A.** 2007. Critical thinking: what it is and why it counts. Insight Assessment. http://www.insightassessment.com.

4. **York Technical College.** 2009. York Technical College critical thinking model explained. http://www.yorktech.com/qep/.

Appendices and Answer Keys.

- Animation file: "Using Critical Thinking Skills to Analyze Case Studies in Microbiology."
- Pretest and answer key
- Posttest and answer key
- Case study
- Assessment instrument for evaluating students after the exercise
- Grading rubric for the critical thinking model
- Case studies used to test students

Course: _____

PRE-TEST

Student name:_____

[Circle the best answer.]

1. Which statement applies to the way that you feel about analyzing a case study in microbiology?
    A. I feel confident that I could analyze a case study.
    B. I'm not sure that I could analyze a case study.
    C. I don't know how to analyze a case study.

2. Would you feel more comfortable analyzing a case study if you had an organized way to figure it out?
    A. Yes, definitely.
    B. Yes, that might help.
    C. No, I don't need any help.

[Read the case study.]

Write down the <u>steps</u> that you would use to analyze this case study

1.

2.

3.

4.

5.

6.

7.

Course: _____

Student name:_____

POST-TEST

After viewing the animation --

[Circle the best answer]

1. Which statement applies to the way that you feel about analyzing a case study in microbiology now?
   A. I feel confident that I could analyze a case study.
   B. I'm still not sure that I could analyze a case study.
   C. I could analyze a case study if I had the "how-to" steps in front of me.
   D. I don't know how to analyze a case study.

2. Would you feel more comfortable analyzing a case study if you had the steps of this critical thinking model available to you?
   A. Yes, definitely.
   B. Yes, that might help.
   C. No, I don't need any help.

Put the following steps of the Critical Thinking Model in order, from first step to last step:

APPLY, FORMULATE, IDENTIFY, REFLECT, EXAMINE, GATHER, EVALUATE

1.

2.

3.

4.

5.

6.

7.

The case study:

A 13-year-old female patient presents at her primary care practitioner suffering from a urinary tract infection. A sample of midstream urine reveals gram-positive nonencapsulated cocci, which are arranged in clusters and are coagulase negative (1).

1. **Cundell, D.** 2000. Bacterial mini-case history studies for courses involving medical microbiology. http://www.MicrobeLibrary.org.

Course: _____

PRE-TEST Answer key

Student name:_____

[Circle the best answer.]

1. Which statement applies to the way that you feel about analyzing a case study in microbiology?
    A. I feel confident that I could analyze a case study.
    B. I'm not sure that I could analyze a case study.
    C. I don't know how to analyze a case study.

2. Would you feel more comfortable analyzing a case study if you had an organized way to figure it out?
    A. Yes, definitely.
    B. Yes, that might help.
    C. No, I don't need any help.

[Read the case study.]

Write down the steps that you would use to analyze this case study

1. Figure out what the problem is

2. Write down all the information that I know from the case study

3. Figure out what other information I need and find it

4. Determine a possible answer to my question

5. Apply all the information that I have so far to this answer

6. Does all of my information support this answer? If so, this is my conclusion.

7. Is there anything else that I should consider about this case?

Course: _____

Student name:_____

POST-TEST Answer key

After viewing the animation --

[Circle the best answer]

1. Which statement applies to the way that you feel about analyzing a case study in microbiology now?
   A. I feel confident that I could analyze a case study.
   B. I'm still not sure that I could analyze a case study.
   C. I could analyze a case study if I had the "how-to" steps in front of me.
   D. I don't know how to analyze a case study.

2. Would you feel more comfortable analyzing a case study if you had the steps of this critical thinking model available to you?
   A. Yes, definitely.
   B. Yes, that might help.
   C. No, I don't need any help.

Put the following steps of the Critical Thinking Model in order, from first step to last step:

APPLY, FORMULATE, IDENTIFY, REFLECT, EXAMINE, GATHER, EVALUATE

1. Identify

2. Gather

3. Examine

4. Formulate

5. Apply

6. Evaluate

7. Reflect

Analyzing Case Studies in Microbiology

IDENTIFY the problem

GATHER information from the case study

EXAMINE the information to see what else is needed

FORMULATE a possible cause of the infection

APPLY this cause to the other information available to see if the case study and other information match

EVALUATE the information for accuracy and reach a conclusion

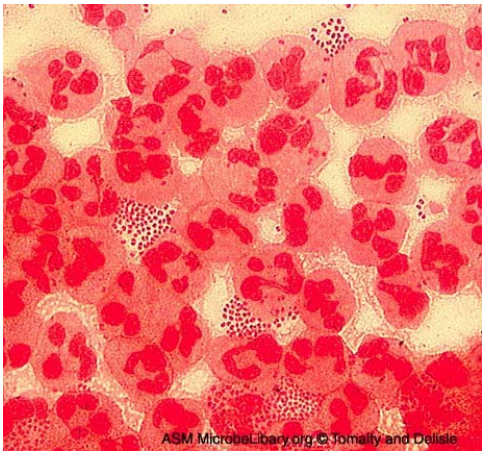
REFLECT upon the conclusion to determine if there were any implications concerning this diagnosis

YORK TECHNICAL COLLEGE CRITICAL THINKING RUBRIC

	Advanced - 4	Competent - 3	Developing - 2	Elementary - 1	Score ___
Identify	Clearly defines the root problem, situation, or question; accurately describes situation; exhibits an open mind; thinks about own thinking process	Recognizes that there is a problem or situation; identifies some component parts; exhibits somewhat of an open mind	Identifies inappropriate issues or problems; unable to accurately describe problem or situation; exhibits some open-mindedness	Fails to identify any problem, situation, or question; ignores pertinent information; exhibits a closed mind	
Gather	Gathers all pertinent information; considers all perspectives and assumptions; reflects on the problem or question	Gathers some pertinent information; considers most perspectives and assumptions	Gathers inadequate information; considers some perspectives and assumptions	Gathers no pertinent information; considers few perspectives or assumptions	
Examine	Identifies relationships between key points; recognizes priorities; analyzes and sorts pertinent elements from information gathered; reflects on the problem or question	Identifies some relationships between key points; discovers most relevant elements from information gathered	Wanders from the issue; recognizes some priorities; sorts some relevant elements from gathered information	Disregards the issues; does not recognize priorities; unable to sort important elements from information gathered	
Formulate	Suggests multiple solutions; identifies a position; devises a logical plan of action; reflects on past experience to support decisions	Suggests some possible solutions; develops an acceptable plan; uses some past experience to support decisions	Presents few options; fails to reach a position; develops a marginal plan; shows difficulty in using past experience to support decisions	Presents no options; fails to reach a position; does not integrate past experiences to support decisions; fails to develop a coherent plan	
Apply	Implements the plan and follows it to conclusion; clearly demonstrates a concept; produces a high-quality product; shows mastery at illustrating an idea	Implements portions of a plan; performs some follow-up; produces an acceptable product; illustrates a concept in progress	Implements a small part of a plan; performs marginal follow-up; produces a marginal product; illustrates the early stages of an idea	Does not implement a plan; fails to reach a conclusion; does not produce a product; fails to illustrate a concept	
Evaluate	Notes bias; judges results objectively; assesses conclusion in terms of validity and reliability; offers alternative solutions; reflects on own thinking process and opportunities for improvement	Detects some bias; addresses validity and reliability; judges results but does not provide alternatives; justifies most results; occasionally reflects on problem or process	Questions some data; bias skews reasoning; draws faulty conclusions; information is interpreted inaccurately; justifies some results; shows some reflection on problem or process	Fails to question data; ignores bias; fails to assess conclusion; justifies results with no reason; does not reflect on problem or process	

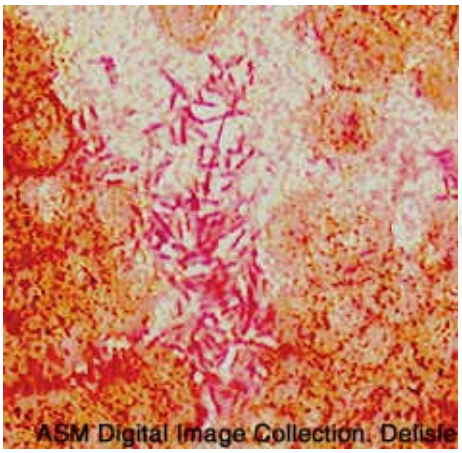
Case A.

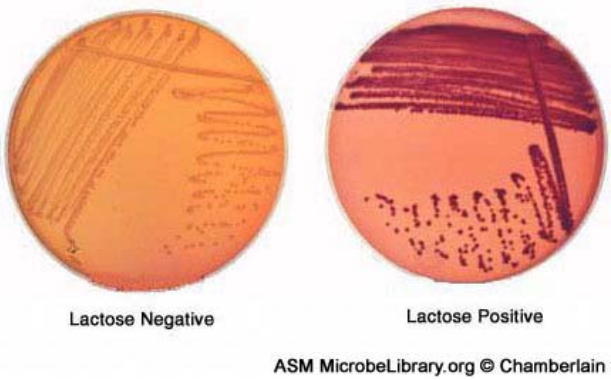
A medical student on an international program in Namibia sees a 1-week-old infant with an eye infection. A sample of discharge from the eye is found to contain encapsulated, paired, gram-negative cocci.



Case B.

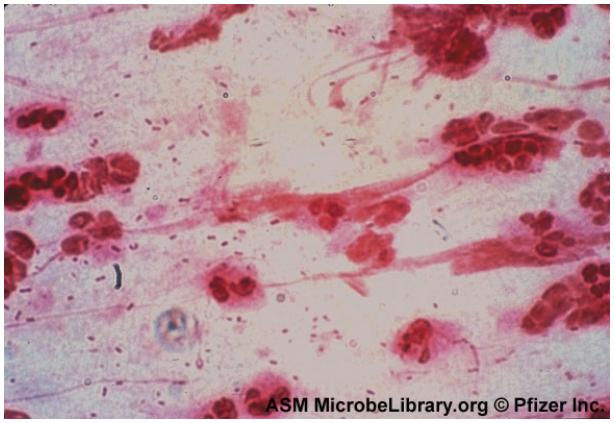
A 9-year-old boy with a 2-day history of diarrhea presents to the emergency room with blood in his stools and increased stool volume. He has vomited once. The boy went to a cookout 5 days earlier and ate a hamburger that was still "pink" inside. On examination he is well, apart from some dehydration. A culture of stool samples produces lactose-positive (pink) colonies on MacConkey agar, but nonfermenting colonies on MacConkey with sorbitol substituted for lactose.



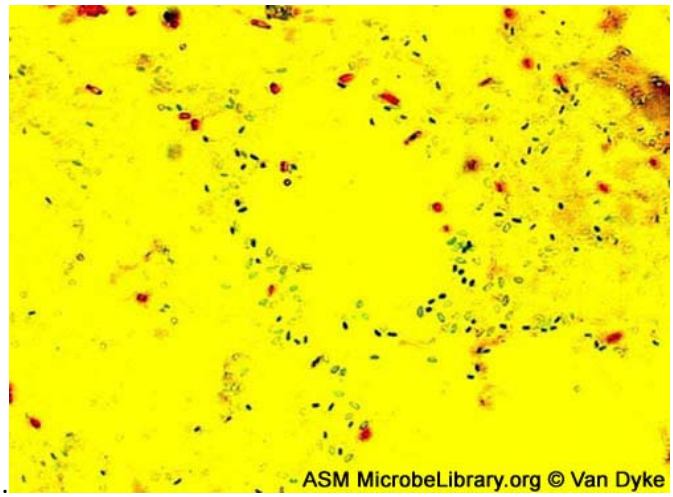


Case C.

A 1-year-old Eskimo child, Melissa, was admitted to a hospital in Alaska following a seizure and is limp and unresponsive. Her mother tells the physicians that the child had a runny nose earlier in the day and has been suffering from a cold for several days since beginning her enrollment at a daycare center. On closer examination, the patient is found to have an elevated temperature, rapid pulse, and supple neck. Overnight her neck becomes stiff, and blood and cerebrospinal fluid cultures are positive for gram-negative coccobacilli, which look like "rice grains" under the microscope. The bacteria need to be cultured under special conditions on blood and chocolate agars.



Case D.

A male injection drug user presents at the emergency room with nausea, vomiting, and severe stomach cramps, which began suddenly 18 hours ago. When interviewed, the patient stated that his last meal was a carton of rice from a Chinese restaurant that he found in a dumpster. Prior to this he was healthy, with no infection of any kind. The attending physician suspects a food intoxication. 

Case E.

A 65-year-old alcoholic was taken to the emergency room with severe necrotic, blackened areas on both feet and several draining ulcers on his heels and toes. He was stuporous. During that evening he had a seizure and was treated with phenytoin and barbiturates. By the end of the night he had developed increasing rigor and respiratory distress and was unresponsive. His neck was stiff and hyperextended and his teeth clenched in a grimace. Specific therapy and supportive care led to his full recovery.

Case F.

A young female university student has been backpacking through the woods in Pennsylvania and presents to her primary care physician with a stiff neck, malaise, and evidence of healed insect bites. She also has a rash on her arm, which forms a series of flat reddened rings in the shape of a bull's eye.