Unfolding Case Studies: Dynamic Mental Models in a Public Health Context

Jo Azzarello

Dr. Jo Azzarello offers us an opportunity to examine the use of case studies in this example chapter. She is an Associate Professor in the College of Nursing at the University of Oklahoma Health Sciences Center. Her specialty expertise is Diabetes Education and the use of Mental Models and computerized Cognitive Tutors. Dr. Azzarello is an active member of the American Diabetes Association, the Council for the Advancement of Diabetes Research and Education, the Southern Nursing Research Society, Sigma Theta Tau International, and the National League for Nursing.

‘Mental model’ is a term used to describe a person’s interpretation of a presenting problem situation. The model might be simple (such as ‘the car is speeding’) or it might be very complex and involve a great deal of scientific or theoretical information. But the important thing about a mental model is that humans rely on them to determine what they believe and how they will act (Senge, 1990). Dr. Azzarello focuses this lesson on training the ability to adapt one’s mental model as one becomes more knowledgeable about the problem situation. Without this ability, one is likely to be working on a suboptimal or inaccurate framing of the problem and arriving at a suboptimal or even incorrect resolution. Adapting one’s mental model in the light of new evidence is the result of analysis, inference and explanation and also captures the habit of mind we have identified as the critical thinking disposition of ‘cognitive maturity.’ This ability is vital to competent clinical reasoning. These are components of problem framing (getting the problem right), a first necessary if subsequent intervention are to be relevant. To supplement the material in this chapter, we also recommend Dr. Azzarello’s 2006 paper in Nurse Educator (cited below).

Background:
One hallmark of growing expertise is an increasing ability to accurately adjust one’s mental model as a problem situation evolves. The purpose of an unfolding case study is to provide opportunities to observe and assess students’ ability to change their mental model of a problem situation when they are presented with additional information that
might expand the scope of the problem, confirm some hypothetical problem parameters but not others, or even conflict with their original conceptualization of the problem.

**Student Population:**
I and my colleagues use ‘unfolding case studies’ to provide our students with a guided learning experience. A case that unfolds (presented to the student gradually) is a better model of how case information emerges in practice, and is optimal for training clinical reasoning. With new information evolving as the student thinks about the clinical judgments required in the case, they are required to make adjustments to their mental models of the clinical problems.

We teach this lesson to senior-level baccalaureate nursing students. Seniors have quite a bit of clinical knowledge and also enough clinical experience to realize that some cases are more complex than they initially appear. This teaching strategy is intended to capture the experience of the emergence of additional key clinical information about a case that occurs in practice and to prepare students for the need to rethink and adapt their mental model of the case. However, unfolding cases could and should be used for students at all levels, taking care to evolve the new case information as their clinical reasoning skills permit.

In our course and in this example the content area for the unfolding case is community health nursing, but any specialty area or subject matter can be used to create the case. This teaching strategy is appropriate whenever one is interested in guiding students’ skills in mental models and assessing their ability to use them dynamically. One can teach this lesson to both individual students and student teams.

**Timing of Session:**
We use this exercise at the end of the semester in our community health course. By that time, our students have read and discussed all of the material related to the topic and we have largely met our teaching objectives for presenting key community health content. This exercise is extremely useful for assessing our learning goals for the students. They have had time to mentally structure the new knowledge in their memory. The unfolding case tests their ability to retrieve and use this new knowledge in a novel case situation. As a result, requiring a written response to an unfolding case is a useful format for a final examination in a course. We describe the format for this use here

Unfolding cases can also be used more broadly in the course. For instance one could introduce this experience to the students at the start of the semester. They are not likely to be as accomplished in their ability to construct the optimal mental model of the community health problem, given their relative lack of content knowledge in this specialty area. But the introduction of this thinking experience early in the course allows them to learn the expectations we have for them by the time the semester closes. A comparison of the early unfolding case experience and the final end of course exercise would thus provide a pretest – posttest design that reflects learning in the area of the use of mental models as well as learning in the course content area.

**Materials:**
We have developed a format for our unfolding cases. Each consists of several consecutive “stages” that are revealed to students, one at a time. The first stage introduces the problem situation and provides enough information for the student to develop an initial mental model of the case. Subsequent stages provide additional information. As the case unfolds, the additional information provided might be highly relevant to the needed clinical judgment, only peripheral to the case, or even irrelevant to the clinical problems the case entails. An example of an unfolding case is included here (See Figure 1).
The difficult work for the instructor, of course, is designing the case and each of its stages well. Instructors may adopt published case studies or develop their own. Either way, the professor needs to think through each case as the students will later be doing. It is important to assure that they will be able to achieve useful mental models. Optimally these models assist them in efficiently synthesizing the new course content as well. Inclusion of irrelevant information at all stages is not a frivolous exercise. When this is well done, the case feels like an actual clinical reasoning experience. When students think aloud and share their emerging mental models this allows instructors to assess if students can differentiate significant from non-significant data. We organize this exercise by preparing all of the case materials in writing and distribute each new stage to students once they have completed thinking and discussing the previous stage. After reading each stage, students answer a set of questions designed to elicit aspects of their mental models. By asking the same question set after each stage and comparing answers across stages, changes in their mental models can be detected.

The Unfolding Case

Stage 1
You are a nurse at the State Health Department. On Wednesday morning, you receive a telephone call from a student at a nearby university who reports that he and his two roommates became ill with nausea, vomiting, and diarrhea after eating at a Chinese restaurant the night before. Two of the students recently returned from travel outside of the United States. None of the roommates have sought medical care and ask if they should skip their scheduled classes that day (all of them have an exam that afternoon). The students are not willing to give you their names or contact information.

Stage 2
Before the call is ended, you complete an Illness Complaint Report as required for all incoming calls. You consider whether or not to investigate further as you review the following information:

- The roommates’ ages range from 18 to 20.
- Symptoms include: nausea, vomiting, diarrhea, fatigue (all 3 students); fever (1 student); headache (1 student).
- None of the roommates report chills, bloody stool, abdominal cramps, muscle aches, or dizziness.
- The students had dinner together at a local Chinese restaurant buffet the previous evening. They shared no other meals on the previous 2 days, although all of their meals were eaten at the university cafeteria.
- Two of the roommates returned from a trip to Toronto, Canada, on Sunday evening.
- Other than their current problem, they are in good health.

Stage 3
You decide to investigate further to establish facts about this case and to find out if others were also ill. First, you call the Chinese restaurant; however, you get no answer because the restaurant has not opened yet. You call the university’s Student Health Center and learn that 18 students were seen yesterday for complaints of nausea, vomiting and diarrhea. They report that usually they see 1-2 cases like this per week. Finally, you call the local hospital Emergency Department. The Medical Director tells you he will check their records and get back with you later in the day.

Figure 1: Unfolding Case Study – Example Illness in a Community

In the community health nursing course, assessment focuses on students’ responses to complex public health issues. We use the cases to help students explore these issues and possible solutions. There is a structure to our guidance in the case and examining each of these aspects helps students think a bit more about their reasoning process. This structure includes some reflection on problem identification (PI), pattern recognition (PR), inferences (INF), hypotheses testing (HG), and solution generation (SG).
To guide mental model formation and adaptation, we repeatedly pose a list of questions after each stage of the unfolding case study. We ask the questions to help students analyze how their conceptualizations of the case are being developed, how information is being used when forming perceptions about the case, how they are using new information to affirm or dispute previous mental model conceptualizations, and how they are analyzing case data, drawing inferences and making explanations about possible interventions. The questions also help uncover underlying beliefs or assumptions being made about the causes of the problem(s). Answers to questions are compared across stages. Here is a brief guide of the repeated question format we use.

1) Based on what you know about this situation, what problem(s) should the clinician address? (PI)

2) What information did you use to identify each listed problem(s)? Why is the information relevant? (PR)

3) What do you think is causing the problem(s)? Why? (INF)

4) What additional information would you like to know about this case? Why? What problem(s) have you ruled out based on what you know now? Why? (HT)

5) What actions should the clinician consider taking? Why? (SG)

Figure 2 shows an example of two grids we have designed to capture the students’ responses to these questions. Notice that the column order is slightly different (column 4 and 5) in the response grids than the question order above. This is done to emphasize that students should be seeking additional information to better inform their mental model.

We ask students why at each stage. This is important. In this case, asking why they are drawing specific inferences and making specific clinical judgments in column 3 and 4 potentially uncovers mistaken content knowledge about their synthesis of the community health content. Asking why in column 5 allows us to be sure that they are doing more than simply looking for information to confirm their initial mental model. We want to encourage them to continue to evolve their mental model through hypothesis generation and information seeking.
### COMMUNITY FOCUSED NURSING CASE STUDY – Stage 1

After reading Stage 1 of the Case Study, answer the following questions. When you are finished and ready to move to the next stage, turn in this page to your instructors and get Stage 2 materials.

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
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</thead>
<tbody>
<tr>
<td>Based on what you know about this situation, what problem(s) should the nurse address?</td>
<td>What information did you use to identify each listed problem(s)?</td>
<td>What do you think is causing the problem(s)? Why?</td>
<td>What actions do you think the nurse should take? Why?</td>
<td>What additional information would you like to know about this situation? Why?</td>
</tr>
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### COMMUNITY FOCUSED NURSING CASE STUDY

To be used with Stage 2 and additional Stages

After reading the new Stage of the Case Study, answer the following questions. When you are finished and ready to move to the next stage, please turn in this page and get the materials for the next Stage of this case.

<table>
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<tr>
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<td>Based on what you know about this situation, what problem(s) should the nurse address?</td>
<td>What information did you use to identify each listed problem(s)?</td>
<td>What do you think is causing the problem(s)? Why?</td>
<td>What actions do you think the nurse should take? Why?</td>
<td>What additional information would you like to know about this situation? Why?</td>
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What previously listed problem(s), if any, did you rule out based on what you know now? Why?

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**Learning Outcomes Assessment**

Assessment of learning achieved in this lesson can be focused on a variety of aspects. The repeated posed questions should be changed to emphasize the chosen area. For example, some possible outcomes that could be studied using this teaching strategy include: 1) how students perceive problems related to the situation and possible solutions that could be tried, 2) how well students can recall information about a case; 3) how students envision the outcome of a case if there is no intervention or if a certain specific action is taken; 4) how students construct their arguments about what is at issue in the case; or 5) how students assess the difficulty or risk associated with the case situation.
Depending on the level of the student and the intended learning outcome, it might be important for students to retain copies of their initial stage grids. Students thought that they would find it helpful to have a copy of each grid to help them remember what they had said previously about the case. Because we did not want them to alter their original answers, we allowed them to use a copy machine that was located outside the classroom to retain a copy of their earlier stage responses. However, not allowing students to make notes or copies of their work as they progress through the case forces an increased reliance on the mental model they have formed. It also requires students to rely more heavily on their recall of details of the problem situation, a more authentic test of actual clinical practice demands. We believe that the level of recall of details of the problem situation reflects level of expertise, with recall increasing as the person develops more sophisticated mental models of the domain.

The Student Work Product:
Students enter their answers on a grid and complete a new grid for each stage of the case. Because we want students to think again about the case each time they are provided additional clinical information (at each stage), we ask students to submit each stage’s response to the instructors before beginning the next stage. This way we can also use the data to assess their evolving mental model, because they have not added or erased responses to prior stages based on the new information. The final set of grids represents how the students’ mental model evolved as new case information became available.

If team mental models are being evaluated, team members work together to discuss their impressions of the case and then come to a consensus as they complete the response grids. Only one set of grids is completed per team. Instructors may assign students to team member roles (e.g., recorder, leader) or let students determine this on their own.

Evaluating Answers:
All of us develop strategies for evaluating this type of work product. Here are some we have found to be useful and fair. After reading all students’ work, we often subjectively compare students’ answers, one to another, ranking them along a continuum of quality from low to high and assigning a score or pass/fail designation to each. We also typically compare student answers to an ideal referent. Scoring rubrics or guidelines should be developed that weight aspects of the students’ work. For example, we assign higher and lower scores under criteria suggested in Figure 3.

The rubric can be used by students to evaluate their own or another student’s grids, or by student teams in the same manner. The rubric should be shared in advance with the students as a effective way to set expectations about the exercise. The instructor’s evaluation of the grids could be reviewed with each individual student or only with those who are struggling with clinical reasoning as a way to openly evaluate, praise and critique their clinical reasoning ability. In the case of students who are exceptionally weak in this area, objective evidence of this weakness proves highly useful for academic counseling.

When the students’ responses are to be graded, you will need to explain your expectations fully before starting the exercise. Problem definition is a higher order thinking skill and as a result students are likely to be initially anxious about the exercise, and whether they will be able to get the ‘right’ answer. Case studies, however, usually have high appeal as a testing format once students begin the work. We begin by distributing the first stage of the case and page one of the grids. After students have read and responded to the first stage, they turn in their answers and receive the second stage of the case and page two of the grid. This continues until all stages of the case have been completed. We most often use three-stage unfolding cases in order to keep evaluation of answers for our large classes manageable. Notice that the grids for Stages 2 and above ask the additional question, “What previously listed problem(s), if any, did you rule out based on what you know now? Why?”
Feedback from the Students:
Students are generally positive about the experience, noting that they feel challenged by the cases. Comments include that the case studies are more like what they might encounter in the “real world” where decisions must often be made before all information is available. Some feel that getting up to turn in their answers and retrieve the next stage is somewhat disruptive to problem solving. This may not be an issue in smaller classes where the instructor can pick up/deliver materials to the students’ desks after a signal of readiness to move on to the next stage. Another solution is to deliver the unfolding case on-line where students can move on once they have submitted responses to a previous stage. Students appreciate a general debriefing on the cases immediately following the exercise while the information is still fresh on their minds.

<table>
<thead>
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<tbody>
<tr>
<td>Higher Scores</td>
</tr>
<tr>
<td>Identify critical problems early in the case (after initial case information)</td>
</tr>
<tr>
<td>Requests for additional information significant for clarify a problem or possible solution</td>
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<tr>
<td>Correctly ruled out problem when refuting information was introduced</td>
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<tr>
<td>Lower Scores</td>
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<tr>
<td>Identify critical problems late in the case (after all information was available)</td>
</tr>
<tr>
<td>Requests for additional information that was irrelevant or would not contribute to problem clarification or solution</td>
</tr>
<tr>
<td>Failed to rule out a problem when refuting information was introduced</td>
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Figure 3: Rubric for Evaluating the unfolding case

References

Although this series focuses on health science content, the techniques are transferrable to all types of training programs and educational projects.

Download other essays in this series for valuable training techniques that focus student learning of reasoning skills and thinking mindset. See Resources on our website.