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**An Open or Shut Case?**

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The hallmark of an open-ended case study is the possibility of multiple outcomes to the problem at hand. This adds to its realism, provokes higher-order thought, and attracts many instructors to case analysis. Yet, there are circumstances in which a closed-ended approach, having a single correct answer, may be preferred. Here, we weigh the advantages and disadvantages of both approaches. Read on!

Looking at Case Studies

In a previous issue of the *Journal of College Science Teaching*, Clyde Herreid outlined a scheme for classifying case study methodologies (Herreid 1998). His taxonomy rested on the teaching method that the teacher might use for a case and the relative contribution of the student and the instructor to the work of analysis. In this column, we view case studies from another angle—one that draws attention to the elements of case study design.

Following Herreid’s suggestion (1997), we propose that case designs can be sorted by the degree to which they are “closed” or “open.” Is there a single correct answer to the questions that the teacher poses? We also focus on the case study learning objectives—the educational goals that cases serve.

For the sake of simplicity, we’ll begin by imposing a dichotomy on our viewpoint. Case designs will be seen as either fully open or fully closed. In many respects, this simplification is analogous to the distinction between the design of ill-structured and well-structured problems—another pedagogical domain that is rich in instructional possibilities (Jonassen 1997).

Comparing Approaches

The open-ended case design begins with the recognition that, in many situations, people don’t know or cannot get all of the necessary or relevant information to solve a problem. Knowledge is in flux, or certainty cannot be obtained (Table 1). Open-ended cases are messy and have a real world feel about them. They evoke multiple lines of inquiry and have many possible solutions.

As an example, a case study might force students to make a decision about expanding the electrical power generation capabilities in a local region. Should the new plant be nuclear, fossil fuel, solar, or wind-driven? Or should the plan involve some combination of the four? Surely, to fully answer such a question students must address ecology, technology, ethics, politics, religion, and culture. They must weigh reasonable alternatives to arrive at a satisfactory outcome. Successful resolution of open cases depends on the context in which they are situated, described, or analyzed. And reasonable people might differ.

Because the instructor does not foreordain a single outcome, open-ended cases are student-directed. Arrival at any one of the many legitimate outcomes is satisfactory. Success depends crucially on the student’s analytical abilities. The student must demonstrate that he or she can build the “best case” argument for why his or her answer or solution is preferred. In short, *process* is the focus.

Conversely, a closed-ended case design is focused on *content*. It begins with the premise that all the knowledge that the student might need to solve a particular aspect of the case is accessible (Table 1). The questions, issues, or concerns raised in the case typically converge toward definite correct answers. For instance, we wrote a case about a 1994 hazing incident in which a college student had his back coated with gasoline and other toxic substances (Cliff and Nesbitt 2000). We included data collected at the hospital to which the young man was admitted and asked students in our anatomy and physiology class to answer a series of questions about expected changes in kidney function and fluid and electrolyte balance. There were single, correct answers to these questions. We wanted the students to reinforce their understanding of key concepts underlying the case. The design is essentially instructor-directed. We (as instructors) set the content outline to be mastered, and we decided what the criteria would be for success.



Educational Objectives

Given these differences, how should an instructor determine whether to select an open-ended or a close-ended approach to case design? This question calls for us to consider the educational objectives that can guide case analysis (Bloom 1956). Open-ended cases are context-specific. Learning outcomes center on the critical thinking abilities that students gain or improve during analysis (Table 2). Learning facts and definitions are not as important as enhancing the thinking skills used to gain them. If an instructor wishes to emphasize higher-order process skills such as evaluation and synthesis, then an open-ended design is preferable.



Alternately, content drives the closed-ended design. The teacher wants the student to solidify his or her knowledge and comprehension of the underlying science (Table 2). In a perfect world, a student strives to integrate the underlying facts and concepts into a coherent portrait of the situation or problem presented by the case study. The instructor is concerned that the student successfully accomplishes this task—that he or she constructs a satisfactory mental model of the subject domain underlying the case (Michael and Modell 2003). This construction is evident when the student can marshal the appropriate facts and concepts and produce astute explanations of the case’s scientific foundations. If this is the goal, then the instructor should choose a closed-ended approach.

Closed-Endedness

Given the realism and intellectual richness of an open-ended design, why would an instructor ever consider using a closed-end one? First, some designs are inherently closed. Some stories do have a single answer—the actual murderer is identified at the end of a crime mystery, for instance. For a case that involves a patient suffering from insulin-dependent diabetes, we want our students to arrive at a correct diagnosis of the disease and to be able to correctly distinguish it from other metabolic disorders that may have similar features but different origins. This is particularly important if we wish them to focus on the underlying physiology of the pancreas or the liver, rather than on the subtle nuances of clinical diagnosis.

Second, the instructor may want to retain greater control of the classroom discussion than is often afforded in an open-ended design. This too depends on the instructor’s educational objectives for using case analyses. If content is at stake and the instructor wants the case analysis to promote definitive understanding, then it is essential that he or she ask specific questions, so that students solidify these relevant features and correct flawed aspects of their mental models. (Remember, there can be correct answers.)

Also, a closed-ended design can encourage students to advance to the application and analysis stage; they must use their knowledge to make sense of the novel scenario offered by the study. When this occurs, students achieve meaningful learning, because correct application and analysis provides evidence of such understanding (Michael and Modell 2003).

In addition, the instructor may want to guide the trajectory of student learning to a greater degree than is usually offered by an open-ended design. Rather than leaving the student to work through the case on his or her own, the instructor provides guideposts that students can follow as they make their way toward a satisfying resolution. In effect, the instructor suggests, “Follow me as I lead you through a successful way of thinking through this problem. You may find this approach to problem solving to be useful when you face similar problems in the future.” This may be particularly helpful for students who are intellectually formative. They are ill prepared to tackle challenging problems within some subjects. By careful design of the sequence of questions in a closed-ended case, the instructor provides an intellectual template or a “way of knowing” that students can adopt to improve their ability to reason through more difficult problems and challenges.

Last, it may be worthwhile to use a closed-ended design for the sake of efficient learning. Time constraints may preclude students from having the fullest opportunity to find what they need to know to solve an open-ended case. Primary reliance on student-directed pathways of learning can be prohibitively time consuming. A closed-ended case design limits the possibilities and constrains the avenues. This may be particularly important in a course where a certain amount of content coverage is essential.

Pedagogically Rich Cases

Stepping out of our simplifying dichotomy, many case studies are neither completely open-ended nor fully closed. The degree of openness springs from the decisions that the case designer makes as the case study is fashioned—by the emphases, thought-provoking queries, prompts, and probes crafted into it. Pedagogically rich cases often take both approaches.

For example, the case study about local power expansion may have open-ended features because its analysis might require students to weigh a number of sociopolitical, ethical, and environmental concerns. Nevertheless, when aspects of the engineering science of power generation are examined, most of these issues are closed-ended. Alternately, a case study on the biology of limb development may contain closed-ended elements that help students understand the relations between a well-established series of developmental events. Yet, it may also have open-ended aspects that invite students to address ill-defined questions about the control of these events at the cutting edge of developmental biology.

This being so, how do we decide which closed and open-ended features to build into a case? For starters, we must consider our educational objectives. Let’s consider our objectives when plotted along a spectrum of closed-ended to open-ended designs (Figure 1). Do aspects of the analysis make it important for students to concentrate on forming, reinforcing, or deepening factual knowledge and on comprehending underlying concepts? If so, we will pursue a more closed-ended approach to help solidify the correct mental models. Do other aspects make it important for students to develop the skills of synthesis or evaluation? If so, then we will create more open-ended features that promote critical thinking.



Another consideration is “the problem of sequence” (Wiggins and McTighe 1998). How should we match the order of the tasks performed during case analysis with the most effective progression of student learning? How can we maximize the likelihood that students will accomplish as many of our learning objectives as possible? This question of sequencing confronts us whether we are planning student analysis of a single case or the analysis of a series of cases over the span of an entire course.

Let us consider the sequencing of the case involving electrical power expansion. The instructor could start off by asking questions designed to help students master the key features of the engineering science. This approach might require students to determine the thermodynamic efficiencies and specific energetic costs of nuclear energy, fossil fuel, and wind-driven power generation. Having arrived at a single, correct outcome for these closed-ended parameters, students would then be prepared to evaluate more open-ended aspects related to public policy. This might entail an analysis of the tradeoffs between the environmental and economic aspects of power generation and the politics involved.

If we used this approach, students would first solidify what they knew about the underlying science and technology of the case to use this information to address ill-defined aspects of the implementation of policy decisions. This would help them scale a hierarchy of educational objectives over the span of a single case analysis. Alternatively, the instructor may start the case with an open-ended question, say about public policy. This approach obliges students to obtain the required closed-ended competency to resolve the more provocative, open-ended dilemmas.

We can apply the same sequencing tactics to a series of case studies over the course of a semester. Initially, we might assign case studies dominated by closed-ended architectures. Throughout the semester students would progressively analyze more integrative cases characterized by increasingly open-ended challenges. In doing so, our students would move from formative to more mature capabilities.

As case study practitioners, we have compelling reasons to incorporate both closed- and open-ended approaches into our designs. It is our responsibility to capitalize on the strengths of these two approaches in creating the most effective case studies. This effort to become better case study designers finds its parallel in the quest to become better storytellers. And good storytellers know that, even if they begin at the same starting point, they discover that a variety of worthwhile tales can develop as different plot lines converge or diverge over the course of the story. Anything is possible when you start with “Once upon a time...”

In story-telling, it’s up to the raconteur, guided by his or her Muse, to bring each tale to a fitting ending—a denouement best suited to its intended effect on the listener. In case study design, it’s up to us, guided by carefully considered learning objectives, to craft the open-ended and closed-ended facets of our case studies so that they end up offering the greatest pedagogical benefit to our students.

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