

The Use of Case Studies and Group Discussion in Science Education

by

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The following text was written to accompany the training videotape, "The Use of Case Studies and Group Discussion in Science Education," produced by the National Center for Case Study Teaching in Science.

Discussion leading is an art form. Few science faculty are good at it. In fact, chances are good that they have never been in a class where the method has been used. All of their college experiences probably have been lectures. Is it any wonder then that they never consider teaching with a discussion, or if they do, that it scares the bejesus out of them? They think, "What if the students don't answer? Then what?" And, of course, that's probably what will happen when they do ask a question or two.

Students passively writing notes in a class are apt to be successively stunned, then incredulous, pasty faced, and fearful when a habitual lecturer suddenly gets it into his head to ask a question smack dab in the middle of his discourse on mitochondrial DNA. "So what do you think Allan Wilson did when he realized that neutral mutations might be used as a molecular clock?" And moments later, "Can anyone tell me what amino acid the AGG codon stands for?" Should the professor be surprised when no one answers? Surely not.

Discussion leading is indeed an art form. And it is *the* method by which the first case studies were taught in the law and business schools at Harvard in the early part of the 20th century. This method holds exceptional promise for teaching science, or, for that matter, any subject. The reason? People love stories, and cases are simply "stories with an educational message." It shouldn't come as a surprise to learn that students learn better if they have a "context in which to learn." Lecturers seldom do this. They believe that if they just lay out the principles of their topic, somehow students miraculously will apply these concepts to real world problems. Miracle of miracles, some students actually do it! But there are a bunch of others that get left behind. They receive D's and 's in our classes.

Discussion leading is an art form. But like all arts, we have to be shown how to do it. And we get better with practice. Rembrandt, Stravinsky, Rodin, and van Gogh did not suddenly display their gifts one fine summer day. Nor did three guys (Carreras, Domingo, and Pavarotti) who had never sung before become the Three Tenors overnight. They had teachers. Plato had his Socrates, Alexander had his Aristotle, the Beatles had Buddy Holly and the Crickets. Even Mozart had a father.

This is a videotape about using the discussion method in case teaching. To some, it is *the only method*. To me, it is one of several ways to teach cases. Its strengths are that it can be vigorous and more engaging than a lecture because students are involved trying to put ideas into their own words. If they say the ideas out loud, weighing the pros and cons and defending their logic, chances are they will walk away with a firmer grasp of the subject than if they just heard about it in a lecture. Moreover, they are probably going to be more interested in hearing their peers talk than in listening to any professor.

There are potential weaknesses to the discussion format. First and foremost, there is a chance that the discussion will be formless, like a verbal amoeba roaming the landscape disgorging factoids and emotional debris from its pseudopodia. We've all been in bull sessions like that. Some classroom discussions are the same. Most practitioners of the method take great pains to avoid this. They set goals. They have specific reasons for choosing a particular case. They have a good opening question. They have analyzed the major issues of the case and know generally what to expect (although there will always be surprises). They have planned a blackboard strategy and know which topics go where and how they are related to each other. They have a classroom management plan, with a time schedule they expect to implement. They have a good idea for bringing closure to the case. And they have a homework assignment planned as a follow-up to the case. There is structure.

It takes planning, but no more than a good lecture takes planning. It's true that there is more risk involved, because in a discussion you're relinquishing control to your listeners. You're inviting them to the party. This is scary for everyone, but I promise you'll get better at it. And there are great benefits. The students do learn more. You won't cover as much material, but who cares if you cover all the material and the students don't remember it? You still won't have done your job.

So above all, discussion leading needs structure. In the videotape, we have tried to highlight many of the key points in leading a discussion case. Let me run through some of these in the order we meet them in the videotape.

1. Advance Preparation

Advance preparation is essential for both you and the students. Earlier I wrote about some of your responsibilities. One of your decisions is whether to give out your case ahead of time or not and what kind of reading you wish the students to do. There are many options, including giving out the case one or more weeks ahead of time, or one class ahead, or even on the day you run the case. It depends upon what you want the students to have done before the discussion.

Once you are in the classroom, there are other things to consider. Should you just launch into the case or do some warm-up activities? Many case study teachers in business and law just jump right into the case. This to me is like those people in polar bear clubs that take unknown pleasure in jumping into icy water and rolling in snow in the dead of winter. Why would anyone want to do it?

I think it is far better to ease into the case. In the videotape, the students were given the “Torn at the Genes” case in a previous class along with a brief homework assignment to answer the questions at the end of the case. The students divided up the workload within each of their groups. Then, when they got together when the case discussion was videotaped, you see them sharing their answers with each other—discussing the answers. This lasted about 15 minutes. This discussion in their groups provided them with vital information, but mostly it energized them. This preliminary work always improves the quality of the discussion because students have had a chance to test their ideas out a bit and practice putting them into words.

2. Choose a Case with Controversy

Which case you choose to use in the classroom, obviously, depends on a lot of factors. But what I will argue here is that the best cases include the elements below, which I first listed in the *Journal of College Science Teaching*, Dec. 1997/Jan. 1998.

- ***A good case tells a story.*** In fact, my personal definition of a case study includes this essential: "A case is a story with an educational message." What makes it a good story is controversy.
- ***A good case is set in the past five years.*** Cases that are recent are clearly more appealing to students than those set in the distant past.
- ***A good case creates empathy with the central character.*** If you don't care about the characters, at least just a little, it is hard to be enthusiastic about the case. So, the more personal information you slide into the case about the participants, the better it is.
- ***A good case includes dialogue.*** Like point three above, dialogue humanizes the protagonists and provides interest. Use it where possible.
- ***A good case is relevant to the readers.*** This almost goes without saying. Try to choose topics that are important to students.
- ***A good case serves a teaching function.*** Surely this is obvious. Why else use it?
- ***A good case requires that dilemmas be solved.*** Cases where the hero has to solve a problem are inherently interesting, especially if students are asked to step into the hero's shoes. The problem should not be easy and should have many possible solutions.
- ***A good case has generality.*** Students, at least good ones, are always asking what is the "take-home message." Hopefully, there will be general principles they will gather from the case and not just specific facts.
- ***A good case is short.*** Short cases are easier to write, easier to read, easier to digest, and easier to teach.

Not all good cases meet these goals, but most reach many of these. “Torn at the Genes” is an example of a fine case. It was written by an undergraduate student, Jennifer Nelson, shortly after she finished taking my summer course in Evolutionary Biology.

3. Set the Scene for the Case

As you begin to discuss the case, it is useful to say a few words to the students about the case. It doesn't have to be much, but you should say something either about the scene itself or point out why the problem is important. This tends to warm up the audience before you blurt out the first question.

4. Use a Good Opening Question

The first question sets the tone for the case. Because I like cases that combine science with ethical or societal problems, I must decide at the outset what issue to start with. I almost always choose to start with the science, or at least, I try to get the facts of the case established. I don't like to have students start giving their opinions until everyone has a clear understanding of the scientific issues. So I would be wary of starting “Torn at the Genes” with the question, “Should Martha eat the tomato?” because students can immediately venture an opinion without even having read the case.

Similarly I would stay away from an initial query of “Should the United States send genetically modified food to third world countries?” as this opens the door to political and ethical questions that are rather distant to the dinner conversation. Moreover, it might be exceedingly difficult to get the scientific points established.

Another reason for saving the ethical, political, and societal issues until later is that these topics generate the most interest. Thus, in the latter part of the case, when conversation is flagging, introducing these topics will immediately pick up the tempo.

I believe the best first question should be non-threatening. Students should not see it as tricky or as a test. I want a question that gets them talking easily. So, as you saw in the videotape, with “Torn at the Genes” I simply asked the students to identify the characters in the case. Then I used this to get out the main issues and arguments.

5. Involve as Many People as Possible

The more people that are involved—presumably saying good things—the more satisfying the discussion. You want students to articulate their understanding of the facts; this increases the likelihood that they will remember the information.

I strongly urge you to use the students' names whenever possible. I always have students use nametags or name signs on their desk the first couple of classes. Then I use their names every time I ask a question. Within two class periods, I can memorize a couple of dozen names. This greatly enhances participation. In addition, students hearing the names

of other students begin to use names and this develops group cohesion. Most of us, especially when we are young, have difficulty speaking in front of strangers. The use of names helps break down barriers. Still, it will take several classes before discussion flows easily.

6. Ask Non-threatening Questions

It is easy to intimidate students. After all, we teachers hold all of the power, don't we? Badgering or belittling students is a sure way to get them to clam up. Moreover, they will hate you for it. The cross-examination method of questioning students may have some virtue in law school, but frankly I doubt that any faculty member would want the tables turned on them. I see little virtue in intimidation and lots of harm.

7. Control the Discussion

What I mean is, don't let one person dominate the conversation. Don't let chaos reign. Don't let bitter arguments flare up. Don't let side conversations occur. Don't let people interrupt one another. You're in charge here.

8. Write Key Points on the Blackboard

I always have a blackboard plan. For example, in "Torn at the Genes," I planned to first write the characters' names on the left side of the board. I planned to first ask "What benefits of genetically modified foods would Ed want to mention," and list these. Then I planned to write a list of concerns that each character mentioned. Then I planned to write in the middle of the board the major points that would make up the bulk of the discussion. Finally, at the end of the class, I planned to write points about the ethics.

Putting key points on the board serves several functions. First, it emphasizes key issues and gives importance to what the students say. Second, it visually demonstrates what has happened that day in class—"This is what we have accomplished." Third, it provides a sense of structure to the discussion. Fourth, it is a list of the issues that are fair game for an examination.

9. Correct Student Error

Faculty frequently ask me, "How do you correct incorrect factual statements that students make during a discussion?" They are concerned that a correction may discourage student participation. Obviously, I don't suggest calling the offending student a blithering idiot. Fortunately, many times other students will bring the correction up themselves. You can encourage this by asking if anyone has any contrary evidence. Often, it is possible to ask the student to reexamine his statement in light of points or evidence you bring up. "John, how would you answer a critic who made this point...?"

Another strategy is to preface your correcting comment by saying, "Sarah brings up a confusing point that many people have..." or "Jason, I'm not so sure that's quite correct."

However you do it, you must correct an incorrect factual statement. If not, the weak students may memorize it, while the strong students will either think you don't know better or are pandering to them.

10. Structure the Discussion

I am opposed to a freewheeling discussion that goes in all directions at once. We have all been in these. They may be fun at two o'clock in the morning in a dorm room packed with your buddies. You might even learn something. But I like to increase the odds of that happening. Moreover, I want the students to know that they have accomplished something.

Consequently, I first select my opening question carefully. Second, I have clear objectives that I want to accomplish either in the reading, discussion, or subsequent homework. Third, I have a time management plan. I plan to stay on each topic a specific amount of time. Fourth, I know the exact points that I want to emerge although I certainly don't know the exact order or way they will develop. Fifth, I have to be alert to the classroom dynamics, being sure that one student doesn't dominate the discussion, that side conversations are stopped, that students are courteous.

In short, I know generally what needs to be accomplished and how to get there. All of these points will be much easier to achieve after you have taught the case once or twice.

11. Movement is Not Random

Body language is vital in the classroom. Let's consider the U-shaped seating arrangement as seen in the videotape. This allows most students to see everyone in the class. This permits you, as the instructor, to freely move from the center of the "U" to the blackboard and back. It gives you the chance to move close to the students, showing your interest in their comments. Be careful that you don't approach too closely, as this would intimidate some students. After all, you are standing and they are sitting. Don't hover above them.

Also, consider nodding and other gestures that will encourage students to develop their points more fully. Further, notice in the videotape that I suggest it is useful on occasion to get out of the way, physically removing yourself from the center of the "U" so that students are encouraged to talk to one another rather than to you. Whatever you do, don't pace or weave back and forth. Act like you care what the students are saying. (I hope you do care.)

12. Closure

How should you finish a case? There are two schools of thought here. The first we can call the "Who Needs Closure?" school. These folks argue that you just let the discussion run its course and wherever you are at the end of class, you stop. You never summarize; you just stop, regardless of where you are. The next class you go on to another case.

Fans of this approach make two points in its favor. They say that this mimics life. Things don't often get wrapped up in a neat package—they sort of peter out. They also remark that when cases are unfinished, people continue to mull them over long after the class is finished. This is a good thing. Right?

The second school of thought is, “Closure? Absolutely. Positively.” Almost everyone involved in a story wants some sort of finish. We crave it. We feel unsatisfied without it. Some faculty choose to wind up their cases by summarizing what they have accomplished. Other instructors ask a student to do this.

You'll notice that I chose to wind up the case in the videotape by having the students vote, thus asking them to commit themselves to a decision about genetically modified foods.

Interestingly, I had a faculty participant at one of my workshops who felt cheated when I used the voting strategy at the end of one of my cases. He still wanted my opinion. I personally feel that giving my opinion isn't especially useful as this will often be taken as “truth” by young students. And if the case is a good one, there may be multiple versions of “truth” that need to be considered. So most of the time I demure when asked about my analysis.

References and Further Reading

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Credits

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