



Commentary

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Why Societal Issues Belong in Science Class

Young people face a future filled with important issues that should be informed by science—such as climate change, genetic manipulation, and the management of pandemics. To meet these challenges, students need an understanding of scientific concepts and the ability to analyze the many claims they encounter through popular media. They must be able to make decisions based on evidence, ethical considerations, and reasoned judgment.

Scientific inquiry is a human endeavor and is therefore inextricably linked to social issues. However, many students think of science as a compilation of facts and a static body of knowledge, rather than a dynamic process. The intersections of science and society are most clearly evident when we consider what science to fund, how to appropriately conduct research, and how to best apply our scientific knowledge. To fully understand the nature of science, students must learn about these important intersections.

A study by the Wellcome Trust (2000) found that science teachers felt the discussion of social aspects of science to be outside their realm of responsibility or expertise. The National Science Education Standards (NRC 1996) stress the importance of addressing these issues with students, but because they are cross-disciplinary and are best assessed through writing and performance assessments rather than multiple-choice tests, they are often neglected in the curriculum.

Real-world problems are multidimensional and transcend the traditional boundaries of educational “disciplines.” One of the best ways to encourage students’ critical thinking is to help them develop the ability to reason through challenging problems. Students find science and society issues inherently engaging; they provide relevance and context for understanding science topics that might otherwise seem isolated and abstract. Unfortunately, students have had little exposure to thinking about how different individuals or groups might be affected by an issue; how to generate and weigh different options, taking into account both facts and ethical considerations; and how to develop a well-reasoned justification. Similarly, teachers who simply pose a provocative question to a class without providing a structure for the subsequent discussion are risking a conversation that turns into a shouting match.

According to a recent study of 3,000 university students (Lind 2009), one of the most effective ways to help students improve ethical judgment is through structured discussion. But too many teachers shy away from discussions,

especially ones about potentially controversial issues. To help students in this respect, teachers need support, resources, and both pedagogical and conceptual structures. Pedagogical structures are specific methods that help create the right conditions for learning in the classroom; Socratic Seminar discussions are one example (**Editor’s note:** See “Socratic Seminars in Science Class,” p. 36 of this issue). Conceptual structures, such as decision-making frameworks, provide a way for students to think about complex problems (Chowning 2005).

Many students think that different positions on an ethical or social issue are just “my opinion versus your opinion”—what ethicists refer to as relativism. Students need to recognize that all opinions are not equally well-reasoned. Although educators should honor the diverse values students bring to the classroom, students should be encouraged to use scientific evidence, ethical principles, and logical reasoning to support their positions. Ultimately, what is most important is how a student explains his or her position, considers the strengths and weaknesses of alternative opinions, and arrives at a sound justification.

When students learn how to more clearly think about and articulate their positions on socioscientific issues, they are better prepared to make decisions about scientific developments that affect their own lives and their broader communities.

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SOCRATIC SEMINARS IN SCIENCE CLASS

*Providing a structured
format to promote
dialogue and
understanding*

Jeanne Ting Chowning

Discussions are important classroom tools—and those that focus on science in society have the potential to interest and engage students. In these kinds of discussions, students can apply their understanding of science content, practice articulating a position, and collectively build a deeper understanding of a complex topic. However, a conversation can quickly veer out of control if expectations are not clearly set by the teacher and if the discussion is not structured appropriately.

This article describes the use of Socratic Seminars, which provide a constructive format for discussion and help facilitate a spirit of shared inquiry among students as they discover meaning in a given text. This article also provides information on how to conduct these text-based seminars



with confidence and outlines some of the educational benefits they provide.

Vignette

The following vignette provides an example of a Socratic Seminar used with a group of high school students in a summer science program:

After reading the article, “Wanting Babies Like Themselves, Some Parents Choose Genetic Defects” (Sanghavi 2006), students sat in a circle, talking with one another about how some prospective parents use preimplantation genetic diagnosis (PGD) to select *for* embryos with genetic predisposition to deafness or achondroplasia (dwarfism). While these conditions are sometimes perceived as dis-

abilities, individuals with such traits often belong to vibrant communities and cultures. I had posed the question: “What is the primary ethical concern that the author raises in the article?”

One student chimed in, “In paragraph 18, it talks about how the mother is concerned about what life will be like for her daughter if her parents are ‘little people’ (with achondroplasia) while she [the daughter] is not. The author is pointing out the argument that we should respect what parents decide about their kids’ future because they are responsible for them.” Another student said: “But does that mean the parents should be thinking about what they want for their children or what’s best for their children? In paragraph 11, the doctor notes that ‘one of the prime dictates of parenting

is to make a better world for our children...dwarfism and deafness are not the norm' (Sanghavi 2006). I think that this is the main ethical issue that the author is raising."

Although students were discussing a topic they felt passionately about, they were waiting their turn to speak directly to one another, building upon the points made by their classmates, and focusing on trying to interpret and understand the text. These are all important elements of a Socratic Seminar. As we debriefed, students told me that earlier in the day they had participated in a debate and found this seminar discussion to be much more productive. In the debate, they had become argumentative with one another, and were primarily concerned with being "right." In the seminar, however, students felt they were exploring a difficult topic together to understand the issue in more depth, and they appreciated how the seminar invited the participation of all students.

What is a Socratic Seminar?

The National Paideia Center (see "On the web"), which has developed extensive materials on using seminars in classrooms, describes Socratic Seminars as "collaborative, intellectual dialogue facilitated with open-ended questions about a text" (Billings and Roberts 2003, p. 16). The formal aspects of these seminars, which are outlined in the next section, "Key elements of a Socratic Seminar," foster collaborative intellectual dialogue, distinguishing them from other types of classroom discussions.

Because of the emphasis that this strategy places on disciplined inquiry, it has acquired the name "Socratic." The seminar format echoes the importance placed by the classical Greek philosopher Socrates (470–399 BC) on empowering students, through conversation and questioning, to build their own understanding and to learn to think analytically. Socrates responded to students' questions with questions of his own (rather than by simply providing an answer), and thereby encouraged his students to look inside themselves for insights and for inconsistencies in their thinking. In modern times, Mortimer Adler championed the use of Socratic (Paideia) Seminars (Adler 1982), and in 1988 founded The National Paideia Center (see "On the web").

Socratic Seminars are sometimes called Paideia Seminars, after the ancient Greek educational ideal that general learning should be the possession of all human beings (Billings and Roberts 2003). Socratic (or Paideia) Seminars are based on Adler's work. He proposed that one of the key goals of education—the enlarged understanding of ideas and values—could be met through questioning and discussion of important texts (Adler 1982). The purpose of the seminar, therefore, is to achieve a deeper understanding about the ideas and values in a particular text. In these seminars, students systematically question and examine issues and

principles raised by the text, and articulate different points of view. This style of discussion encourages active learning in that students analyze and apply concepts in a variety of ways (Perkins 1993). The group conversation assists participants in constructing meaning through analysis, interpretation, listening, and participation (Tredway 1995).

Key elements of a Socratic Seminar Text

The text (or article, film clip, or other artifact) should contain important and powerful ideas and values that relate to "big ideas" in science (see "Example texts," p. 40). Primary sources work especially well as they lend themselves to the types of interpretive questions that spark the most productive discussions. The text should be at the appropriate level for students in terms of complexity, and should relate directly to core concepts of the science content being studied. A certain degree of ambiguity or potential for different interpretations also makes for richer discussion.

All participants should read the text in advance of the seminar. It is helpful to number the paragraphs in a text so that participants can easily refer to passages during discussion.

Classroom environment

The classroom should be arranged so that students can look at each other directly, because the seminar is primarily a dialogue among students, not between individual students and the teacher. A circle or square works well. Some teachers like to use desks and have students use name card tents, while other teachers prefer simply to use chairs without desks. The teacher may sit in the circle but should not be raised higher than students. Students should

FIGURE 1

Discussion norms.

In addition to the classroom discussion norms you may have already set, it is important to include the following norms, or ones that are similar:

- ◆ Do not raise hands.
- ◆ Listen carefully.
- ◆ Address one another respectfully.
- ◆ Base any opinions on the text.

Additional norms might include:

- ◆ Address comments to the group (no side conversations).
- ◆ Use sensitivity to take turns and not interrupt others.
- ◆ Monitor "air time."
- ◆ Be courageous in presenting your own thoughts and reasoning, but be flexible and willing to change your mind in the face of new and compelling evidence.

be prompted to speak to one another, not the teacher.

The discussion norms should be prominently posted (Figure 1). Some teachers also like to post a main focus question.

Questions

Questions are the cornerstone of a successful seminar, and the teacher should have several prepared in advance. Some teachers also like to have students arrive in class with a series of questions they have developed.

Teachers may wish to begin with a literal question (such as, “What is PGD?”) to ensure that students understand the relevant science content before discussing the social contexts. However, most seminars focus on questions that interpret the text. This is an important point: Rather than asking for student opinions, the goal is to encourage well-justified reasoning based on evidence in the text. This strategy keeps the discussion from becoming personal or conflicting with

an individual student’s beliefs. Difficult topics are thus examined from the perspective of the author’s intent or meaning. Students who might otherwise remain silent or unwilling to discuss a topic that interferes with their beliefs can instead analyze and try to understand an author’s argument as presented in the text.

One question should be chosen as the key interpretive question of the seminar to focus on and begin the discussion. All questions should lead participants to the text’s core ideas and values, be open-ended, reflect genuine curiosity, and not have “one right answer.” Questions should also require students to use the text in their answers; for example, many seminars begin with a question such as “What is the most important idea in the text?” (Figure 2). In the PGD example, an interpretive question such as “What is the main ethical consideration the author raises in the article?” is a productive starting point. Other potential questions specific to this article include “How does the author view the use of PGD for what are conventionally considered disabilities?” and “According to the article, how does PGD reflect our cultural preferences?”

During the seminar, questions such as “Who has a different perspective?” will move the discussion along. Teachers should not step in to try to rescue the conversation, but instead should be patient and allow students time to respond. Toward the end of the seminar, some teachers like to use closing questions that encourage students to apply the ideas to their personal experiences and opinions. These closing questions do not require the text to be answered but provide students with the chance to relate their own perspectives. Examples of such questions include, “Do you think PGD should be regulated or should it be each person’s own decision? Why or why not?” and “Is there a ‘right use’ of PGD? If so, what is it?” These types of questions should only be used by teachers more experienced in the seminar format, and then only with caution, as they might bring the conversation out of the realm of justified and evidence-based reasoning and into the realm of personal beliefs.

Lastly, debriefing questions (Figure 2) help students reflect on the process of the seminar itself and are an important aspect of bringing closure to the discussion.

Seminar structure

The teacher is in charge of providing structure for the seminar and can do the following to keep students on task.

Before the seminar

- ◆ Introduce the Socratic Seminar and its purpose (to facilitate a deeper understanding of the ideas and values in the text through shared discussion).
- ◆ Have students read the text. Some teachers use pre-discussion writing assignments as a “ticket” to partici-

FIGURE 2

Sample seminar questions.

To serve as the key question or to interpret the text:

- ◆ What is the main idea or underlying value in the text?
- ◆ What is the author’s purpose or perspective?
- ◆ What are the ethical concerns raised by the text?
- ◆ What does (a particular phrase) mean?
- ◆ What is the most important word/sentence/paragraph?

To move the discussion along:

- ◆ Who has a different perspective?
- ◆ Who has not yet had a chance to speak?
- ◆ Where do you find evidence for that in the text?
- ◆ Can you clarify what you mean by that?
- ◆ How does that relate to what (someone else) said?
- ◆ Is there something in the text that is unclear to you?
- ◆ Has anyone changed their mind?

To bring the discussion back to students in closing:

- ◆ How do the ideas in the text relate to our lives?
What do they mean for us personally?
- ◆ Why is this material important?
- ◆ Is it right that...? Do you agree with the author?

Debriefing questions:

- ◆ Do you feel like you understand the text at a deeper level?
- ◆ How was the process for us? Did we adhere to our norms?
- ◆ Did you achieve your goals to participate?
- ◆ What was one thing you noticed about the seminar?

pate in the seminar. Share any expectations related to assessment.

- ◆ Review the discussion norms (Figure 1, p. 38).

During the seminar

- ◆ Be seated at student's level and remind them to address each other (and not the teacher).
- ◆ Pose the key question. Ask participants to clarify, elaborate, and verify their statements using particular passages in the text.
- ◆ If the conversation gets off track, refocus students on the opening question by restating it. Use additional questions to bring the discussion along.
- ◆ Record the main ideas discussed and the contributions people make (using a shorthand or diagram).
- ◆ Summarize the main points made in the discussion, either at a quiet point or toward the end of the discussion. Alternatively, ask if a student can summarize the main points.

After the seminar

- ◆ Ask debriefing questions of the students.
- ◆ Share your own experience with the seminar as a facilitator.

As Lynda Tredway notes, the teacher's role in this type of seminar is to "guide students to a deeper and clarified consideration of the ideas of the text, a respect for varying points of view, and adherence to and respect for the seminar process" (Tredway 1995, p. 28).

Integrating ethics

There are several ways to encourage students to focus on ethical dimensions of the topic being discussed. The most straightforward way is to incorporate a focus on ethical considerations into the interpretive question. For example, ask students, "Which ethical consideration does the author think is most important?" Choosing a text that explicitly addresses ethical issues is another strategy. If students have had prior exposure to ethical principles and considerations, a seminar can help them understand how justifications for certain positions can incorporate those considerations.

Assessment

Assessment can focus on student preparation for the seminar, student reflections or writings following the seminar, or participation in the seminar itself. A seminar rubric developed by Northwest Association of Biological Research teachers (see "On the web") helps assess student analysis and reasoning, discussion skills, and civility. Students may self-assess or be assigned to assess the participation of a peer.

Student learning and seminars

A growing body of research supports the use of text-based Socratic Seminars. Several studies have documented the effectiveness of using seminars to promote metacognition, interest in learning, and critical thinking skills. Polite and Adams (1996) conducted an in-depth qualitative analysis of a middle school in Tennessee that had adopted Socratic Seminar methodology and found that approximately 80% of the student sample engaged in higher-order formal operational or metacognitive activity. The researchers noted that one would expect the majority of their sample to be functioning at concrete operational levels, with little to no metacognitive ability. Another independent evaluation by Robinson (2008) examined academic achievement at nine Paideia schools (seven of which were defined as "at risk") and found positive academic impact on all schools. Seminars are a key component in the methodology of instruction at a Paideia school.

Recent research at the undergraduate level (Smith et al. 2009) indicates that peer discussions can enhance student understanding of a science topic. The authors point to research that the percentage of correct answers nearly always increases after peer discussion. Interestingly, the researchers determined that the positive effect resulted from gains in understanding acquired during discussion, rather than from the peer influence from knowledgeable students. Even when none of the students originally knew the correct answer, discussion among them led to greater understanding. The implications of this research for the

Example texts.

Bioethics-related texts

- ◆ Jodi Picoult (2004): *My Sister's Keeper* (fiction, "savior siblings")
- ◆ Laurie Zoloth (2005): "What Does It Mean to Be Human?" (stem cells)
- ◆ Garrett Hardin (1968): "The Tragedy of the Commons" (environmental ethics)

Biology-related texts (excerpts)

- ◆ Charles Darwin (1859): *The Origin of Species* (evolution, history of science)
- ◆ Jared Diamond (1992): *The Third Chimpanzee* (human evolution and behavior)
- ◆ Aldo Leopold (1949): "Thinking Like a Mountain" (ecology)
- ◆ Lewis Thomas (1974): *Lives of a Cell* (cell biology)
- ◆ Stephen Jay Gould (1980): *The Panda's Thumb* (evolution)
- ◆ Rachel Carson (1962): *Silent Spring* (ecology)

seminar model are clear: Shared inquiry and discussion can build greater student understanding.

Letting go

Conducting a Socratic Seminar for the first time can be intimidating. In most classroom settings, teachers are not accustomed to giving up so much control over the direction of a discussion. Often, a classroom discussion consists of a teacher asking questions of individual students, rather than students talking with one another. Even though the process of “letting go” feels risky, our teachers have also observed that the greatest rewards can come from this type of discussion. Students rise to the occasion when they learn they are expected to have a mature, “grown-up” discussion, and when they are properly prepared with a review of the purposes and norms of the seminar. A seminar also builds cohesion in the class as students collectively struggle to understand a text. Once students have experienced one Socratic Seminar, they often want to do more of them.

Seminars support inquiry in the classroom as students collectively build a broader understanding of the issues and values present in a challenging reading. Given the rapid pace of scientific discovery, particularly in the biological sciences, all students will need to make ethical decisions about issues that arise as a consequence of new technologies. When students discuss these issues openly, under the guidance of a teacher and through structured dialogue focused on understanding ideas and values, they acquire the habits of mind and critical-thinking skills required in the modern world. Seminars provide an engaging vehicle for promoting dialogue about ideas related to science in society; deepening student understanding of complex ideas through discourse; and developing students as active learners, thinkers, and citizens. ■

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On the web

National Paideia Center: www.paideia.org

Northwest Association for Biomedical Research: www.nwabr.org.

Socratic Seminars information, rubrics, and other materials: www.nwabr.org/education/primer.html

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