Role-Based Panel Discussions to Teach Socio-Economic Consequences of Wastewater Treatment

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INTRODUCTION

Wastewater treatment is getting more and more complex. From a biotechnological point of view, numerous new treatment techniques have been established in the past two decades to meet the increasing need to remove harmful substances. In addition, wastewater treatment is governed by socio-economic and geopolitical interests. To complicate matters further, the everyday life of each individual is affected by this topic. For example, contaminants such as (xeno)estrogens can accumulate within the environment (e.g., drinking water, food) and can cause infertility in male humans (2, 5). Unsurprisingly, emotion is involved in this socio-economic issue (4). Classical lecture-styled teaching methods often fail to reveal these emotional and multilayered interactions and tensions in society. As discussions outside the scientific community often include irrational reasoning, students need to be trained to react to invalid arguments. By use of a role-based panel discussion, this goal could be reached. Thus, the aim of this project was to give undergraduate microbiology students at the University of Innsbruck (Austria) an insight into the socio-economic and geopolitical dynamics of wastewater treatment from multiple points of view. The panel discussion was part of a biotechnology seminar, which served as preparation for a subsequent practical course on this topic.

PROCEDURE

Overview of the project and time required for each step

The biotechnology seminar consisted of two main parts. In the first part, students prepared a series of seminar talks covering the main topics of wastewater treatment (see Step 3 below). This first part ensured that all students were familiar with the basic terms and could, therefore, contribute to the subsequent panel discussion. In the second part (Steps 5 and 6), a group of students discussed a specific topic in more detail from multiple points of view.

Preparation for the panel discussion (located at the university)

Step 1 (60 min): Short general introduction to the topic by the lecturers and selection of the mode of participation for the students (either classical seminar talk or panel discussion; drawn by lot). Possibility to exchange topics (“market place option”). Panel discussion topic chosen by the students: “Estrogens in wastewater.” Alternative topics offered to the students were:

- “Antibiotics in waste water.” This topic might raise the following questions: Appropriate use of antibiotics in health care or in intensive mass animal farming; antibiotic resistance; alternatives to antibiotics; how to remove antibiotics from waste water?
- “Sewage sludge.” This topic might raise the following questions: Should sewage sludge be used as fertilizer to produce food; alternative possibilities to use/deposit sewage sludge; sewage sludge as potential phosphorus source with regard to world-wide future shortage of phosphorus?

Students were also encouraged to contact experts for subject-specific questions.

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Step 3 (2 × 150 min): Series of seminar talks (10–15 min per student; on the whole 10–12 different seminar talks held on two separate days) which introduce the whole group to the topic of wastewater treatment from different point of views such as historical development of wastewater treatment, main pollutants (C, N, P; micropollutants), how to analytically detect these substances, removal of these pollutants (e.g., nitrification, denitrification, anammox, phosphorus precipitation, biological phosphorus removal), main compartments of a wastewater plant, bioreactor types, sewage sludge treatment, typical problems occurring in a wastewater plant, local legislative regulations.

Step 4 (100 min): Excursion to the wastewater treatment plant (optional). Panel discussion located in the wastewater treatment plant (or any other suitable location; 45–60 min).

Step 5 (10 min): Preparation of the room arrangement for the panel discussion in the seminar room of the main building of the compound.

Step 6 (45–60 min): Panel discussion consisting of an introductory round by each panel member, discussion of controversial questions posed by the host and the audience, conclusion. Typical questions were:

- Which diseases can be caused by estrogen-polluted wastewater? How valid are studies on this topic?
- Who is to blame and who deals with the costs? Is it the customers who purchase contraceptives containing estrogen, the pharmaceutical industry, the gynecologists, or the community? Is it necessary/possible to forbid contraceptives containing estrogen?
- How can the amount of estrogen getting into the wastewater be reduced?
- Are there any technical solutions at hand to remove estrogens on a larger scale within reasonable costs?

Choice of panel members (chosen topic “Estrogens in wastewater”)

The aim was to collect a variety of controversial standpoints which allow a critical, profound, and diversified discussion on a popular science level. The roles were chosen and designed by the students themselves (see Appendix 1). On a metalevel, the following roles are recommended for this topic (to ensure a high number of different perspectives, only one student is assigned per role):

The host: The task of this panel member is to go where it really matters by questioning on a technical, as well as the metalevel.

The local: has private interests, suffers from immediate effects (e.g., parents with a sick child, organic farmer whose sheep might be affected). This person is not an expert but is highly informed and represents the local community.

The physician: knows about the health risks and encourages the authorities to implement promising programs in the field of health care (e.g., a gynecologist).

The industry: follows commercial interests; can either benefit or suffer from the effects of the substance (e.g., representative of the fishery association, representative of the pharmaceutical industry).

Public authorities (note that in Austria, wastewater treatment lies in the hands of public authorities): represents public interests, thus has interests in reducing the amount of the substance in the water cycle, is confronted with the costs, and has to deal with daily issues (e.g., an executive director of a wastewater plant).

The scientist: looks for solutions to eliminate the substance from the water cycle, and tries to develop methods to detect the substance (e.g., biotechnological expert specialized on micropollutants).

The roles chosen encouraged the students to make inquiries in many different subareas in order to prepare themselves for the discussion. Whereas the physician tried to find scientific data on health risks, for example, the student representing the public authorities was interested in finding statistics on the costs. The farmer, in contrast, looked for data on whether sheep are affected by the substance, while the worried mother tried to find information about what she could do at home in her daily routine to protect her children. The student representing the pharmacy industry, however, focused on how much a company earns annually by selling contraceptives, and tried to find other involved parties to blame for the contaminated water, such as the customers themselves for buying the products. The host tried to get an overview of the topic, and prepared critical and radical questions for all the panel members. Additionally, this student was ready to point to arguments that were not based on facts or prompt a panel member to elaborate or clarify a statement.

Tips

- The host plays a very important part in role-based panel discussions. It is vital to encourage the host to use Socratic questioning (1) to guide the discussion in a critical and profound way (“Why are you saying that? Can you give me an example? Can you rephrase that? What evidence is there to support what you are saying? And, of course, the host should constantly use the word “Why”). It is in this manner that learning through reflection takes place.

- In this seminar, an expert took part in the discussion (audience). As a result, a touch of authenticity was granted and a relation to reality was provided. The expert—in our case the executive director of a wastewater plant—gave insights into his daily work, bringing the discussion back to the current situation in Austria. Although the discussion will certainly benefit from any expert in the auditorium (e.g., a gynecologist, a representative from the fishery association), it is not crucial for its success. In most cases the lecturers can take over this role, if necessary.
• The panel discussion was part of the assessment system (80% of the grade); the assessment criteria (research and preparation, line on arguments, performance technique) were introduced to the students beforehand and oral feedback was given. Thus, the work load for the students was embedded in the grade composition, which, from our point of view, can be seen as a key factor for motivation and engagement.
• Interaction of the audience is crucial for the success of this method because the whole discussion benefits from the critical questions and comments. Since the whole group was familiar with the main principles (see Step 3), everybody was able to contribute to the discussion. It is important for the lecturers to communicate the need for interaction beforehand, as well as during the panel discussion. This lies beyond the skills of most (student) hosts.
• We suggest the lecturers supervise marginal conditions (time management, interaction with the audience, room arrangement), as this might be too difficult for the student host to deal with while hosting the discussion.

CONCLUSION

Assuming the roles of different players in this socio-economic and geopolitical issue enabled the students to identify themselves with previously unfamiliar positions. While trying to defend a particular point of view and arguing from one limited perspective, they got emotionally involved in the learning matter as the whole discussion turned into a gut issue. This so-called affective learning (3) is a well-known power source for learning in general. Furthermore, due to the different perspectives, students gained individual knowledge based on a social constructivist approach (6) because they designed the various roles allowing them to come up with their own conclusions, constructing their knowledge in social interaction. Provocative questions (raised from the audience, as well as addressed to the audience), which were asked spontaneously, made everyday implications visible for everybody. This method is tailored to students who need to understand the importance of the interaction of multiple factors, and delivers insight into highly complex matters. Additionally, this method provides understanding of different interests by various communities.

So far, role-based panel discussions have been applied twice on this topic. What was striking, though, was the fact that most male students went for the classical seminar talk and changed their task drawn by lot previously during “the market place option” (see Step 1). Respectively, the percentage of women participating in the discussion panel was high: (2010: total 15 students, 10 female (66.67%); panel discussion 100% female participants (5 out of 5); 2011: total 18 students, 6 female (33.33%); panel discussion 66.67% female participants (4 out of 6)).

SUPPLEMENTAL MATERIALS

Appendix 1: Detailed description of panel members

ACKNOWLEDGMENTS

Pamela Vrabl thanks the other team members of the biotechnological seminar and practical course—Thomas Pümpel, Christian Ebner, Christoph Schinagl, and Thomas Lichtmannegger—who enabled this form of teaching. Pamela Vrabl was supported by the Austrian Science Fund Project P22220-B11. The authors declare that there are no conflicts of interest.

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