Ditch the Debate: Preparing Preservice Teachers to Nurture Productive Discourse About Controversial Issues

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Abstract

This article showcases a lesson for preservice teachers designed to better prepare them in making instructional choices that support teaching and learning about complex socioscientific issues (SSI). Many of society's most pressing social issues require the understanding and application of scientific knowledge. To do so, individuals must navigate not only the scientific dimensions of the issue, but also the moral considerations that arise from the application of scientific knowledge to these complex issues. We begin this article with a discussion of a framework for effective SSI-based teaching followed by a discussion of the unique challenges to teaching and learning that are posed by engaging students with complex, moral issues such as SSI. We then outline a lesson in which preservice teachers were exposed to two example SSI-based lessons. One lesson was designed to exacerbate challenges associated with engaging with morally fraught issues, whereas the other was designed to mitigate these challenges. Throughout this experience, students were encouraged to reflect on their experiences from their perspective as students and as developing teachers. This article concludes with recommendations for practitioners who may wish to implement this lesson, including suggestions for possible adaptations.

Introduction

Many of society's most contentious debates, such as how best to manage the COVID-19 pandemic, climate change, or genetic modification, cannot be addressed without accounting for both their scientific and social dimensions. Known as socioscientific issues (SSI), these problems require navigating not only scientific concepts but also politics, economics, and morality (Zeidler, 2014). Unfortunately, the political landscape one must navigate when considering these issues is becoming increasingly fraught. Finkel et al. (2020) have found that acceptance of members of other political parties has dropped so much in recent years that people often harbor stronger feelings of hate toward the opposing party than love for their own. The widening ideological fissure poses a major threat to the design of solutions, falsely suggesting that finding a solution for many political issues, including SSI, is a zero-sum game.

Navigating these issues can be a challenging affair in the best of circumstances. Conflicting interests between diverse stakeholder groups often prevent the design of simple solutions. Because of the nature of the systems these issues operate within, an ideal solution for one group of stakeholders could pose major risks to the health, well-being, or interests of other stakeholder groups (Kahn & Zeidler, 2019). Teachers today are faced with the challenge of preparing students to engage with potentially contentious SSI in one of the most divisive political climates in recent history.

Teachers have expressed worries about covering contentious SSI not explicitly identified in standards without adequate support and preparation (Tidemand & Nielsen, 2017). Although there is a growing body of work designed to support teachers in implementing SSI-based instruction in the form of teaching frameworks and curricula, there is a gap in resources explicitly designed to prepare teachers to foster productive classroom discourse in a political climate that is growing increasingly polarized and contentious. As teacher educators, it is our responsibility to equip educators with knowledge and skills that allow them to engage with these issues in ways that foreground the skills needed to positively transform society in an environment that creates barriers to collaboration.

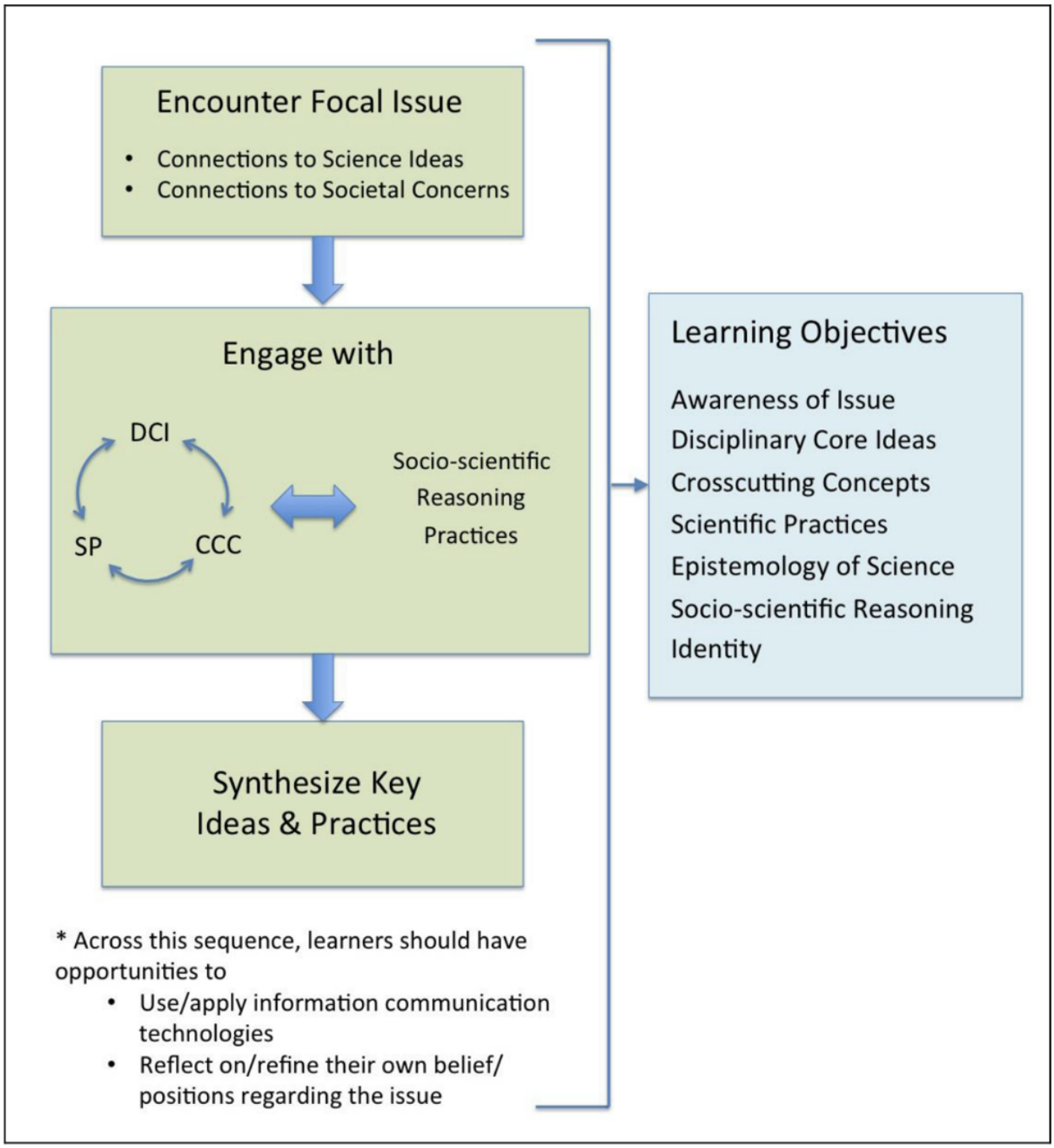
In this article, we present a lesson for preservice science educators that helps prepare future educators to address these challenges. We begin by presenting a framework for SSI-based teaching and learning and highlighting recent research that helps to explain why facilitating SSI learning experiences can be challenging. Then, we present a description and design rationale for a lesson for preservice science educators that illustrates how lesson framing can shape the ways students can participate in SSI-based instruction that foregrounds contentious issues. Finally, we conclude with a reflection on the lesson and recommendations for implementation.

SSI Teaching and Learning

The Socioscientific Issues Teaching and Learning (SSI-TL) framework (see Figure 1) is a pedagogical framework that is grounded in empirical research and reflects our best understanding of how to scaffold SSI instruction (Sadler et al., 2017). The SSI-TL framework was designed to promote three-dimensional learning goals (disciplinary knowledge, knowledge of crosscutting concepts, and scientific practices) as outlined in the *Next Generation Science Standards* (NGSS Lead States, 2013; see also National Research Council, 2012). In addition, the framework supports students' understanding of the epistemology of science by allowing students to engage in authentic practice and by explicitly asking students to reflect on the nature of science. SSI-TL experiences are also designed to develop students' socioscientific reasoning (Sadler et al., 2007), a construct that describes the ability to reason about complex and often contentious issues. Finally, Sadler et al. (2017) argue that an additional goal of SSI instruction should be developing learner identities that recognize the value of science during civic engagement, allowing them to apply science to solve societal problems inside and outside of the classroom.

Figure 1

Socioscientific Issues Teaching and Learning (SSI-TL) Framework



Note. From "Evolution of a Model for Socio-Scientific Issue Teaching and Learning," by T. D., Sadler, J. A., Foulk, and P. J. Friedrichsen, 2017, *International Journal of Education in Mathematics, Science and Technology*, 5(2), p. 80 (https://ijemst.net/index.php/ijemst/article/view/110). CC BY-NC-SA 4.0.

Instruction guided by the SSI-TL framework begins by introducing students to the focal SSI that serves as an anchoring phenomenon for the unit. During this initial encounter, students can explore the connections to scientific ideas and societal concerns that make these issues particularly challenging to address. As the unit progresses, students participate in lessons

designed to deepen their knowledge of the scientific and social dimensions of the issue through critical consumption of media and more traditional science lessons. These lessons should create contexts in which students explore relevant disciplinary core ideas and crosscutting concepts while engaging in science practices as they work to make sense of the focal issue. At the conclusion of the unit, students are asked to synthesize their understanding, often in the form of an argument, media product, or policy recommendation that addresses the scientific and social dimensions of the issue. Throughout this experience, students should have opportunities to reflect on their own beliefs, refining them as they develop a deeper and more nuanced understanding of the issue.

To implement SSI-TL to its fullest potential, learning environments must be designed to allow students to develop the skills needed to leverage scientific knowledge in ways that positively transform society. SSI-TL creates opportunities that allow students to legitimately participate in forms of discourse that are often encountered outside of the classroom when working to address these issues on a societal level (Simonneaux & Simonneaux, 2009). The development of an identity that supports and values one's contribution to discourse surrounding the complex issues we face as a society is an important goal of SSI-based instruction (Sadler et al., 2017).

Recent Research on Discourse About Controversial Issues

Problem

SSI-TL engages students directly with ill-structured problems that lack simple, clear-cut solutions. These problems are often political in nature, and successfully navigating these issues involves the evaluation of moral and ethical considerations alongside more traditional science practices. To truly develop our students' ability to leverage science through civic engagement, we must also support the development of their moral and political literacy (Zeidler, 2014). This means preparing students to navigate their personal values, emotions, and moral principles while engaging with these issues in ways that are likely to result in meaningful, positive changes to society (Zeidler, 2014). Research into moral psychology and conflict resolution has documented that when individuals engage with issues that they believe are fundamentally issues of "right" or "wrong" (i.e., moral issues), there can be major shifts in how these individuals think as well as engage with others (Kugler & Coleman, 2020; Skitka et al., 2021). For example, beliefs rooted in moral convictions have been shown to result in dogmatic thinking, with information often being evaluated based on its alignment with one's moral convictions rather than more rigorous epistemic evaluations (Morgan & Skitka, 2020; Skitka et al., 2021). Likewise, it has been found that events tied closely to moral convictions are often judged by their outcome rather than the merits of the processes that led to that outcome (Mueller & Skitka, 2018; Skitka & Houston, 2001). In addition, individuals often display greater levels of intolerance of those who do not share the same beliefs (Wright, 2012; Zaal et al., 2017) and struggle to design solutions when problems are closely tied to their moral convictions (Delton et al., 2020; Skitka et al., 2005).

These findings have clear implications for SSI-TL. Dogmatic thinking can be a barrier to appreciating the epistemology of science and the trustworthiness of knowledge generated through its practices and can impede higher level socioscientific reasoning by reducing the perceived complexity of the issue and decreasing the likelihood of revising positions in light of new evidence. Focusing on outcomes and overlooking the processes of knowledge creation is inconsistent with the SSI-TL goals of helping students engage in scientific practices and appreciate the epistemology of science because the integrity of scientifically derived knowledge stems from the processes that lead to the creation of that knowledge. Finally, learning experiences that elicit moral responses run the risk of creating a tense, unpleasant environment that hampers collaboration and productive discourse.

Although the difficulties associated with thinking about moral issues point to real challenges to the goals of successful SSI-TL, the type of thinking elicited by moral convictions trains students to engage in forms of discourse that further the political divide. Educators should attend to the ways in which activities can frame issues and discourse. Asking students to engage in activities that implicitly promote dogmatic thinking, discourage collaboration, and stoke divisiveness may reinforce these problematic frames. Given the goal of developing students' ability to address these issues in ways that create positive change, legitimate participation in SSI discourse should create opportunities for students to navigate authentic disagreement in the classroom in ways that foreground collaboration and understanding.

Navigating Moral Convictions in the Classroom

A recent study by Kugler and Coleman (2020) presents a novel solution. In this study, pairs of undergraduates with strongly opposing views on moral issues were asked to draft a joint position statement on the issue about which they disagreed. Kugler and Coleman devised an intervention (see Table 1) to manipulate participants' perceptions of issue complexity that was administered before participants met to draft their statements. Participants in the high-complexity condition were presented with an intervention text that emphasized multiple, interconnected perspectives and considerations, whereas participants in the low-complexity condition were presented with a text that presented more dogmatic perspectives of the issue. It is important to note that Kugler and Coleman did not set out to manipulate the beliefs and values of individuals but rather their view of the issue's complexity.

Table 1

Treatment Conditions Used by Kugler and Coleman (2020)

High-complexity intervention	Low-complexity intervention
Participants were told they were being given background information to read because "'it is important to consider different perspectives.'"	Participants were told they were being given background information to read because "'it is important to have a clear perspective.'"
During the reading, opposing points were integrated into a single framework.	During the reading, opposing points were contrasted.

Note. Kugler and Coleman (2020) discuss treatment conditions on p. 220.

Individuals in the high-complexity treatment experienced more positive emotions during the discussion, spent more time learning about the opposing perspective, and devoted less time to defending their own point of view than individuals in the low-complexity group. Participants in the high-complexity treatment also demonstrated higher levels of complexity in their written descriptions of the issue following the discussion with individuals they disagreed with, whereas low-complexity participants demonstrated lower levels of complexity in their post hoc descriptions of the focal issue. All pairs in the high-complexity group were able to successfully draft a response in contrast with 45% of pairs in the low-complexity group, and the responses drafted by students in the high-complexity condition were of higher quality than those in the low-complexity group.

It seems, then, that framing contentious issues as complex can help create environments that offset some of the challenges that accompany the navigation of morally fraught issues. The following section discusses a lesson aimed at developing discourse practices that support the educational goals of SSI-TL by framing issues as complex, emphasizing stakeholder experiences, and orienting students toward collaboration.

Lesson

The focal lesson took place in a master's-level science teaching methods course containing nine preservice teachers (PSTs). Throughout the semester, students were asked to engage in a series of learning experiences designed to support their ability to leverage SSI-TL as an instructional tool. We highlight the final lesson of this series. The lesson was positioned as a closing discussion on the impact of discourse while teaching. This lesson was motivated by concerns raised by the PSTs earlier in the semester, exploring the driving question: "How can we create positive learning experiences about contentions issues?" The PSTs were troubled by the challenges associated with teaching using SSI and wanted to ensure they did so in ways that were approachable and responsible. This lesson aimed to expose PSTs to examples of pedagogical choices that either align or create friction with the goals of SSI-TL discussed above.

Rationale

This lesson presents PSTs with opposing examples of how SSI-TL could unfold. Human gene therapy (HGT) was chosen as the focal issue because PSTs were expected to actively construct and evaluate arguments rather than simply recalling arguments from the recent news cycle or debates over social media. Whereas PSTs were likely to have recently considered arguments regarding COVID-19 or climate change due to their prominence in the news and social media, they were less likely to have done so for an issue that they were not being exposed to as frequently. Likewise, HGT has been used to study moral reasoning in SSI, making it suitable for our purposes because there is empirical evidence that it elicits moral reasoning in postsecondary settings (Sadler & Zeidler, 2004).

The first portion of the lesson showcases a "negative" case that provides an example of pedagogical choices that limit the perceived complexity of an issue and asks PSTs to engage in activities that reinforce dogmatic thinking, stoke divisiveness, and impede collaboration. The second half of the lesson is dedicated to a "positive" case, wherein PSTs experience an example lesson featuring pedagogical choices designed to emphasize issue complexity and require students to legitimately participate in practices valued in civic discourse. These cases use contrast to illustrate how pedagogical choices can shape teaching and learning. A comparison of instructional features of both cases can be found in Table 2. Although these cases represent extremes that may not often occur naturally, all the features of the negative case were drawn from the authors' experiences as secondary science teachers, researchers, and students.

Table 2
Pedagogical Decisions Foregrounded in Lessons

Characteristics	Negative case	Positive case
Dogmatic vs. nuanced thinking	Assigned "all or nothing" positions.	Positions could be nuanced and reflect ambivalence.
Authority (in)dependence	Arguments can be constructed without considering stakeholders.	Stakeholder knowledge and experience are positioned as valid regardless of position.
Focus on outcomes or processes?	Assigned positions to defend	Forced to consider the reasoning behind positions
Intolerance and distance	Physically dividing class Framing others as "opponents"	Consider other perspectives for common ground.
Difficulties in Collaboration	Consider "opponent's position" for debate.	Consider other perspectives for common ground.
Implicit goals	Win debate.	Develop well-rounded understanding.

Lesson Sequence

Eliciting Prior Knowledge of Gene Editing

To activate prior knowledge, the class was asked to share what they knew about HGT while avoiding making value statements like “HGT is wrong/right.” The PSTs were given 5 minutes to discuss their ideas in pairs and were then given the opportunity to share key ideas with the class. One PST recorded responses on a chalkboard to serve as a content support that the class could refer to throughout the lesson. The PSTs took to the task well, avoiding sharing opinions and value judgments during this segment. A sufficient level of content knowledge was discussed to support the continuation of the lesson. Important ideas contributed by the class included technical understanding of the science behind HGT (e.g., CRISPR, germline vs. somatic editing, and general knowledge of genetics), potential benefits of HGT (e.g., preventing diseases such as cystic fibrosis), and ethical concerns (e.g., the morality of designing children and the risk of furthering wealth disparities through HGT). This segment took approximately 10 minutes.

Next, the instructor reviewed key aspects of SSI-TL, including examples of commonly used SSI, goals of SSI-TL, and research-supported advantages of SSI-TL. The importance of helping students see the complexity of an issue, the varying impacts on different stakeholders, and the need for reflective inquiry and skepticism when encountering new information were discussed. These points were derived from the socioscientific reasoning framework proposed by Sadler et al. (2007).

HGT Debate Activity: Negative Case

Next, PSTs transitioned into a debate that forced students to engage with the issue in ways that resemble the challenges that arise during encounters with issues closely tied to one’s moral convictions. The class was told that they would be participating in a debate about whether HGT should be legal. To create an environment that stifled collaboration across perspectives, the class was divided into two groups and asked to move to two different parts of the room. The PSTs were encouraged to think about the “opponent’s” position so that they could anticipate and counter arguments, framing stakeholders as adversaries that must be defeated rather than potential collaborators.

The class was told that their goal was to devise a clear, strong argument for their position and that the question was not when but if HGT should be allowed. By assigning PSTs either for or against, students were forced into adopting a dogmatic, overly simplistic perspective on the issue. This also created a learning experience that overlooked the processes, experiences, attitudes, and reasoning that shape the positions of real stakeholders. Additionally, by preassigning positions, PSTs crafted arguments that supported their assigned beliefs rather than inductively formulating positions based on their understanding of the issue.

The class struggled with the inflexibility of the assigned positions. A particularly noteworthy moment occurred when one PST, whose faith was a major part of her identity, grappled with ambivalence.

> This technology can help a lot of people who are suffering from terrible diseases, and that's a really good thing, but at the same time, this technology really isn't compatible with [my religion's moral framework] . . . I feel like allowing [HGT] in some situations would be okay, but I don't think I can be fully for or against it.

Similar struggles with ambivalence were heard from other classmates throughout the activity. Without prompting by the instructor, both groups gravitated to the idea that the ethics of HGT are complex and contextually dependent. Discussions in both groups acknowledged that most people's positions were likely to fall somewhere in the middle of the two extremes, again, without being prompted by the instructor.

Gene Therapy Debate Discussion

After 5 minutes, conversations indicated that the PSTs had enough experience to participate in an informed discussion reflecting on their experiences both as students and as educators. The discussion focused on their experiences participating in the activity, how they envisioned the activity unfolding in a classroom of middle or high school students, and any concerns they had about the activity. PSTs raised concerns about the artificial dichotomy of positions, noting that this does not reflect the nuanced attitudes of most people. PSTs noted sources of moral ambivalence, such as HGT having the potential to help people while also posing risks to equity and challenging belief systems (e.g., religion) that individuals use to structure their moral frameworks. This was used as an opportunity to reinforce that science is necessary but not sufficient to solve SSI and that other types of knowledge are valuable. Another noteworthy moment was when one student referred to the groups as "teams," language that was not used in the activity introduction. This provided an opportunity to discuss the negative implications that tribalistic thinking can have on civic discourse.

Once the discussion reached a point at which it was clear that the activity reduced the complexity of an issue, was inauthentic, and reinforced problematic ideas and practices, the activity moved to a brief phase of direct instruction. The class was reminded that socioscientific issues are often contentious and that their students may have strong moral stances related to these issues. The importance of engaging students in practices that support democratic civic engagement and creating a classroom environment that allows students to feel safe and valued was emphasized.

Gene Therapy Perspective-Taking Activity: Positive Case

The second activity featured instructional decisions that encourage students to engage in thinking that is better aligned with the goals of SSI-TL. The PSTs were placed in groups of two or three and assigned to stakeholder groups. This activity was designed to emphasize

the complexity of HGT by showcasing the diversity of stakeholder perspectives and to support student agency. Two groups were assigned stakeholders that had potential medical benefits from HGT. One group assumed the perspective of individuals who wish to conceive a child and are carriers of a gene that causes a hereditary disease (i.e., cystic fibrosis). Another group engaged with the issue from the perspective of individuals with a hereditary condition causing blindness that gene therapy has been used to successfully reverse (i.e., Leber congenital amaurosis). A third group was assigned the perspective of the National Human Genome Research Group, a division of the National Institutes of Health that specializes in researching the application of genomics in medicine, including HGT. Finally, one group was assigned the perspective of an advocacy group whose primary goal is to advocate for socioeconomic equity. This perspective was chosen to elicit critiques of irresponsible applications of HGT. Future iterations could include groups that are likely to oppose HGT for other reasons, such as religious groups who may oppose the altering of natural genomes.

Before formulating positions, the class was asked to spend a few minutes developing their characters by considering the identity of the stakeholder, the stakeholder's experiences and values, and what factors might be important for understanding their relationship with HGT. By assigning the PSTs stakeholders rather than positions, students were forced to consider the stakeholders' experiences and use those experiences to inform their positions. This was done to establish stakeholder knowledge and experience as valid, regardless of their ultimate position. This also allowed the PSTs to develop more realistic positions that reflect the nuance and ambivalence that often accompanies attitudes toward these issues.

The class was then asked to consider how they could support the argument their stakeholder would likely advance. To nudge the PSTs toward a collaborative mindset, they were asked to consider possible areas of agreement with other stakeholders who may hold different positions. Finally, the class was told that the goal of the activity was to develop a well-rounded understanding of the issue. A comparison of instructional features of the negative and positive cases can be found in Table 2. The class was given 10 minutes to complete this activity.

In a postactivity discussion, the PSTs shared important aspects of their characters, what they felt their characters' positions might be and why, and where their characters may find common ground with others who disagree with their position. PSTs' arguments demonstrated an understanding of complexity and stakeholder perspectives, two facets of high-quality socioscientific reasoning. All groups identified areas of common ground with other stakeholder groups—a significant asset when engaging in problem-solving discourse in contentious contexts.

Reflection

The class was then asked to reflect on the differences and similarities between the two activities. The PSTs shared their responses and discussed their experiences, generally noting that the second activity was a more authentic, positive experience. A summary of the key ideas of the lesson was presented to the class. These included similarities such as both activities engaging students in socioscientific discourse and asking students to adopt a position. In addition, differences such as asking students to formulate positions rather than being assigned one, communicating a goal of “understanding” rather than “winning,” focusing on human experiences and perspectives rather than “sides,” portraying issue complexity rather than hyper-simplistic portrayals, and asking students to attend to common ground with others were discussed. To conclude the lesson, the PSTs were asked to reflect on which activity they would prefer as a student and which activity would result in a better learning experience. Students identified the second activity as superior on both fronts.

Conclusion

Given the novice status of PSTs and the short timeline of many teacher preparation programs, these programs often must focus on developing foundational practices and knowledge rather than nuanced practices such as those discussed in this article. Prior to this activity, PSTs participated in lessons that provided important background knowledge that supported their ability to engage with the ideas in this lesson on a high level. Of particular importance were lessons on SSI and forms of SSI-based instruction; the importance of creating a safe, equitable learning environment; and the role of discourse in learning.

By the time PSTs experienced the lesson featured in this article, they had explored problem-based learning in general and SSI as a particular kind of problem that can serve as an anchor for teaching and learning. The SSI-TL framework (see Figure 1) had been presented, and PSTs had used the framework to explore and analyze two sample SSI units. Major assignments for the course included peer teaching, lesson and unit planning tasks, and preparation of a case study based on their experiences within a science-classroom-based internship. The PSTs had flexibility in the choice of focal topics for these activities, and most had incorporated SSI as a focus for at least one of the aforementioned assignments (e.g., one PST enacted an SSI lesson for her peer teaching, several PSTs incorporated SSI in their lesson planning, and two PSTs explored SSI teaching as a part of the case study they prepared).

The importance of discourse in science classrooms and the need to create productive classroom-based discourse communities were themes that were threaded throughout the course. PSTs had read about and discussed strategies for facilitating discourse in science classrooms and were expected to incorporate discourse opportunities in their peer teaching and lesson planning. Equity and diversity and approaches for creating a welcoming environment for all learners were also themes emphasized throughout the course. In the week leading up to the HGT activity, PSTs had been challenged to consider how their diverse students’ funds of knowledge could be leveraged in science classrooms. This valuing of

student ideas and the perspectives and resources they bring with them into the classroom was positioned as a building block for the HGT perspective-taking activity. The success of the HGT activity and the PSTs' reflections on the differences between the negative and positive cases was set up at least in part based on their previous explorations of SSI teaching, discourse, and diversity and equity in science learning spaces.

Research indicates that intellectual and pedagogical change is best supported by interventions that allow participants to accumulate hours of experience over the course of several weeks (Desimone, 2009). As such, this lesson is best positioned as an extension or culminating activity rather than a stand-alone experience. This allows students to focus on nuance rather than working to develop foundational content knowledge. Likewise, enacting this lesson as a culminating activity creates opportunities for students to revisit ideas broached earlier in the semester. Spacing lessons such that students revisit content multiple times throughout a course is a strategy that has been shown to be effective at improving long-term retention (Rohrer & Pashler, 2007).

Teacher educators leading a science education methods course may find this lesson to be helpful, particularly if PSTs express anxieties related to SSI-based teaching. Educators have stated that having adequate support and resources when covering contentious SSI not explicitly identified in standards is a worry that accompanies this type of instruction (Tidemand & Nielsen, 2017). Although there is an ever-expanding collection of high-quality, evidence-based SSI curricular resources (e.g., Powell, 2021) available to support teachers, the nuances of classroom discourse may be difficult to make explicit in these resources. This lesson can be used to address this, providing teachers with concrete strategies as well as an opportunity to practice these strategies in a responsive learning environment rather than in the classroom without the opportunity to ask questions or receive feedback from instructors or peers.

Finally, HGT was chosen for this lesson because it aligned with the interests of the PSTs and the goals of the instructor in this course. Course instructors are encouraged to modify this lesson to suit their unique needs, selecting focal issues and relevant stakeholders that they feel best align with the goals of their practice. For example, if teachers wish to incorporate a local, emerging SSI into their instruction, there may not be curricular resources aligned with the issue at hand, leaving teachers to design their own. Teacher educators may wish to incorporate this lesson into an instructional design module for PSTs or use it as a professional development exercise for inservice teachers hoping to develop their capacity to effectively deliver SSI-based lessons. In this situation, it may be helpful to select a place-based issue (e.g., the water quality of a local river) and relevant stakeholders (e.g., community residents and local government officials) that more closely align with the types of issues being considered by educators in those contexts.

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