



## Case Study of Science and Social Studies Teachers Co-Teaching Socioscientific Issues-Based Instruction\*

Engin KARAHAN<sup>1</sup> Gillian ROEHRIG<sup>2</sup>

### ARTICLE INFO

#### Article History:

Received: 06 July 2017

Received in revised form: 4 Oct. 2017

Accepted: 21 Nov. 2017

DOI: 10.14689/ejer.2017.72.4

#### Keywords

environmental ethics, case study,  
community involvement, service  
learning projects

### ABSTRACT

**Purpose:** Science education literature has indicated that teachers do not always feel comfortable teaching socioscientific issues (SSI) that are infused with several social domains. In order to address this problem in teaching SSI, this study is designed to understand and describe the experiences of a science teacher and a social studies teacher, who collaboratively designed and taught an SSI-based environmental ethics class. **Research Methods:** The purpose of this descriptive case study was to portray how a science and a social studies teacher co-design and co-teach an environmental ethics class.

The data collection instruments were interviews, observations, and reflective journals. Thematic analysis of the data was made via a qualitative data analysis software. **Findings:** The findings indicated that both participants criticized the science curriculum for not being able to address every dimension of SSI. Therefore, they structured their environmental ethics class based on the "triple bottom idea" in order to look at those issues from social, economic, and environmental points of view. One of the highlights of their environmental ethics class was the opportunity given to the students to work on projects they felt passionate about. The participants described their role in the environmental ethics class as a consultant, which was different from traditional settings. Therefore, they no longer provided the content, but rather consulted with their students to explore their vested interests. **Implications for Research and Practice:** Giving students power to choose their own project topics, the teachers aimed at enhancing the motivation of students in taking pro-environmental actions, as well as developing their own perspective about controversial SSI. Considering the community involvement of the students, this missing piece of students' community involvement and agency in most educational settings was strongly present in the environmental ethics class.

© 2017 Ani Publishing Ltd. All rights reserved

\* This study was made possible by National Science Foundation grant CBET 1209402. The findings, conclusions, and opinions herein represent the views of the authors and do not necessarily represent the view of personnel affiliated with the National Science Foundation.

\*\* This article has been produced from Engin Karahan's doctoral dissertation.

<sup>1</sup> Corresponding Author: Eskişehir Osmangazi University, TURKEY, karahan@umn.edu, ORCID: <https://orcid.org/0000-0003-4530-211X>

<sup>2</sup> University of Minnesota, USA, roehr013@umn.edu

## Introduction

Socioscientific issues (SSI) are described as scientific topics with social significance as identified by society. (Fleming, 1986; Sadler, 2009; Sadler & Zeidler, 2003; Zeidler, Walker, Ackett, & Simmons, 2002). These ill-structured problems “do not have single correct answers, cannot be meaningfully addressed through memorized or well-rehearsed responses and are not subject to relatively simple algorithms” (Sadler, 2009, p. 11). They are subject to different social factors, such as politics, economics, and ethics (Sadler, 2011), various social domains, and areas of open inquiry (Klosterman, Sadler, & Brown, 2012). Their solutions are multiple and uncertain, and are necessarily influenced by science concepts and theories as well as social factors such as political, economic, humanistic and ethical aspects (Klosterman, Sadler, & Brown, 2012). Science education literature has indicated that science educators do not always feel comfortable teaching SSI that are infused with several social domains (Levinson & Turner, 2001; Zeidler, 2014). However, students need to be exposed to different alternatives and perspectives in order to make informed and critical decisions in socioscientific issues (Hyslop-Margison & Graham, 2004).

Teachers experience challenges in the teaching of social and ethical aspects of science in secondary schools. The literature has indicated that even though controversial socioscientific issues in science classrooms have been a main focus in the science education field since the Science, Technology, and Society (STS) movement in the 1970s (Levinson, 2006), teachers have not fully addressed these issues in their classes for several reasons, such as lack of knowledge or experience (Dillon, 1994; Osborne, Duschl, & Fairbrother, 2002). Thus, although teachers hold positive attitudes for teaching controversial SSI, only a small percentage regularly integrate them into their science curricula (Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006; Lee & Witz, 2009). While examining the perspectives of teachers on SSI integration in science classes, Sadler et al. (2009) found that teachers held different belief systems regarding incorporating SSI in their instruction, such as the position that science education should be value free or non-committal with respect to focusing on SSI instruction.

The literature has revealed that science curriculum is usually not able to address every aspect of SSI (Ryder, 2001), because those issues are subject to various social domains, such as politics, economics, and ethics (Klosterman, Sadler, & Brown, 2012; Sadler, 2011). Hence, science teachers often struggle to address socioscientific issues in their classrooms due to their lack of expertise in social domains of SSI. In order to address this problem in teaching SSI, this study investigated how a science teacher and a social studies teacher collaboratively designed and implemented an SSI-based environmental ethics class. The literature indicates that only a few studies (e.g., Levinson & Turner, 2001; Harris & Ratcliffe, 2005) explored the collaboration between science teachers and social studies teachers in teaching SSI. Therefore, there is a gap in the literature regarding the co-teaching of science teachers and social studies teachers in teaching SSI.

### *Co-Teaching*

The profession of teaching has long been recognized as an isolated work (Barth, 1990). However, research on teaching has been intrigued with the possibilities created by collaboration among educators in the same physical space (Cook & Friend, 1995). Research has indicated that collaboration among teachers with planning and teaching help them meet the needs of diverse students, as well as fulfill professional responsibilities in the classrooms (Thousand, Villa, & Nevin, 2006). When teachers with varied expertise and frames of references collaborate regularly, their students benefit more socially, behaviorally, and academically (Morgan, 2012).

Co-teaching became popular during the era of open schools (Cohen, 1973). In co-teaching, "two or more professionals deliver substantive instruction to a diverse or blended group of students in a single physical space" (Cook & Friend, 1995, p. 2). Friend and Cook (2007) explained co-teaching as having four components: two certified teachers, instruction delivered by both teachers, a heterogeneous group of students, and a single classroom where all students are taught together. It aims to bring the strengths of teachers with different expertise together, therefore, allowing them to better meet student needs (Bauwens, Hourcade, & Friend, 1989; Walsh, 1992). Thousand, Villa, and Nevin (2006) listed four predominant co-teaching approaches as follows:

- (a) supportive teaching, in which one teacher takes the lead and others rotate among students to provide support, b) parallel teaching, in which co-teachers work with different groups of students in different areas of the classroom, c) complementary teaching, in which co-teachers do something to enhance the instruction provided by another co-teacher, and d) team teaching, in which coteachers jointly plan, teach, assess, and assume responsibility for all of the students in the classroom. (p. 242)

Research has indicated that the positive outcomes of co-teaching models include improved academic and social skills, attitudes, and self-concepts for low-achieving students (Walther-Thomas, 1997; Schulte, Osborne, & McKinney, 1990), and increased student performance on high-stakes assessments (Thousand, Villa, & Nevin, 2006). Students with diverse learning characteristics in K-12 could be taught effectively in settings where teachers collaborate (Villa, Thousand, Nevin, & Malgeri, 1996). Students in co-taught classes can "receive more instruction and are involved more systematically in their learning than would be possible in a classroom with only one teacher, [therefore,] the combination of two teachers reduces the student-teacher ratio and provides opportunities for greater student participation and engaged time" (Cook & Friend, 1995, p. 6). In addition to student outcomes, co-planning and co-teaching also result in a variety of positive outcomes for the teachers (Thousand, Villa, & Nevin, 2006). The literature has highlighted the collaboration of the teachers in their professional development by sharing their pedagogical and content-related strengths and expertise, as suggested by co-teaching practices (Bauwens, Hourcade, & Friend, 1989; Walsh, 1992).

## Method

### *Research Design*

The purpose of this descriptive case study was to portray the ways a science and a social studies teacher co-design and co-teach an environmental ethics class that focuses on SSI around a large watershed. Therefore, the research question that guided this study was, "How do a science and a social studies teacher experience co-designing and co-teaching an SSI-based environmental ethics class?" Using a descriptive type of case study (Yin, 2003), it aimed to describe a phenomenon (teachers' experiences of co-designing and co-teaching an SSI-based environmental ethics class) and the real-life context (a classroom located in a community within a large watershed in Midwestern USA) in which it occurred. Since the contextual factors for the socioscientific issues addressed in this case were so significant, the classroom within the context of the community in which they were located was represented as a whole case in order to fully understand the teachers' experiences in the setting.

Among four types of case studies, a single case with embedded units was employed in this study to look at the same issue, but investigate the different decisions made by participants (Yin, 2003). For this single case, the embedded units included the science and social studies teachers in a school located in a large watershed. The justification for this configuration is that, even though the experiences of each participant (science teacher and social studies teacher) centered around an SSI-based environmental ethics class, the smaller contexts they were in (e.g., their roles in the class, background, and expertise) allow them to be categorized as subunits within the big case.

### *Research Sample*

The participants of this study included a science teacher and a social studies teacher who co-taught a high school environmental ethics class. Participant teachers of this study were actively involved in a National Science Foundation (NSF) funded project, which was an on-going professional development program striving to provide secondary science teachers with a context to teach local socioscientific issues related to a large river basin watershed. Their teaching assignments were mostly in biology, ecology, environmental ethics, world history, microeconomics, and humanities (see Table 1).

**Table 1***Information about participant teachers*

	<i>Alex</i>	<i>Dirk</i>
Age	32	42
Teaching Experience	10 years	20 years
Teaching in Current School	8 years	20 years
Subjects Currently Teaching	Biology, Ecology, Environmental Ethics	World History, Humanities, CIS Microeconomics, Environmental Ethics
Subjects Previously Taught	Biology (10 years), Ecology (5 years)	World History (20 years), Microeconomics (15 year), Humanities (15 years), Environmental Ethics (6 year)
Classes/Specific Minnesota River Basin Content	Ecology, Environmental Ethics	Environmental Ethics
Degrees Held	Life Science (BA), Education (MA)	Economics (BA), Educational Leadership (MEd)
Teaching License	7-12 <sup>th</sup> Grade Life Science	7-12 <sup>th</sup> Grade Social Studies

*Research Instruments and Procedures*

The data collection instruments for this case study were interviews, observations, and reflective journals. Two different semi-structured interview protocols for participant teachers were designed and implemented. The first interview protocol aimed at illustrating the participant teachers' epistemological and pedagogical beliefs about SSL, specifically around the Minnesota River Basin. The second interview protocol targeted participant teachers' co-teaching practices in teaching SSL. The first interview protocol was implemented with each teacher individually, as they held unique perspectives about the SSL, whereas the second interview protocol was a group interview conducted with both teachers to explore their co-designing and co-teaching experiences. In addition to interview data, the observation data from the participant teachers' classroom with the complementary reflection journals recorded after each observation was included to support and validate the primary data sources.

*Validity and Reliability*

In order to support the validity of the measures, the codes emerging within one data source were compared with the other data sources, thus triangulating the codes

against multiple data sources. Another validation strategy in this study was to provide rich and thick descriptions for transparency. Last, intercoder reliability methods were employed. Part of the data was coded by two researchers and then checked the congruity between these code groups.

### *Data Analysis*

The data analysis procedure occurred via open coding, identification of patterns and categories, and building themes and models. Thematic analyses of the data were made via a qualitative data analysis software called NVivo. In the open coding procedure, the essential codes that illustrate the phenomena were revealed. Hence, main findings emerged as patterns. These patterns represented the meso-context level (social, cultural, political, organizational, and economic conditions established in the local community and educational institution), the micro-context (expectations, beliefs, preferences, and goals of teachers), and eventually participant teachers' co-teaching practices of SSI integration. Lastly, the themes were built based on those patterns that initially emerged.

## **Results**

In this section, the contexts of community and school are first described. Then, each participant teacher's beliefs about the SSI around the Minnesota River Basin, as well as teaching SSI around those issues, are addressed. Lastly, their co-teaching experiences are portrayed.

### *The Community*

The high school is located in a large suburb in Midwestern USA. The city has experienced a rapid growth in population in the last few decades. People growing up here have witnessed a shift from a primarily agricultural community, to a second-ring suburb of retail shopping, single-family home subdivisions, and an increasing variety of local industry.

In describing the river-related issues in their communities, participant teachers discussed a variety of different problems. The issues participant teachers mentioned involved seasonal floods, frac sand mining, renewable energy efforts in malt brewing, and algae blooms in a local lake. They frequently complained about lack of awareness and even ignorance of residents in their community about the issues around the river. Since they live in a community, neither a rural town nor a metropolis, the teachers believed that it was a challenge for the residents to have a solid perspective. They added that individual interests and backgrounds of the community members played a significant factor in dealing with these community-based issues.

### *The School and Classroom*

This study took place in an environmental ethics class co-designed and co-taught by a science and a social studies teacher. The class was comprised of 25 male and 6

female students. The class was taught in the Environmental Learning Center (ELC), a free-standing building that sits on the edge of the high school's campus, surrounded by plenty of open space. The physical structure of the building caused the nature of this class to be different than that of most classes in formal school environments. The students taking this elective class had been mostly those "who wanted to go out in the environment and take responsibilities in community-based issues," Alex stated. The ELC building is surrounded by an open area where former students' environmental science projects are presented. The building is mostly used by Alex and another science teacher for the science classes, and Dirk uses the ELC only for the Environmental Ethics class.

*Portrait I: Alex*

Alex is a science teacher with 10 years of experience. His teaching assignments have mostly been biology, ecology, and environmental sciences. In addition to the ELC where he teaches most of his classes, Alex sometimes uses another classroom in the school building. In general, Alex was confident in using the classroom in the ELC and the different technologies available there, since it was the place where he usually taught his environmental classes. As he described his teaching style, Alex frequently highlighted the idea of place-based education and project-based learning. "We need to push that idea of kids learning by doing, and helping their community," Alex often said. Even though he strongly supported the idea of student-centered instruction, Alex also admitted that he sometimes gives lectures, especially in his Biology classes.

*Alex's beliefs about the SSI around the river basin.* Alex had focused on community-based environmental issues in his previous environmental science classes and was aware of the issues around the river basin. Through the student projects in which groups of students focused on a variety of different community-based environmental problems, he had become more aware of those issues, as well as being actively involved in the solution of those problems. He addressed the complexity of the issues around the river basin and different perspectives and positions involved in the issue. Alex described how people's interests affect their perspectives about the issue as follows:

*Depending on what your interest is or what you see value in, you're going to make it so you don't feel that what your interests are causing the problem. #Semi-structured teacher interview I*

While expressing his point of view about the issue, Alex often used the analogy of a "silver bullet" to describe the multifaceted nature of the issue. He stated that although there was no silver bullet in the issue, many people still considered agriculture as the only focus. Alex criticized the perspective of the people who focused on agriculture as the only contributor to the issue. In order to demonstrate his empathy for farmers, Alex often made arguments about the ambiguity of the controversy. For instance, he specifically pointed out Native Americans' long-term observations about the conditions of the river. He stated that the Native American

community in their town believed that the sediment was always in the river, which caused them to call the river “cloudy river.”

Regardless of their interests, Alex believed that every actor in the issue held some sort of bias based on their vested interests. Therefore, the public needed to hear the voice of each actor in order to be able to take a multi-perspective approach. He also criticized environmental agencies for dominating the controversy by blaming only farmers for being responsible for the river basin issues.

*Alex’s beliefs about scientific studies around the river issues.* Being a science teacher, Alex often addressed scientific data collection and analysis used while studying the river. According to him, comparison of the data collected in different times and locations was the way to explore the problem. In terms of studying the river, he often suggested that scientists needed to collaborate with the local residents, as they had been observing the changes in the river for a long time. He believed that researchers studying the river basin needed to have conversations with the local residents in order to understand the science behind what those residents had been observing for their whole lives.

In general, Alex was quite skeptical about scientists and their studies. He often addressed the different factors affecting the trustworthiness of science, such as funding and personal background. He highlighted that scientists could possibly skew their data in order to show what their funders wanted them to show. As he recognized the potential bias in science, Alex also highlighted that the public usually listened to the scientists who had better arguments. However, he felt that having a better argument in science did not necessarily mean having strong scientific findings. That is why Alex hoped that the scientists with stronger arguments also had better science behind their arguments. In order to determine the credibility of scientific studies, Alex believed that people, including high school students, needed critical thinking skills to ask the right questions and evaluate the scientific arguments. Regardless of their background, he hoped that his students were able to look at the scientific studies critically to be able to decide whether these studies were biased or not.

*Alex’s beliefs about SSI-based instruction.* As he expressed his beliefs about SSI based instruction, Alex highlighted the potential of socioscientific contexts in creating space for student agency. Criticizing traditional science classes, Alex believed that teachers usually assumed students had an interest in science content,

*Telling the kid that you have an interest in something is not gonna work, either. That used to be like, what do you mean I am interested in something. They are actually forced to have an interest, and it is sometimes fake to make it a little bit, too. #Semi-structured teacher interview I*

In order to address issues of student interest in science, he believed that teachers needed to help students figure out their interests, and then make the necessary connections within the context of socioscientific issues. Based on his experiences in the Environmental Ethics class, Alex believed that this was a challenging, yet

effective, way of teaching. In addition to giving students the freedom to figure out their own interests, Alex also added that students could learn better if they investigated the issue themselves. As long as students were given opportunities to control their own learning processes, they could become experts on the particular topics related to their interests,

*For a kid to really learn a lot about it, and really, the best strategy is that the kid does it himself. The kid goes and does the research, does their project on their own. They are really gonna know a lot. And, they are gonna be an expert, and they are gonna have a greater understanding about what's going on with the Minnesota River. #Semi-structured teacher interview I*

Alex also addressed how students perceive SSI. In terms of judging the trustworthiness of information, he criticized his students for not being critical and skeptical. Therefore, Alex stated that his main objective was to have students think critically and be skeptical about SSI. However, he added that people underestimated how hard it was to be critical and skeptical. In order to think critically about the controversial SSI, he emphasized the fact that students needed to know about the issue and gain a broad perspective on it.

#### *Portrait II: Dirk*

Dirk is a social studies teacher with 20 years of experience at his current school. Even though he teaches different social studies content, such as history, microeconomics, and the humanities, Dirk and his students often described Dirk as an economics teacher due to his BA degree in economics. Correspondingly, he encourages his students to examine various issues from an economics perspective. In his social studies classes, Dirk strongly encourages his students to think critically and determine their own positions. As a social studies teacher, Dirk often makes references to citizenship education in the context of environmental science classes. In one of his interviews, Dirk stated that “you talk about immersing and connecting the kids to where they live, and then you have an active citizen on your hands.” Despite his social studies background, Dirk takes advantage of his outdoor interests while teaching the Environmental Ethics class.

*Dirk's beliefs about the SSI around the river basin.* While demonstrating his understanding of the river-related issues, Dirk expressed his struggle to understand the science related to these issues. He was also disappointed about the disagreement among scientists as to whether steep riverbanks/increased precipitation or agricultural activities were the main contributor to the river basin issues, which is why he rarely attempted to explain the science behind these issues. Nevertheless, Dirk was aware of the social factors that he thought made these issues more complex. According to him, the social dimensions of the issue require people to look through different lenses while investigating it.

*We have to understand those lens ideas, social, environment, economic. I think it is hard. Sometimes it is a situation that all three are engaged...I think you have to be willing to hear all points of view, but you can't take one as the truth. #Semi-structured teacher interview I*

Dirk also addressed the decision-making processes in dealing with the issue. He stated that he personally preferred listening to extreme points of view first, and then trying to find the consistent ideas from both extremes that can be centered to bring a more moderate view. Dirk believed that the complexity of the issue, as well as the involvement of groups with different vested interests, required people to make their decisions based on critical thinking. However, he was concerned that most people made up their minds based on their initial thoughts, which were more emotionally driven than logical. He added that people did not make decisions unless the consequences impacted them directly. Therefore, the closer people were to the issue, the more they were engaged, but this proximity also caused them to follow their emotions rather than logic.

*Dirk's beliefs about scientific studies around the river issues.* Even though he rarely addressed the science in his interviews, Dirk frequently addressed the bias factor in science. Although he expected researchers to be less biased, he added that funding played a significant role in presenting the reality. In addition, Dirk believed that the scientific data itself did not necessarily tell the truth, because the data could be fit into the lens that people held based on their vested interests,

*I think you can make the data and research fit what lens you want to see it incorporated into. That's where I get nervous about who is doing the right study. I always try to remain objective to see what's their bias, what's their slant on the issue. #Semi-structured teacher interview I*

In order to decide who demonstrated bias in their study, Dirk suggested taking an objective look at the scientific studies. He added that if he had a chance to ask questions to those scientists, he would probably ask them to reveal their own biases, as well as to defend each other's positions.

*Dirk's beliefs about SSI-based instruction.* Similar to Alex, Dirk highlighted the necessity of helping students find connections to their interests while exploring SSI. Dirk believed that, in order to be fully engaged in an issue, students needed to see the connections to their lives. In order to do that, he suggested taking students to the places where they could see the parallels to their own experiences. One of the reasons why Dirk was so insistent on the idea of finding connections to students' lives was because the students did not think about the river issues, even though the river was their backyard. He believed that students needed to define their feelings first in order to ground their ethics.

*I think the big thing here is our vested interest. And, that's a huge topic. Like he said, I don't think some kids even think about it. Because my side of ethics, you gotta define what you feel about certain things to have any type of platform to base your ethics out of. #Semi-structured teacher interview II*

In terms of students' criteria for the reliability of information resources, he stated that students paid attention to the resources that were easier to understand. That is why they usually made inquiries about SSI via media because scientific resources were too hard to understand. Dirk also criticized his students for not having critical

reading skills. He stated that if he did not lead them, his students read to complete the task instead of really understanding and critically thinking about it.

In order to encourage students to think critically about an issue like the ones around the river basin, Dirk suggested pushing the extremes first in presenting the issue to the students. He believed that students could be provoked as they saw the extreme sides of the issue because students' thinking about controversial issues was driven by their emotions. Thus, the classroom discourse about controversy would be enriched.

*Even dealing with controversial issues in my school, it seems that the emotional component, or whatever their parents have felt, becomes what the kid feels, and then that drives what their thinking. That's what scares me. Personally, I would enjoy pushing the extreme. To me, that would be more enriching #Semi-structured teacher interview I*

### Instruction

*Co-designing environmental ethics class.* Environmental Ethics was an elective science class co-taught by the participant teachers. The reason that students enrolled this class was mainly its project-focused and student-driven structure. As Alex described the student body, he stated that students do not take this class just to learn science. In fact, most students taking this class were not interested in traditional environmental science content. He added that the class had both high and low achieving students in it. The main motivation to take this class was to go out and help the environment.

*They just don't care, whatever man, I don't care. It is just a graph, it is just numbers. That's not why they are in the class. It is not what they want. It has everything in it. And, we want every kid to explore their interests. Going out and doing actual work. That's the main thing we want. #Semi-structured teacher interview I (Alex)*

While designing the class, Alex and Dirk took this into consideration. Unlike most environmental science classes, they designed a less science-driven class in order to create a space for social aspects and student-driven projects. After attending the River Run professional development program, they centered their course content around the SSI around the Minnesota River Basin. Addressing the objectives of their class, both Alex and Dirk strongly highlighted critical thinking as the main goal. As a result, they wanted their students to be informed decision makers, instead of blind consumers. While the teachers co-designed their class, Dirk strongly pushed the idea of a triple bottom line that required students to look at the SSI around the river basin from social, environmental, and economic perspectives.

*Our class is based on the triple bottom line: social, environmental, and economic. So, we work hard to get the kids to see each of these...I think that just asking them to look at three different lenses really helps. #Semi-structured teacher interview I (Dirk)*

The idea of the triple bottom line was a baseline for the content of the Environmental Ethics class. Alex and Dirk often emphasized the triple bottom line idea and made explicit references to it throughout the academic semester. Therefore, they required their students to examine any environmental issue from social,

economic, and environmental perspectives. As a result, Alex and Dirk aimed at educating responsible citizens of the future. In their syllabus, they described their goal as “producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution.” They both believed that the way to produce this citizenry was to encourage students not only to understand the science behind socioscientific environmental issues, but also to examine those issues from the three perspectives in the triple bottom line idea.

One of the main points that made the Environmental Ethics class different from other science classes was the explicit inclusion of social aspects. Dirk believed in the importance of social aspects and often criticized the traditional environmental science curriculum and textbooks. With his social studies background, Dirk’s role was mostly to highlight the social aspects of environmental issues. Indicating the environmental science textbook that they were supposed to use for this class, he criticized environmental science classes about missing the opportunity to present the topics using multiple lenses. Therefore, Alex and Dirk decided not to use the environmental science textbook. Instead, they enriched their environmental ethics curriculum with outside resources, such as documentaries, newspaper articles, and outside experts in order to fully address both scientific and social aspects of environmental science content.

*Student-driven projects.* As mentioned before, Alex highlighted the idea of place-based education and project-based learning in teaching environmental science content. Dirk strongly believed in the premise of citizenship education and the triple bottom line as a framework for environmental science teaching. Therefore, Alex and Dirk decided the main premise of the class was to challenge students to do projects that helped their communities. In addition to being critical thinkers and informed decision makers, Alex and Dirk strongly encouraged their students to improve the quality of the environment surrounding them. They believed that the way they structured the class “challenged students to produce something” during the semester. In deciding the objectives for the student-driven projects, they assigned two different goals: “learning goals” and “content learning goals.” The content learning goals involved the usual environmental science content, such as “wildlife, water quality, aquatic life, soils, bio-geochemical cycles, pollution, interconnected systems, bio indicators, and human interactions with the environment.” They also explicitly stated that each content learning goal needed to be tied to SSI specific to their area. The learning goals were built on the “triple bottom line idea that required students to solve community-based problems through the perspectives of social, economic, and environmental.”

Alex and Dirk strongly highlighted student agency in the Environmental Ethics class. “Vested interest” was the word both teachers frequently stated in order to address the personal reason for students wanting to work on an issue. Indeed, the first assignment they gave was asking students to determine their own vested interests. In their first class, Dirk described a person with vested interest as “an individual with strong interests in the outcome of a decision that results in gain or

loss for that individual.” Presenting the service learning projects as broadly as possible, Alex and Dirk aimed at uncovering the different vested interests of their students. In addition, Dirk believed that by looking at environmental problems with diverse perspectives based on the triple bottom line idea, students would be able to make connections more easily regardless of their interests and backgrounds,

*If they don't feel passion towards or connect it, it might not register. But, at the same time, maybe they are getting it as they begin to present many of these different diverse ways to look at different topics. #Semi-structured teacher interview I (Dirk)*

Both teachers stated that SSI-focused content also helped them to give their students opportunities to explore their own interests. Like most SSI-based content, the issues around the basin are multifaceted and incorporate the interests of different groups of people with different vested interests. Thus, it creates opportunities for students to focus on their interests within their projects.

*SSI-based instruction.* The environmental ethics class began with fundamental principles and concepts in environmental science. Therefore, that was where Dirk emphasized the triple bottom idea, which requires students to see different aspects of SSI. They also had field trips to different places, such as a tributary of the Minnesota River on a Native American reservation. On those field trips, Alex was usually the one who lectured students about the environmental science content. Then, Dirk fostered a discussion about ethical, economic, cultural, and social contexts. To illustrate, during their field trip to one of the tributaries of the river located on a Native land, Alex first addressed the ecosystem around the river, discussing the health of the river and surrounding vegetation, and then Dirk raised questions about land ethics and Native culture.

In the first few weeks of the semester, Alex and Dirk highlighted the content in which they had expertise. Alex explained the scientific method and the ways to use it in student-driven projects. For instance, in the first class, he introduced different chemicals that existed in the river, and then led a discussion about the ways to investigate river basin issues. When Alex introduced the science around the river basin, Dirk intervened several times to address the role of bias in scientific studies. In addition, Dirk frequently highlighted ethics and economics in environmental studies. He introduced the concepts of cultures, worldviews, ethics, economics, and sustainability in the context of environmental science. Dirk also made references to specific terminology for ethics and economics, such as anthropocentrism, biocentrism, ecocentrism, preservation, conservation, land ethics, deep ecology, ecofeminism, and environmental justice.

As they moved to the second half of the semester, students increasingly focused on their service learning projects. The goal for the first project was to make a public service announcement or an informational video that “was informative and reflects the goal of seeing the chosen topic through the triple bottom line, the different lenses of social, economic and environmental.” The second project, which the teachers called a service-learning project, required students to identify “a river-related issue in their community, research the problem, examine possible solutions, and take

action/perform a service.” In these two projects, Alex and Dirk had to grapple with a dilemma related to their choices of content and pedagogical approaches. One of the requirements of both projects was to focus on SSI around the river basin. However, Alex and Dirk strongly supported the idea of student agency. Thus, they decided to ask their students to focus on the community-based environmental issues towards which they demonstrated a “vested interest,” as long as they stayed in the big picture of the watershed.

*The role of teachers.* Due to the mostly student-driven structure of the Environmental Ethics class, the roles teachers assumed were quite different from those of traditional settings. As they presented the community-based SSI, each teacher used his own content expertise to promote students’ understandings of those issues. Alex often presented the ecological, biological, and environmental aspects of those issues, while Dirk added the social, cultural, economic, and ethical influences. To illustrate, when they introduced the river-related issues, Alex’s role was mainly addressing the science behind the issue, such as ways to measure the pollutant levels in the river, the acceptable and extreme values in scientific data, and potential impacts of sediment and chemicals on the river system. Then, Dirk added the economic factors that forced farmers to keep their existing practices, the vested interests of the various groups, the ethical standards people needed to have while exploring solutions, and the consequences of the sediment and chemical load on social lives in surrounding communities. As they presented their expertise by approaching SSI from multiple perspectives, Alex and Dirk strongly encouraged their students to take similar approaches while investigating different community-based issues for their projects. In this way, they modeled multidisciplinary thinking.

As mentioned before, although he was not confident about the science behind the environmental topics, Dirk was quite critical about science itself. When Alex made references to scientific processes while talking about the environmental issues, Dirk played a key role in being critical about what scientists say. He frequently addressed the need to engage multiple perspectives in order to fully understand SSI around the river basin.

For the community-based service learning projects, Alex and Dirk decided to take a unique role in order to promote student agency in their classroom. Instead of assuming usual teacher roles, Alex and Dirk consulted their students on the pathways they chose to follow for their projects. They believed that it was an effective way to help students choose their projects based on their interests,

*Our job, is it is almost like you need to be with them, you are just consulting. You are always consulting with them to see that they are going down that pathway choosing, you know, to follow that interest. That's really weird, but it is an interesting way to teach, I think. #Semi-structured teacher interview 1 (Alex)*

Alex and Dirk strongly encouraged their students to present the environmental issues from the perspectives of different actors, thus including the voices of different groups of people. Hence, students could examine those issues from different perspectives to figure out their own position. Dirk frequently asked their students to

be true to the triple bottom line idea. Since they introduced the triple bottom line as a basis for any student work, both teachers constantly reminded their students to adopt those perspectives in any stage of their projects, including investigating the problem, creating solutions, and presenting their work.

### Discussion and Conclusion

This study investigated the experiences of a science and a social studies teacher co-teaching an SSI-based environmental ethics class. Based on the analysis of the data, this section generates discussions around the research question.

The science education literature reveals that the science curriculum is usually not able to address every aspect of SSI (Ryder, 2001), because those issues are subject to various social domains, such as politics, economics, and ethics (Klosterman, Sadler, & Brown, 2012; Sadler, 2011). There were several occasions when both Alex and Dirk criticized the science curriculum for not being able to address every dimension of SSI. Therefore, they structured their environmental ethics class based on the “triple bottom idea” in order to look at those issues from social, economic, and environmental points of view. Similar to Sadler’s (2011) argument that teaching science content was not enough for students to be able to negotiate the real-world problems, Alex and Dirk dedicated a significant part of their environmental ethics curriculum to social studies content (e.g., ethics, culture, economics) in order to help their students to become better able to deal with the environmental problems in their community. Addressing both scientific and social dimensions of the community-based river issues, Alex and Dirk intended to help their students to make informed decisions, as well as taking active roles in those community-based problems. The literature reveals that when students are exposed to different perspectives and alternative viewpoints, they are more likely to make informed, critical, and democratic choices (Hyslop-Margison & Graham, 2004). The teachers presented the community based river-related issues from the viewpoints grounded on social, economic, and cultural contexts in order to prepare students being critical and informed decision makers who are able to examine those issues from multiple perspectives, instead of blind consumers.

As Alex and Dirk designed their environmental ethics class, more than half of the academic semester was dedicated to student-driven community based projects. As they prepared their students for those projects, Alex and Dirk decided to use a variety of different resources created for both the scientific community and the public, because they strongly believed that those resources were more appropriate to inform and encourage their students to explore SSI around the river basin. The literature in SSI indicates that teachers have complained about lack of useful curricular materials and textbooks in enacting educational innovations, particularly SSI-based instruction (Sadler, Klosterman, & Topcu, 2011). Zeidler’s (2014) extensive review on SSI suggested that “research on how teachers can use and modify existing resources shows promise for allowing teachers to best match their curriculum to local needs and student interests” (p. 705). After deciding that the curriculum and the

textbook designed for the environmental science classes did not meet their expectations for the community-focused class, Alex and Dirk dedicated their time to design their environmental ethics curriculum based on the resources that specifically addressed the local environmental issues from multiple perspectives.

Alex and Dirk described their role in the environmental ethics class as consulting, which was different from traditional settings. Therefore, they were not the providers of content anymore, but rather consulted with their students to explore their vested interests. Both teachers reported that their students considered their projects as a passion to improve the quality of their lives, as well as those of people around them, instead of an assignment. Thus, they were able to act as individuals in making their own informed decisions and become proactive in issues of environmental sustainability, in particular, as literature has suggested (Bencze, Sperling, & Carter, 2012; Mueller, Zeidler, & Jenkins, 2011; Simmonneaux & Simmonneaux, 2009; Tytler, 2012). In the classroom, the teachers shared the roles based on their pedagogical and content-related strengths and expertise, as suggested by co-teaching practices (Bauwens, Hourcade, & Friend, 1989; Walsh, 1992). Hence, the environmental ethics class covered both science and social studies content. Moreover, because of the expertise of each teacher, the pedagogical strategies employed met the demands of providing the multidisciplinary content, as well as filled the needs of the diverse student body.

One of the highlights of their Environmental Ethics class was the opportunity given to the students to work in the projects they felt passionate about. Science in formal school environments has usually been described as authoritative and monolithic (Fensham, 1997; Yager, 1992). Giving students power to choose their own project topics, the teachers aimed at enhancing the motivation of students in taking pro-environmental actions, as well as having their own perspective about controversial SSI. As a result, students were likely to gain greater ownership of their own learning experiences throughout the academic semester. The sense of agency in the environmental ethics class empowered students to use the class to make changes in their lives and surroundings. The literature supports that by indicating that a sense of agency helps students identify themselves within science through advance participation in their community-based issues by taking actions at both individual and community levels (Basu et al. 2009; Calabrese Barton 2008; McNeill & Vaughn, 2010).

The literature indicates that teachers' personal beliefs have a great impact on their classroom instruction (Berkman et al., 2008; Rutledge & Mitchell, 2002). The findings of this study revealed that both Alex and Dirk believed in the idea of student ownership as a strong pedagogical approach. Therefore, their practices in the Environmental Ethics class were strongly influenced by their beliefs. Alex and Dirk provided their students with opportunities to explore their own interests, and centered their projects on those interests.

The implications of the study indicate that the co-teaching an SSI-based class helps teachers provide richer learning experiences through their pedagogical and

content-related expertise. Thus, teachers who co-teach SSI-based classes may feel more comfortable addressing controversial SSI that are complex and multidimensional in nature.

### References

- Barth, R. S. (1990). *Improving schools from within: Teachers, parents, and principals can make the difference*. San Francisco: Jossey-Bass.
- Basu, S. J., Barton, A. C., Clairmont, N., & Locke, D. (2009). Developing a framework for critical science agency through case study in a conceptual physics context. *Cultural Studies of Science Education*, 4(2), 35-371.
- Bauwens, J., Hourcade, J. J., & Friend, M. (1989). Cooperative teaching: A model for general and special education integration. *Remedial & Special Education*, 10(2), 17-22.
- Bencze, L., Sperling, E., & Carter, L. (2012). Students' research-informed socioscientific activism: Revisions for a sustainable future. *Research in Science Education*, 42(1), 129-148.
- Berkman, M. B., Pacheco, J. S., & Plutzer, E. (2008). Evolution and creationism in America's classrooms: A national portrait. *Public Library of Science Biology*, 6, 920-924.
- Cohen, E. G. (1973). Open-space schools: The opportunity to become ambitious. *Sociology of Education*, 46, 143-161.
- Cook, L., & Friend, M. (1995). Co-teaching: Guidelines for creating effective practices. *Focus on Exceptional Children*, 28(3), 1-16.
- Dillon, J. T. (1994). *Using discussion in classrooms*. Buckingham, UK: Open University Press.
- Fensham, P. (1997). School science and its problems with scientific literacy. In R. Levinson & J. Thomas (Eds.), *Science today: Problem or crisis?* (pp. 119-136). London, UK: Routledge.
- Fleming, R. (1986). Adolescent reasoning in socio-scientific issues, Part II: Nonsocial cognition. *Journal of Research in Science Teaching*, 23, 689-698.
- Friend, M., & Cook, L. (2007). *Interactions. Collaboration skills for school professionals* (5<sup>th</sup> ed.). Boston, MA: Allyn & Bacon.
- Harris, R., & Ratcliffe, M. (2005). Socio-scientific issues and the quality of exploratory talk what can be learned from schools involved in a 'collapsed day' project? *The Curriculum Journal*, 16, 439-453.
- Hyslop-Margison, E. J., & Armstrong, J. (2004). Critical thinking in career education: The democratic importance of foundational rationality. *Journal of Career and Technical Education*, 21(1), 39-49.
- Klosterman, M. L., Sadler, T. D., & Brown, J. (2012). Science teachers' use of mass media to address socio-scientific and sustainability issues. *Research in Science Education*, 42(1), 51-74.
- Lee, H., & Witz, K. G. (2009). Science teachers' inspiration for teaching socio-scientific issues: Disconnection with reform efforts. *International Journal of Science Education*, 31(7), 931-960.
- Levinson, R. (2006). Towards a theoretical framework for teaching controversial socioscientific issues. *International Journal of Science Education*, 28(10), 1201-

1224.

- Levinson, R. & Turner, S. (2001). *Valuable lessons: engaging with the social context of science in schools*. London, UK: Wellcome Trust.
- McNeill, K. L., & Vaughn, M. H. (2012). Urban high school students' critical science agency: conceptual understandings and environmental actions around climate change. *Research in Science Education*, 42(2), 373-399.
- Morgan, K. N. (2012). Middle school and high school general-education and special education teachers' coteaching experience (Doctoral dissertation, Argosy University, Nashville).
- Mueller, M.P., Zeidler, D.L., & Jenkins, L.L. (2011). Earth's role in moral reasoning and functional scientific literacy. In J. DeVitis (Ed.), *Character and moral education: A reader*. New York: Peter Lang.
- Osborne, J., Duschl, R., & Fairbrother, R. (2002). *Breaking the mould? Teaching science for public understanding*. London, UK: The Nuffield Foundation.
- Rutledge, M. L., & Mitchell, M. A. (2002). Knowledge structure, acceptance and teaching of evolution. *American Biology Teacher*, 64, 21-27.
- Ryder, J. (2001). Identifying science understanding for functional scientific literacy. *Studies in Science Education*, 36, 1-44.
- Sadler, T. D. (2009). Situated learning in science education: Socioscientific issues as contexts for practice. *Studies in Science Education*, 45, 1-42.
- Sadler, T. D. (2011). Situating socio-scientific issues in classrooms as a means of achieving goals of science education. In T. D. Sadler (Ed.), *Socio-scientific issues in the classroom: Teaching, learning, and research* (pp. 1-9). The Netherlands: Springer.
- Sadler, T. D., Amirshokoohi, A., Kazempour, M., & Allspaw, K. M. (2006). Socioscience and ethics in science classrooms: Teacher perspectives and strategies. *Journal of Research in Science Teaching*, 43(4), 353-376.
- Sadler, T. D. & Zeidler, D. L. (2003). Scientific errors, atrocities, and blunders: using bad science to promote moral reasoning. In D. L. Zeidler (Ed.), *The role of moral reasoning and discourse on socioscientific issues in science education*. Dordrecht: Kluwer.
- Schulte, A. C., Osborne, S. S., & McKinney, J. D. (1990). Academic outcomes for students with learning disabilities in consultation and resource programs. *Exceptional Children*, 57(2), 162-172.
- Simonneaux, L., & Simonneaux, J. (2009). Students' socio-scientific reasoning on controversies from the viewpoint of education for sustainable development. *Cultural Studies of Science Education*, 4(3), 657-687.
- Thousand, J. S., Villa, R. A., & Nevin, A. I. (2006). The many faces of collaborative planning and teaching. *Theory into Practice*, 45(3), 239-248.
- Villa, R. A., Thousand, J. S., Nevin, A. I., & Malgeri, C. (1996). Instilling collaboration for inclusive schooling as a way of doing business in public schools. *Remedial Special Education*, 7(3), 182-192.
- Walsh, J. M. (1992). Student, teacher, and parent preference for less restrictive special education models-Cooperative teaching. *Case In Point*, 6(2), 1-12.
- Walther-Thomas, C. S. (1997). Co-Teaching Experiences The Benefits and Problems That Teachers and Principals Report Over Time. *Journal of Learning Disabilities*, 30(4), 395-407.
- Yager, R. (1992). Viewpoint: What we did not learn from the 60s about science

- curriculum reform. *Journal of Research in Science Teaching*, 29, 905–910.
- Yin, R. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oak, CA: Sage.
- Zeidler, D. L., Walker, K. A., Ackett, W. A., & Simmons, M. L. (2002). Tangled up in views: Beliefs in the nature of science and responses to socioscientific dilemmas. *Science Education*, 86, 343–367.
- Zeidler, D.L. (2014). Socioscientific Issues as a Curriculum Emphasis: Theory, Research and Practice. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of Research on Science Education, Volume II* (pp. 697-726). New York, NY: Routledge.

### Fen Bilimleri ve Sosyal Bilgiler Öğretmenlerinin Sosyobilimsel Konular Temelli Öğretimi: Durum Çalışması

#### Atıf:

- Karahan, E., & Roehrig, G. (2017). Case study of science and social studies teachers co-teaching socioscientific issues-based instruction. *Eurasian Journal of Educational Research*, 72, 63-82, DOI: 10.14689/ejer.2017.72.4

#### Özet

*Problem Durumu:* Sosyobilimsel konular, bilim ile bağlantıları bulunan ve toplum tarafından sosyal önem arz edilen durumlar olarak tanımlanmaktadır. Günümüz fen bilimleri dersi öğretim programları incelendiğinde; sosyobilimsel konulara ayrı bir öğrenme alanı olarak yer verildiği görülmektedir. Fen eğitimi alanında gerçekleştirilen çalışmalar ise fen bilimleri öğretmenlerinin sosyobilimsel konuları derslerine entegre etme konusunda gerekli yeterliklere sahip olmadıklarını göstermektedir. Fen bilimleri öğretmenlerinin bilimin sosyal ve etik yönünü öğretmede yaşadıkları tüm zorluklara rağmen, sosyobilimsel konuların fen bilimleri ve sosyal bilgiler öğretmenleri tarafından işbirliği içerisinde öğretimine odaklanmış çalışmalar ise sınırlıdır. Alanyazındaki bu eksikliği gidermek adına, bu çalışmada fen bilimleri ve sosyal bilgiler öğretmenin işbirliği içerisinde tasarladıkları sosyobilimsel konular odaklı çevre etiği dersi incelenmiştir.

*Araştırmanın Amacı:* Bu çalışmada fen bilimleri ve sosyal bilgiler öğretmenin sosyobilimsel konular odaklı çevre etiği dersini işbirliği içerisinde tasarlama ve öğretim sürecindeki tecrübelerini anlama ve betimleme amaçlanmıştır.

*Araştırmanın Yöntemi:* Fen bilimleri ve sosyal bilgiler öğretmenlerinin sosyobilimsel konular odaklı çevre etiği dersini işbirliği içerisinde tasarlama ve öğretim sürecindeki deneyimleri üzerine odaklanılan bu çalışma, nitel araştırma yöntemlerinden durum çalışması şeklinde gerçekleştirilmiştir. Bu durum çalışmasında, araştırmacıların tek bir durumu incelerken katılımcıların farklı düşünce ve davranışlarını inceleme imkanı vermesi dolayısıyla yerleştirilmiş iç içe geçmiş tek durum deseni seçilmiştir. Araştırmanın çalışma grubunu Amerika

Birleşik Devletleri'nde bir ortaöğretim kurumunda çevre etiği dersini işbirliği içerisinde yürüten bir fen bilimleri ve bir sosyal bilgiler öğretmeni oluşturmaktadır. Araştırmanın verileri yarı yapılandırılmış görüşmeler, gözlem notları ve yansıtıcı günlükler ile toplanmıştır. İlk görüşmede katılımcıların sosyobilimsel konular ile ilgili epistemolojik ve pedagojik inançlarını belirleme, ikinci görüşme de ise öğretmenlerin çevre etiği dersini işbirliği içinde tasarım ve öğretim sürecindeki tecrübelerini anlama amaçlanmıştır. Gözlem ve günlüklerde ise öğretim sürecinde gerçekleşen durumlar, görüşmelerde katılımcıların ortaya koydukları tecrübelerini destekleme amacıyla kullanılmıştır. Elde edilen verilerin analizinde ise sırasıyla açık kodlama, örüntü ve kategorilerin belirlenmesi, tema ve modellerin oluşturulması izlenmiştir.

*Araştırmanın Bulguları:* Araştırma bulguları, fen bilimleri ve sosyal bilgiler öğretmenlerinin, öğretim programının ön gördüğü çevre eğitimi dersi içeriği ve ders kitaplarının sosyobilimsel konuların tüm boyutlarını yeterince içeremediklerine yönelik eleştiriler getirdiklerini göstermektedir. Dolayısıyla, sosyobilimsel konulara odaklandıkları çevre etiği dersini çevre sorunlarına sosyal, ekonomik ve çevresel bakış açıları ile inceleyebilmek adına üç boyut fikrine göre tasarlamışlardır. Öğrencilerini ders kapsamındaki projelere hazırlarken, ders dışı kaynakların öğrencileri sosyobilimsel konulara hazırlama ve motive etmede daha etkili olduğunu düşünerek ders kitapları yerine bu kaynakları kullanmayı tercih etmişlerdir. Bu bulgulara ek olarak, çevre etiği dersinin ilerleyen süreçlerinde öğrenci gruplarının ilgi duydukları alanlara yönelerek projelerini bu alanlarda gerçekleştirmelerini motive ederek, öğrencilerin karar verme süreçlerindeki kontrolünü zenginleştirmeyi amaçlamışlardır.

*Araştırmanın Sonuçları ve Önerileri:* Fen bilimleri ve sosyal bilgiler öğretmenleri sosyobilimsel konular odaklı çevre dersindeki rollerini açıklarken, geleneksel öğretmenlik sorumluluklarından farklı olarak kendilerini danışmanlar olarak tanımlamışlardır. Dolayısıyla, kendileri içeriği sağlamaktan sorumlu kişi olmak yerine, öğrencilerin sosyobilimsel konular bağlamındaki ilgi ve çıkarlarını keşfetmelerinde onların danışacakları uzmanlar haline gelmişlerdir. Araştırmaya katılan öğretmenler; öğrencilerine ilgi duydukları konulara yönelik projeler gerçekleştirmelerine fırsat verme, öğrencilerini çevre dostu adımlar atmaya motive ederek tartışmalı sosyobilimsel konularda kendi bakış açılarını bu adımlarda ortaya koymalarını hedeflemişlerdir. Öğrencilerin gerçekleştirdikleri toplumsal çevre hareketleri göz önünde bulundurulduğunda, çevre eğitiminin öncül hedeflerinden olan öğrencilerin çözüm süreçlerinde rol oynayarak bir parçası olmaları hedefinin bu ders kapsamında sağlanması için önemli bir çaba gösterildiği ortaya çıkmaktadır. Öğretmenlerin sosyobilimsel konular ile ilgili farklı bakış açılarını öğrencilere kazandırma ve öğrencilerin kendi kontrolleri doğrultusunda aktif rol almaları, onların toplumun sosyobilimsel konulardaki yaygın algılarını eleştirebilme ve aksi doğrultuda adımlar atabilme noktasında önemli bir faktör olmaktadır.

*Anahtar Sözcükler:* Çevre etiği, durum çalışması, toplumsal katılım.