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A Matter of Content: Investigation Biology Teachers' Understanding of Socioscientific Issues

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Subject

It has been argued that the primary aim of science education is to prepare students for making informed decisions on societal issues that relate to science (OECD, 2006). Accordingly, there has been a call for introducing science students to socioscientific issues – i.e. social, ethical and political issues that have conceptual ties to science (Sadler & Zeidler, 2003). Scholars usually envision that teaching socioscientific issues involves connecting science and everyday life (Evagorou, 2011), since “the most fruitful topics for learning about science in society are authentic social debates with personal relevance to the student, and being of a controversial character” (Eilks et al., 2014 p. 89). In particular, teaching socioscientific issues almost necessarily implies “a learning environment that values inquiry [...] and independent thinking” (Zeidler et al., 2011, p. 296). To be sure, the teacher has a paramount role in the design of such learning environments (Lazarowitz & Bloch, 2005).

So far, relatively few studies have shed light on how teachers navigate socioscientific issues and how they perceive their role in designing the needed learning environments. Nevertheless, there are a few indications that there are challenges to the uptake of socioscientific issues. For example, Lee et al. (2006) found that implementations are often “short-lived and rather superficial”; and that, in teaching, socioscientific issues are often “addressed instructionally” (p. 108). Further, according to Lee and Witz (2009), most science teachers feel that their most important task is to teach the principles of science, and any substantive pedagogical changes represent a burden. Indeed, teachers may find it challenging to thematize values and ethics (Sadler et al., 2006).

In order to support a more consistent and comprehensive implementation of socioscientific issues, we conducted a study that operated with the following research question: *How do upper secondary teachers understand and implement socioscientific issues?* We chose as our context, biology teaching at the highest level in Danish upper secondary school, because biology in the Danish curriculum is conspicuously aligned with the socioscientific issues movement. For example, it is stipulated that the very aim of biology teaching is to contribute to “the human’s understanding of itself as biological organism and as societal citizen – and [...] provide] the disciplinary background for the development of responsibility, decision-making, and action with respect to present societal conditions with a biological content” (Ministry of Education, 2010).

Design

In order to elucidate the research question, we collected data from Danish Biology teachers through interviews and questionnaires. First, we conducted five group interviews with a total of 11 experienced biology teachers from five different Danish upper-secondary schools. We elected to interview teachers in groups in order to study how the teachers collectively made sense of the role and function of socioscientific issues and in order to increase the subject-validity of the

interviewees' utterances (e.g. Bryman, 2012). The interviews were all semi-structured (Kvale, 2008) and followed this overall pattern:

1. A reflection exercise in which each teacher listed the socioscientific issues they had taught within the last two years;
2. A series of questions relating to the role and function of socioscientific issues in the teachers' teaching as well as questions concerning how the teachers assess student performance when teaching socioscientific issues;
3. A series of questions concerning the affordances and challenges of teaching socioscientific issues.

The transcribed interviews, were analyzed using thematic analysis following the regimented procedure proposed by Braun and Clarke (2006), in order to identify key emerging themes in the teachers' talk-in-interaction.

Second, we designed a questionnaire consisting of open questions. This questionnaire was distributed to members of a closed (invite-only) Facebook group for Danish biology teachers in upper secondary school. A total of 100 teachers filled in the questionnaire. The questionnaire focused on how the respondents would characterize or define socioscientific issues in general and how they integrate such issues in their teaching practice (all questions where open). The questionnaire data was also analyzed using thematic analysis (see above).

Findings and analysis

The analysis of the transcribed interviews led to the identification of three overarching themes that seem to emerge from the talk-in-interaction among the teachers in this sample:

1. The teachers consistently entertained and applied what can be called a *content-centered understanding of socioscientific issues*.
2. The teaching of socioscientific issues is beset with a range of multifarious challenges.
3. The formative and summative assessment of student performance is difficult when teaching socioscientific issues.

A content-centered understanding of socioscientific issues

This theme is complex in the sense that it comprises several layers and aspects. Indeed, as we will argue in the presentation, there are at least two different ways in which the teachers entertained a content-centered understanding of socioscientific issues.

First, the teachers' understanding of socioscientific issues was 'content-centered' in the sense that they tended to thematise socioscientific issues with a focus on the biological content in a way that is somewhat *detached* from the ethical or societal sphere. As some teachers put it: the biology content "pollution" is a socioscientific issue because "the politicians make demands on industry and agriculture" (1F, 24-30) and because it contains economic aspects as "it has a cost in agriculture if they are not allowed to fertilize using nitrogen" (2B, 36). Thus, the teachers generally seemed to hold that a specific biological content is a socioscientific issue simply by the fact that it is of potential relevance for society. Crudely put, the underlying reasoning seems to be that *every* biological topic or content is socioscientific because *in the end – but not necessarily in teaching situations* – that topic is contextualized in society. Indeed, as one teacher stated, "biology itself is societal. [...] the issues biology engages with are issues

which we engage with in society” (4L, 34). The apparent underlying notion in this respect seems to be that socioscientific issues to a large extent can be taught by thematizing purely factual content knowledge. This vision of socioscientific issues may undermine the very rationale behind introducing such issues in the curriculum.

Second, the teachers’ understanding of socioscientific issues was ‘content-centered’ in the sense that they tended to thematise socioscientific issues as *instruments* for teaching a specific biological content. The teachers mentioned that they often teach content knowledge, and then use a specific socioscientific issue as a perspective in order to make sure to put the content into context. For example, one teacher exemplified this by explaining:

“if we take some genetics, like for example heredity and diseases, then there will always be some rules of thumb about which diseases one chooses, that is the ones mentioned in the book. With that, we do always take a look at what [diseases] one screens the children for today, back in the days one tested the heels and a few diseases, today it is 9-10 diseases. Then I ask the students to go out and figure out what children are screened for and why we do it and why we do not screen for more diseases, and that is a socioscientific perspective. But it is still only a perspective”

(1F, 105)

The teachers also reported the role of socioscientific issues, to be “a motivator” or “an appetizer” for different topics or as a way to scaffold the teaching of a specific topic or content much like “a framework to work from” (5Y, 89). In general, the teachers seemed to entertain an understanding of socioscientific issues according to which the biological content (to which a specific socioscientific issue is tied) has *primacy* because the societal aspects of that issue are a distant context and the use of the issues itself in their teaching is mainly instrumental for teaching a core biological content.

The teaching of socioscientific issues is beset with a range of multifarious challenges.

Another prevalent aspect in the teachers’ talk-in-interaction concerns reasons why it may be difficult for biology teachers to plan and implement socioscientific issues teaching. This theme is somewhat complex: When the teachers talked about the challenges to the uptake of socioscientific issues teaching, they did so at several different points and in multifarious contexts in the interviews. It was possible to categorize the challenges to the uptake of socioscientific issues teaching according to three levels

- Challenges at the systems level. Here the teachers expressed that time is a perennial constraint on implementing socioscientific issues; further, the sheer amount of mandatory biological content in the curriculum also makes implementing socioscientific issues difficult
- Challenges at the teacher level. A major challenge to the uptake of socioscientific issues seemed to be the teachers’ interests and attitudes. For example, some teachers explicitly stated that teaching biological content was their main interest, others even stated that teaching related to socioscientific issues is boring: “I am not committed to it, I mean, I think it is boring too. It is boring” (2B, 356). In parallel, the teachers generally did not feel qualified to teach socioscientific issues.

- Challenges at the student level. Here the teachers often talked about what they perceive as the students' inability to engage in socioscientific discussions and/or argumentation because of a lack of knowledge about the subject specific biological contents of the socioscientific issues to properly engage in discussions and/or (biological) argumentation about it.

Formative and summative assessment when teaching socioscientific issues.

Most of the teachers stated that they perceive their role as different when there is a socioscientific issue in their teaching, and hinted that the classroom environment is more “open” than traditionally, as they for example “do not have the same assessor role, when we have a socioscientific debate” (1C, 147), and as the students “are allowed to come up with opinions [...], they might have different opinions and discuss” (1F, 149). Further, the teachers seemed to focus mostly on assessing their students' ability invoke biological content knowledge in the argumentation. For example, according to one teacher the assessment criteria that she would reference when assessing students in a socioscientific issue on pollution involve “pollution questions, decontamination, re-establishment of streams – here, they will have to estimate, they should say something about biodiversity and things like that. [...] they will have obtained enough knowledge to estimate the consequences of e.g. an intervention” (1C, 305-307).

Results from the questionnaire study

Due to the proposal constraints, we will only focus on one item from the questionnaire in this proposal. The 100 respondents provided a total of 209 characterizations of socioscientific issues (each respondent could provide up to three characterizations). These characterizations ranged in length, with some being quite long and specific, such as “relating to the world based on subject-specific content” (Q4, 194), while others consisted of just a few words characterizations, such as “examine problems” (Q4, 204). The thematic analysis of these characterizations led to the identification on four overarching categories of teachers' characterizations (see Table 1).

Category	N	%
A way to frame specific biological content	105	50%
An issue of interest or an issue that affects humans	52	25%
A way to engage students in a discussion or debate	28	14%
A way to apply specific biological content on a societal level	24	11%
Total	209	100%

Table 1: Respondents' characterizations of socioscientific issues

As can be seen from the distribution across categories (Table 1), the teachers' understandings of socioscientific issues largely focus on specific biological content. This resonates with the

findings from the interview study. In the presentation we will present the full analysis of the questionnaire study.

Contribution

While this was a small-scale study, the data is so rich that it affords a very fine-grained view into how Danish upper-secondary school biology teachers reflect and talk about socioscientific issues. Some of the findings from this study resonate with the growing international literature on socioscientific issues. First, many of the challenges to the uptake of socioscientific issues in biology teaching, that the teachers in study identified, have been identified in other countries and across disciplines (see e.g. Lazarowitz & Bloch, 2005; Sadler et al., 2006). While previous researchers have documented the tendency that teachers focus on teaching the subject-specific factual content in socioscientific issues (see e.g. Lee & Witz, 2009), this study provides new perspectives to the way in which biological content holds a central role in the understanding of teachers. Importantly, the teachers harbored the idea that an issue is socioscientific because it, *in the end*, but *not necessarily in the actual teaching situation*, is contextualized in society. But such an understanding may undermine the rationale behind teaching socioscientific issues in the first place – i.e. improving students' systems thinking and decision-making, as well as supporting students' collaborative argumentation (Tal et al., 2011; Evagorou, 2011).

The findings from this study suggest that a practice of teaching socioscientific issues calls for support for teachers on multiple levels. A first step could be to develop materials for that help teachers in implementing socioscientific issues in a way that does moves beyond thematizing biological content. However, since this study identifies a problem at the conceptual level, it seems to be necessary to work with teachers in order for them to enrich their understanding and beliefs about socioscientific issues. In the presentation, we will discuss concrete ideas for how to collaborate with teachers about constructing viable beliefs about socioscientific issues,

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