When “scary” science “just feels wrong”: how the facts in a masculine fact-based debate couldn’t stop science students’ feminine feelings

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Received: 18 January 2018 / Accepted: 25 November 2018 / Published online: 15 May 2019
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Abstract

The purpose of this study is to discuss notions of femininity and masculinity in situations of argumentation among Swedish upper-secondary students who are studying Natural Science. The empirical material is drawn from an ethnographic inspired study, where I followed a group of students in all of their science teaching throughout a semester. This study includes three classroom situations where the students are given a task to play roles where they either argue for or against nuclear power and where they are asked to argue for or against genetically engineered organisms. The students also asked to defend the position of one country in negotiations to limit greenhouse gas emissions in an international climate conference. This study will focus on relational situations at the micro level that are related to masculinities and femininities at the macro-level. The results show how the constructions of argumentation in the role playing tasks are based on an economic terminology and rationality, which can be said to represent a masculine approach. In contrast, the discussions that followed the role playing allowed for affective presentations, which are often regarded as feminine. This study discusses how a critical perspective can contribute to the awareness of the logic of these rendered performances.

Keywords Science education · Argumentation · Role play · Images · Femininity · Masculinity

Students today live and work in an era characterised by complex problems with no simple cause–effect relationships nor obvious solutions. The climate provides a telling example as there are comprehensive discussions about the source and consequences of the problem, and how we should evaluate the importance of those consequences. Further examples include GMOs, food nutrient content, nuclear power, and biological diversity. This study focuses on roleplay used in science education in upper secondary school and examines three debates where students took on sustainable development issues. The aim is to discuss

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the opportunities and limitations of roleplay of argumentation, in particular in regard to notions of femininity and masculinity.

Education for sustainable development (ESD): a value-laden subject

Recent technological developments require us to deal with issues in, for example, medicine and genetic engineering that were previously unimaginable. Daily the media report on local and global events that involve several actors and conflicts of interest. Knowledge of science is often key to the origin of conflict and knowledge of science influences those who propose solutions. Examples of such conflicts include claims of health-hazardous mobile phone radiation, debates about nuclear waste management, questions about whether a right to health includes aesthetic enhancement, and the genetic modification of cattle and crops. Chantal Mouffe (2008) argues that if we do not want to entrust such issues to experts and the market economy, the issues need to be discussed in a democratic public sphere. Mouffe points out that there is risk with the belief that socio-political decisions are based on rational thought, and she reminds us that uncertainty and emotion impact decision statements. Education for sustainable development (ESD) continuously confronts value-laden questions, known as Socio-Scientific Issues (SSI) (Kolstø et al. 2006) or Socially Acute Questions (SAQ) (Simonneaux 2014). As they concern ethics and matters of life and death, these issues concern us and we must thus take them into account.

ESD emphasises different parts of the world. Arjen E. J. Wals (2009) still believes that most of ESD's content moves within the intersection of ecological, economic and social dimensions of sustainable development; in which a neoliberal masculine market orientation dominates economic direction (Connell and Wood 2005)—an orientation based on conventional male and Western notions of objectivity, logic, and abstraction, and a notion of a rational economic masculinity (Pearse and Connell 2016).

Sharon Todd (2012), Gert Biesta (2006) and Angela Calabres Barton et al. (2008) argue that schools need to make space for the uncertain and the unexpected. A lack of obvious answers is a characteristic, according to Bob Jickling and Wals (2008), of many sustainable development issues. Regula Kyburz-Graber et al. (2006), who have for some time studied education in environmental issues, claim that teachers and students struggle with making decisions in the face of open-ended questions that do not have obvious answers and these can therefore create insecurity.

In many areas, teaching includes both the presentation of knowledge and activities to help the students to learn, which impacts how and what the students learn by themselves and from their surroundings (Bazzul 2012). Several researchers point to the connection between what happens in the classroom and what these events can give rise to. For example, Jesse Bazzul and Heather Sykes (2011) have seen that certain groups of biology students can become marginalised, and other studies show (e.g., Orlander et al. 2015) that cultural values, prevalent across science education and which define femininity and masculinity, can mould the content.

School could be said to nurture students into social, cultural and political regimes (Biesta 2011), which inform for example debate, examined in this study, and gendered power relations. Raewyan Connell, who has studied masculinities for decades, stresses the possibilities built into education:

The importance of education for masculinity politics follows from the onto-formativity of gender practices, the fact that our enactment of masculinity and femininity

bring a social reality into being. Education is often discussed as if it involved only information, teachers tipping measured doses of facts into pupils’ heads; but that is just part of the process. At a deeper level, education is the formation of capacities for practice. A social justice agenda in education must concern the full range of capacities for practice, the justice of the way those capacities are developed and distributed and the ways they are put into effect. (Connell 2005, p. 239)

Femininity and masculinity performed at school

Some issues of power relations within sustainable development are seen in Rebecca Pearse’s (2010) observations of the Australian climate movement; she has shown that the movement often involves gendered orders, in which the masculine structures hold a superior global position. This presentation of the world order has a long history and widespread cultural and social effects that are enacted in a community both by individuals and by the collective (Schippers 2007). For example, Evelyn Fox Keller and Helen Longino (1996) show that a masculine ideal has influenced the development of modern science and its practice. Although some researchers have found the contrary to be true, many argue that in most discourse science is presented as rational, cold, methodical, and objective—and free from the involvement of emotions (Sinatra et al. 2014). Keller (1985) argues that science has long been rooted in a myth that affective and intellectual work are separate; a myth that favours objective, fact-based statements. Keller describes how subjectivity, emotion and nature are described as feminine, while objectivity, reason and thought are described as masculine (Keller 1985). Nina Björk (1999) sees possible comparisons to traditional narratives about the development of modernity being driven by the masculine, in other words by rational individuals, and how those narratives exclude “the other,” in other words the feminine.

Although history has shown us that the concepts of masculinity or femininity change slowly, they are not fixed performances. Instead, they are on-going social processes. In everyday practices, social movements, and global economic relations, these concepts are transformed through discursive processes (Foucault 2002). That gendered norms must be understood relationally, as part of a larger social process, makes it valuable to investigate how notions of masculinity and femininity are expressed within different teaching practices (Connell 2005).

While the students can have an impact on what is performed, what they can perform depends on which possible performances are presented to them, and that is entangled with power relations and historical gender constructions of the context, including the school itself (Pearse and Connell 2016).

Images

Luce Irigaray emphasises teaching’s important opportunity to be open to different images, contingencies, or imaginary representations of femininity and masculinity (Irigaray and Green 2008). Irigaray (1985a, b) has long explored what she calls the masculine and feminine imaginary, which she believes enables various kinds of fantasies. According to Irigaray, knowledge is always gender coded. The constructions of knowledge in the classroom are seen to be an effect of the ways in which different areas of knowledge are sustained through the images that appear in linguistic and material practices. Translated

to the activities in the classroom, Irigaray's theorisation of images (symbols, beliefs and metaphors), which are dynamically and relationally constructed through classroom practices and curriculum materials, means that activities have an impact on the interaction in the classroom. This impact enables different ways for the students to relate to the physical reality.

For education in schools, it is important to examine what kind of images are used in teaching (Youdell 2011) and how these are performed (Foucault 1994/2002). Hence, the purpose of this study is to interlace a philosophically informed investigation of images with an ethnographically based account of interactions in the classroom. The aim is to discuss the possible impact of these images. Indeed, a real challenge for a researcher is to apply discussions based on the philosophy of femininity and masculinity to situations and presentation studied in science education classroom practice, presentations that are shown to be "conventionally masculine" (Pearse and Connell 2016, p. 32).

In my experience, the concepts of femininity and masculinity evoke strong emotional reactions. Femininity connotes the female body, masculinity the actions of men. The use of these terms might reinforce the dichotomy between women and men, excluding those who identify as neither, both and/or fluid. Concepts of femininity and masculinity also depend on age and heritage, culture and ethnicity, among other factors. Scientists, theorists and philosophers such as Irigaray, Keller, and Björk have helped to problematize these issues by revealing the exclusion of groups, values, emotions, aesthetics, and the affective that do not fit into rationalism or do not influence how scientific discourse develops. These aspects have been labelled irrational and illogical (Björk 1999). Yet these are values that exist not only in the lives of women but in all humankind: the only difference that these narratives have not become part of the story. Björk (1999) believes that had these stories not been excluded from, and instead been woven into, narratives, then history would have taken a different course. Irigaray (1985a, p. 21) calls it "a difference not taken into account" and believes that there are images that were not given an opportunity to emerge. Björk (1999) uses the word *chimera* to describe the idea that rationality rules modernity and the modern economy. Furthermore, Björk shows that contrary to the perception of rationality as rational, rationality is influenced by desire and utility. Emotion and reason interweave, yet there are those who strive to keep them apart to create hierarchies of power.

Nowadays there is a body of research discussing femininity/femininities and masculinity/masculinities; researchers have examined how these terms relate to individuals being male or female (Paechter 2006). We need to remind ourselves that the concepts of femininity and masculinity in this study are not about biological or anatomical differences between the sexes. In other words, that woman and femininity are not regarded as the same and neither are man and masculinity (Connell 2005). Accordingly, it is not important whether actions are taken by a girl or a boy. Instead, the focus lies on what kind of images *become available* for girls and boys in relations addressing in-between us (Irigaray 1985b). This study focuses on the interplay between discursive, imaginary, linguistic and embodied understandings, which according to Irigaray (1985a, b) shapes us as well as shaping the knowledge and social relationships that are being produced in any given context.

This study looks at relational situations on a micro level in a school practice by focusing on actions performed in teaching situations where students were instructed to play roles in which they argued either for or against solutions to sustainable development issues. The study goes on to relate these performances to patterns of femininities and masculinities on the macro level. Images of masculinities, as previously mentioned, include market orientation, objectivity, reason and rational thought, fact-based statements, logic and abstraction, and rationality. Images of femininities include emotions, the affective, subjectivity, desire,

uncertainty, and irrationality. In relation to international politics, Smith, in Connell (2005, p. xxi), argues that ESD is a part of “the key” to shifting the focus from the individual level to socially constructed gender relations, stating that “international trade and global markets are inherently an arena of gender politics” (Connell 2005, p. xxi).

Aim and research questions

Accordingly, this study focuses on classroom situations where the students debated three issues: nuclear power, GMO and the climate. My interest lay in the examination of the images performed in roleplay that used argumentation. I am especially interested in those performances that relate to the construction of femininity and masculinity on the macro level. The findings lead up to my questions about what opportunities and limitations these performances offer, and to do so I posed the following methodological question: What kinds of images are performed?

Data collection

The data used in this study comes from events in a science class that I followed during one semester. In addition to collecting audio recordings of class discussions and to all the teaching materials, I conducted group interviews with 15 students and one interview one-on-one with the teacher. All participants were given information about the study verbally and in writing beforehand, and they agreed to participate on the understanding that they could withdraw from the study at any time. The names of all the students have been kept anonymous (Swedish Research Council 2017).

The 26 students who took part come from a variety of ethnic backgrounds and some speak languages other than Swedish at home. They all attended a first-year social-science programme, “Science Studies 1b 100p”, at an upper secondary school. The courses in “science studies,” with small variations in content and length, are required courses in Sweden for students who take non-science programmes.

Methodology

Relational approach

Schoolwork and its actions are interpreted with a relational approach (Butler 1999b) by studying how expressions are constructed and related to events in a situation (Irigaray 1985b, 1993, 1994, 2000). Collective understandings need to be studied in the practice in which subjectivities operate (Connell and Messerschmidt 2005). Many researchers, such as Deborah Youdell (2011) and Donna Haraway (1988), regard the making of meaning in school as complex, often containing contradictory actions that cannot be considered universal; on the contrary, they need to be understood as situational and contextual. The concept of situated acts is based on an idea that Keller and Longino (1996) describe as a philosophy of embodied and socially, temporally and spatially located knowledge.

Accordingly, the empirical examples in this study should be regarded as examples of actions that have been expressed in temporary situations in a certain context. The same person can show many different types of actions and they can also show conflicting actions.

Thus, the actions in this study cannot be considered as an expression of who the people are, but rather should be seen as an expression of something that is done (Butler 1999a). What is seen as a natural or normal action is regulated by and through discourses (Butler 1999b). In educational situations, the available discourses have an impact on the access to certain ideas and knowledge, and on which questions can be asked and, therefore, these discourses may control the construction of the students' meaning making. The discursive context creates subject positions (Foucault 1972) from which teachers and students speak. According to Foucault (2002), the work in school and its classroom practices are part of the contemporary discursive tendencies, where the working method and the content are affected by access to the ideas and knowledge of the time. Hence, the overall structure of the classroom practice is of importance for classroom activities, not only in terms of what will be possible for students to learn in school but also for the analysis of the study results. In what we do, we must in one way or another relate it to discourses in context (Foucault 1993).

Different reading strategies

The analysis process consists of reading through transcripts of the roleplay debates and subsequent interviews. Different reading strategies were used for textual analysis. One strategy included the material being worked from its context and its purpose (Östman and Wickman 2014). Thus the data was processed with a regard to the conditions and requirements in which the actions are conducted, and worked on the principle that the analysis should take teaching requirements into considerable consideration.

Today, grading-driven teaching has a given place in the Swedish school system (Öhrn and Holm 2014). In simpler terms, the teacher strives to act in relation to the subjects' "overall purpose" and "core content," and to the national curriculum's rating system (National Agency for Education 2011), by which I mean that the teacher interprets and implements the framework given to him/her. This emerged during the discussions observed in this study and in the interview with the teacher. The students' actions need to be related to the context's guidelines.

Using another strategy of reading, called "reading-out" (Säfström and Östman 1999), the study analysed content through a specific or multiple perspectives, rather than through established perspectives—hoping to deviate from assumptions and from that which seems obvious in the situation. This context entails a search for themes in relational actions and then a discussion about what the themes include or exclude in relation to femininity and masculinity. Such as when femininity images are used as examples of emotions, the affective, subjectivity, desire, uncertainty, as opposed to masculine images connoting fact-based statements, market orientation, objectivity, reason and rational thought, logic and abstraction.

It is possible to describe the analytical work as flowing from the micro perspectives of transcribed texts and the macro perspectives, to the analysis of images and possible discourses in play—and back again.

The production of data

The teaching sequences that constitute the transcribed empirical data come from three different occasions where the teacher used roleplay as a didactic approach to the curriculum goals. The three topics had some similarities and also differences. The students expected that the first

debate, nuclear power, would take into account renewable energy options such as wind and solar power, for example. When it came to the second topic, GMO, the students faced ethical questions, which most ESD issues entail. In the third roleplay, about the climate, the students, representing countries, had to reach an agreement, in other words they had to go from negotiation to action: the students had to convince the other students that their solution had advantages. To do so, their argumentation had to be effective and use a scientific vocabulary. I will now go through the roleplay for each topic in the order that they took place.

Nuclear power

The teacher had before the roleplay gone through alternative energy sources, both renewable and non-renewable. Three groups of students had to argue for nuclear power, three groups against—the teacher assigned them their position on the topic. Then the students tried to find their arguments—they used different methods, some keeping the group together, some delegating within the group. The internet was the most common source of arguments for and against nuclear power. When they were ready to debate, the groups faced each other across a table under supervision of the teacher. At the end of each roleplay, the teacher asked the groups what they had learned from the other group, and whether the other group’s arguments had swayed their personal opinions about the topic. The roleplay was assessed according to written criteria that the students had access to at the time of the argumentation; the teacher used a print-out of the criteria to take notes during the debate.

Climate negotiations

The second debate concerned the climate, for which the students simulated a climate convention—each group of students took on the role of a country and received information about what that country considered as important, which the group then used as to research and prepare their arguments. The goal was that the negotiations would produce a new climate agreement, as the existing agreement was soon set to expire. The teacher had explained that the students had limited time to negotiate. The students were free to move between three rooms to negotiate with other countries. At the end, the entire class discussed the outcome. In the subsequent discussion the teacher asked the students to step out of their roles, but the students nonetheless fell back into their roles, and never reached an agreement.

Genetically modified organisms (GMOs)

The teacher began with lectures about cells. Then, the teacher divided the class into groups and decided which groups were for and which against GMOs. The groups prepared by seeking arguments for or against GMOs—again the internet was the most common source. Then the debate followed, after which the students were asked to step out of their roles and discuss their personal views in a session that lasted longer than the discussions on the other topics.

Analysing the data

I analysed the texts on the basis of written statements and objectives in the school context; a strategy that made it possible to conclude that the events in the classroom circulated around the requirements formulated in the syllabus for science studies and its “aim of the subject,” as follows:

On the basis of the current issues and events, teaching should give students the opportunity to use the knowledge and the working methods of science. This means that while the teaching should cover a variety of content, such as environmental and climate issues, the distribution of resources of the Earth, recycling, health or genetic modification, it should also demonstrate how these issues can be managed using a scientific approach. By discussing and exploring issues with a social dimension, students should be given the opportunity to consolidate, deepen and develop their scientific knowledge to be able to meet, understand and influence their own contemporary conditions. (National Agency for Education 2011)

And as stated in the syllabus criteria for knowledge requirements:

Students can in basic terms discuss issues with scientific content of importance to the individual and society. In discussions students use scientific knowledge to put simple questions and to give simple explanations and arguments. In addition, students can give some examples of conceivable standpoints or alternative courses of action, and give simple supporting arguments. (An example of knowledge requirement for the lowest grade (E) in science studies)

The teacher arranged situations and argumentation roleplay that required actions that met the curriculum requirements and which could enable the students to meet the knowledge requirements. Both the “aim of the subject” and “knowledge requirements” meant that emphasis was placed on the scientific content.

After working with the written statements and objectives in the school context unit of analysis, the transcripts were processed in several ways and from several different aspects (Säfström and Östman 1999). The process can be summarised in steps (Orlander 2011):

1. Read and reread the transcripts from each roleplay, searching for images to attain an initial sense of which arguments were included.
2. Search for variations in the images. Put similar examples used in each debate into groups. Write titles for these groups that captured the meaning of the images. Reread transcripts to detect further groups and title them.
3. Look for overarching themes in the groups.
4. Highlight the themes with the help of empirical examples at the same time as shifting the analysis from the micro to the macro perspective. This step further refined the themes of images, at the same time as it developed the exploration of discourses in play and how they related to each other.
5. Conduct a final analysis of how different images constructed various discursive positions, while at the same time excluding others.

An example of analysis work in step four.

The situation presented here is meant to exemplify my detailed analysis work on a micro level. Here the performances were connected to themes which in turn connected to images of femininity and masculinity on a macro level as mentioned, where images of femininity could be analysed as examples of emotions, the affective, subjectivity, desire, uncertainty, and images of masculinity as examples of fact-based statements, market orientation, objectivity, reason and rational thought, logic and abstraction. In this particular situation, the students and the teacher talked about different electricity generation technologies and about the source of their information.

1	Natalja:	You said it's <i>expensive</i> [nuclear power], but it's the opposite, so... the
2		<i>production cost is low.</i>
3	Teacher:	Where did you <i>found that information</i> ? You say it's expensive, you say it's
4		cheap [the group], where did you find it? Let's hear it. It's one person's word
5		against another's.
6	Jessica:	They counted in Finland, it became <i>awful expensive</i> . They <i>had to finish a</i>
7		<i>reactor.</i>
8	Teacher:	It became <i>too expensive</i> ?
9	Jessica:	Yes
10	Jesper:	If we take <i>hydropower</i> instead, we would <i>generate less power</i> than a nuclear
11		plant, and then it will also be <i>more expensive</i> .
12	Julia:	But you can expand wind power...
13	Natalja:	But it takes a lot of it too, the wind has to blow which <i>doesn't happen up here</i> or
14		in Finland

The expressions in the excerpt constructed different kinds of images. In lines 1, 2, 6, 11 there were expressions such as *expensive*, *production cost is low*, *awfully expensive*, *finish a reactor*, *too expensive*, that together constructed images of market orientation. In lines 3–5 construction of images showed rationality, as in the need to have evidence, such as the expressions *where did you find the information?*. In lines 10–11 and 13–14, there was evidence about the fact-based statements *hydropower—generate less power*, *the wind has to blow*, *does not happen up here*. Relating the content of images to femininity and masculinity, the content of the relations in this situation mainly contained expressions of masculinity.

In the fourth step of analysis, I was struck by how the themes to a large extent showed close similarities in relation to constructions of the economic-based images. Overall, the three roleplay debates emphasised different themes of images. In the nuclear debate, the emphasis was on arguments that the students saw as “scientific evidence”. In the climate discussions, the emphasis of the arguments around the negotiation table was on economic points of view, in addition to scientific evidence and an economic point of view. The GMO debate raised ethical questions, which the other debates did not address as much.

Although there were external differences, the analysis of the debates showed that the most dominant orientation of the arguments could be considered as a set of practices that is often understood as masculine (Schippers 2007).

Images emphasising logic of rationality and objectivity

The teacher's grading criteria, accessible also to the students, made it clear that nuclear power arguments required scientific explanations. Therefore, it was not surprising that the material often contained "scientific facts". Or, as one of the students, Fouad, said in a follow-up interview, their work leading up to the debate referred to scientific evidence as a "hard fact".

Fouad Everyone goes on about hard facts and during the debate everyone took up, kind of, what they had found. I... we searched a lot on the... we were looking for the disadvantages of nuclear power, what was bad about it

The nuclear debate, where one "hot fact" encountered another hot fact after another, seemed also to bring up another interesting aspect: depersonalisation. For example, very few students used the personal pronoun "I". One of them had dressed up in a shirt and tie, a sort of uniform that depersonalised the role he played. The fact-based conversation seemed to lead to a distant approach to the content, allowing the creation of an appearance of an objective approach: "It is not me speaking, the scientific facts are speaking".

The students said it was harder to find scientific evidence on the internet about the benefits of GMOs, compared to the other topics. One of the students had an argument dismissed as irrelevant by an opponent.

Jasmin One can, for example, genetically modify... yoghurt. If you eat this yoghurt, you can... well... you can be cured for example from gastritis, or if you inject genetically modified bacteria to avoid holes in the teeth. These are two conceivable future scenarios

Kasper You keep saying that "it might". Nothing is certain today. That's what you mean. There is no... underlying research that confirms that one can see those effects. secures it up that you can do so

Jasmine But there is nothing to indicate that things would become worse. Everyone thought that mobile phones would isolate us and make us stay inside with our headsets, but none of that has happened. We are still social and go out and

Kasper Yes, but, if I may quote one thing from Tom Surkkula, chairman of Medical Research for the Responsible Application of Science and Technology: "It is unfortunately a matter of time before people get sick from unexpected and undetected harmful substances."

Teacher From GMOs?

Kasper Hmm [Yes]

Given that the students needed to be convincing, they needed to support their counter-arguments with some form of knowledge of science. If one could confirm the insecurity with facts, then the evidence counted as valid. In the nuclear debate, for example, some expressions of uncertainty were supported by facts about the slow and hazardous degradation of nuclear waste.

Nicole Around 50 percent of our energy comes from nuclear power

Sinem Secure technology for electricity production

Glen Nuclear power is not a safe energy source

Kasper Why?

Glen Nuclear waste is hazardous. It takes *100,000 years* before it disappears from the environment

Here *50 percent* is countered with *100,000 years*. Rather than argue and discuss the issues, the students fell back on information that they had rehearsed in order to trap their opponent. In these situations, the best arguments won. These were fact-based debates that echoed a mechanical view of existence, and in which facts were countered with facts. Images conventionally regarded as expressions of masculinity seemed to have the priority.

That did not mean that students disliked this kind of work. On the contrary, some of the students said that they valued the roleplay, among them Yasmine who told me in a follow-up interview that competitive debates gave her motivation to learn more.

Jasmine ... it was a bit like this, I'm a bit of a competitive person, so I wanted after all to win that [debate], but it was a draw. But then I wanted, I wanted to know more about this subject. When you have advanced a little bit, you want to know more all the time

The students also said that the process had the potential to make them change their mind: "Now I'm more pro-nuclear," as Juliette put it.

The procedure of the roleplay in a school situation seems to be based on an assumption that the use of argumentation is unproblematic, even apolitical as long as you have the basic skill to make an argument based on scientific facts (Lundegård and Wickman 2007). This kind of rationality relies on scientific content being a given, and therefore argumentation is seen as unproblematic. It also relies on an assumption that a society has only good intentions, and therefore argumentation can be seen as apolitical (Öhman and Öhman 2012). These "givens" support an illusion of modern society where science can solve problems, whereas actually many people believe that experts, science and reason cannot take on humanity's problems because these problems are so big (Mouffe 2008).

In the nuclear debate roleplay, the students approached the issue at a distance with an evidence-based approach that limited personal opinions. The students had beforehand practiced taking different positions on the issues. Some of them already had some knowledge of nuclear power from school, a few had enough knowledge to be able discuss the subject even before the debate, while others were new to the subject. The follow-up interviews found that some students had changed their minds as a result of the debate, which shows how important schools can be, which in turn poses the question what content the students encounter in school, and what kind of images are made possible. Pitting advantages against disadvantages reflects, from a discursive point of view, a kind of masculine rationality. The framing of the roleplay in this study, the choice to have the students debate, produced this kind of rationality. Maybe this was not at all that surprising given that we know that rationality has historically been valued in science (Keller 1985).

Images emphasising masculinity through focusing on economic rationality

It was striking how the contemporary trends, or discourses, were actualised in the student discussions. Economic terms and interests were used to evaluate an argument; the students relied almost entirely on an economic point of view. The other subjects were also largely

debated using economic terminology. Miriam used the masculine expression “to take risks” as a pre-condition or engine that would drive continued economic development.

Miriam There are always risks with what you do, but you have to take risks to make things better. One has to have the courage to take risks, to develop anything. When you discover an allergy, you have to... you have to detect the allergy and maybe detect it earlier than we had thought was possible so that you can search for cures, and then it'd be better to manipulate the genes in food, it will be better to manipulated genes in food [to remove allergens]. But the developing countries ... and they need of course ... and by helping them, we help... when the world gets better and the economy gets better... the economy is growing rapidly, and by simply increasing and improving [the world] by daring to take risks, it will be much better in the long term, even in the short term it can change quite quickly and get better

Note that Miriam had also debated nuclear power, and was interviewed along with three other students after that debate during which she chose an economic approach: she said that she had had no knowledge of that approach before.

In this dialogue, Miriam and another girl, Lotta, both said they had enjoyed the debate:

Lotta I learned a lot of new things compared to what I knew before. Before I was almost just against nuclear power, and now I'm more pro, I think

Miriam Same here. I was also very much against it. When I heard their arguments, I changed my mind as well. I'm still against it, but like more positive when I heard that you have to have 400, or something, [wind turbines] instead of one nuclear power plant, so it's like... wind power saves money compared to nuclear. Now I've got a picture as well of how they are building the future

An important question is whether the students had learned all the relevant facts. For example, whether it is true that nuclear power is cheap—does the electricity price take into account only the cost of building and running a plant, or does it also take into account the cost of plant decommission and waste management?

Another interesting aspect of the roleplay was the use of “us and them”, signifying a division where the Western economic world order served as a role model for the rest of the world—which characterises a post-colonial era. The rich developed countries are “us” and the poor underdeveloped countries are “them”.

Miriam They lose a lot economically when they do not have these crops that can ... and do not have this development that we have in the developed countries. So, we have this development, we can do more things, we can grow our economy more, which they cannot do. With the help of that [development] they get more. So that they live longer and can go to school more, have the opportunity to work and also develop such things. It also changes quite a lot. To get better in many more countries, in Africa, maybe. The fact that many countries which are getting better, can use their natural resources for their lives and... and be better at... get a small part of ...

The negotiations and debates showed starting positions based on assumptions or an acceptance of perspectives that were perceived as being taken for granted, such as the West serving as role model, for example, or that the results of climate talks would not affect a country's economy.

- Saudi Yes. All of us, the United States, Saudi Arabia and Russia, and Uganda have... thus agreed that all countries must contribute financially. Even those who do not have as much money should also contribute financially, though not with as large a sum
- China But it's not
- Saudi So, it does not affect the country
- China What we mean here, in China, it is that we... We believe that you should help the poor countries. Not that the poor countries should help you
- Saudi The poor countries will not help us, but... the poor countries will also help the other poor countries, that all contribute with a small sum, which does not affect the country too much

The students stuck with economic terms when they talked about Samoa, using Samoa as an example of a country at acute risk from climate change. As the students set money as the baseline, a potential environmental disaster was presented as an expense. The students seemed to think that an economic argument, such as “act now or pay later”, added weight to their argument. And the roleplay showed that they thought that a country, such as for example Saudi Arabia, would only take other countries' wishes into account as long as their own economy would not be damaged. The countries are presented with numbers or with the name of the country when possible; for example, Saudi Arabia = Saudi.

- Saudi It helps us financially, that is to say that we can reduce taxes on oil in good conscience. It's not affecting us a lot financially. If...
- Country 3 But, how does it affect the environment? If it is cheaper to buy oil, then one buys... then you buy more
- Saudi No, we must reduce the tax on oil, 25 percent, so we go even with that... we reduce the use of oil. In that way, we will not lose. For oil's the biggest thing... contributes financially to the country. In exchange, we lower the tax, so that we still get money for it, but... Then we agree that we go down... The more money we get for it, the more we lower

The students focused on how much a country was prepared to pay for action—and they worked on the assumption that whether a country was rich or poor determined how much that country was willing to contribute. This became the most clear during the climate talks, as the rich countries were granted the most power. Yet at the same time, the students lacked knowledge, or understanding, of key players—for example the existence and role of OPEC, with one student asking “Is it a dictatorship?”.

- Saudi Okay, anyway... So, you are a member of OPEC? Want to join?
- Russia We... still have not explained what OPEC is!
- Saudi It's a collaboration with all who engage in the kind of oil and industry, and stuff
- Russia Define cooperation. To raise it?

- Saudi No, not to raise. But, it's just that we all agree on the same thing. For example, to reduce taxes on oil... and when, well... everything that has to do with oil
- USA What is OPEC? Is it a dictatorship, so to speak?
- Saudi No, it is not a dictatorship. It is the countries ... they lead it together
- USA So, it is with meetings and voting?
- Saudi Yes

The students brought up other economic power players, such a profit-seeking multinational companies that can create dependence on their products and services.

- Kasper I might add something there. 90 percent of GMO seeds are now controlled by a single company, thus they have patents and contracts and so on... It's them... to sell to the EU countries where countries become developing countries, they become dependent on that particular company... and then they have to buy the pesticides too. They need to do that. Instead of spending money on development, we want to put money directly for countries so that they do not have to be dependent on an international company that just wants to make a profit

On the whole, the above kind of performance, Kasper's critical approach to economic power, did not occur often. This is just a glimpse of the students' arguments, but this glimpse shows that the arguments were in line with neoliberal masculine discourses with an emphasis on economic terminology (Connell and Wood 2005). Expressions such as *financial problems*, *costs*, *money*, *reduce taxes*, *economic crisis*, *risk* were common, as well as the assumption that a country's sole focus was to minimise economic loss, which was seen as a given or a kind of superior logic.

Images of uncertainty: discussions outside of the role

With regard to opportunities and limitations, note that two approaches were present in these teaching situations. A first approach was that an argument must be countered with a "hard fact", as the student Fouad called it, which limited the possibility for other kinds of images. The second approach, as seen in the discussions that ensued, saw these hard facts given a subordinate role, while the affective was allowed space. Historically, fact-based statements and values have often been connected to masculinity while the affective has been connected to femininity (Keller 1985).

The very expression "climate negotiation" includes an uncertainty, as we do not know what a negotiation will lead to. And without a clear end result, how can a performer's performance be measured? Yet research highlighted in the media, does point to a desirable end result, telling us that we need to tackle the challenges as soon as possible, which creates a broad consensus that negotiations should lead to solutions. The term "negotiation" also tells us that the issue at hand is complex and tells us that we can expect "on the one hand, on the other hand" debates, rather than simple arguments "for" or "against".

After the roleplay, the teacher asked the students to step out of their roles and asked for their personal opinion: had anyone changed their mind? At that point, the students communicated insecurity and anxiety, images conventionally regarded as feminine (Todd 2012), and that indicated that those feelings could not be reduced by knowledge of scientific reasoning.

Teacher Has anyone changed their mind after this debate? Maybe you were ‘for’ but feel more ‘against’ now? Do you follow what I mean? Is there anyone who has changed their mind?

In these follow-up discussions, the students expressed an uncertainty that was not visible in the same way during the debates, when there had been an expectation that all the arguments would be based on a knowledge of science. Afterwards, the students instead used expressions such as *absolutely crazy*, *feel*, *feels completely wrong*, *feels unnatural*.

As Daniel expressed it:

Daniel Yes, I am a little ambivalent, sort of. I’m a little bit of both, it cannot be natural at all, it is *absolutely crazy* really, if you think about it. But then I *feel* like as

Teacher What advantages or disadvantage carries the most weight... and you say both?

Daniel One can produce more, more meat from a cow, for example

Teacher And what’s bad?

Daniel The bad is then, it is that I think it *feels completely wrong*. It *feels unnatural*

Or Remo who said that gene manipulation could go too far, which was *a little scary*:

Remo I agree with most of it. It’s okay, and we have already told you why, but it is *a little scary* because it can go too far. So, when you think that people start to decide how their children will look like and... genes and so. It’s *a little scary*

Osrid said that genetic manipulation can lead to things that would be *totally sick*:

Osrid I think also like this, that in the sport, it then would be possible to make children... maybe you cannot, I do not know... sort of that they [the children] become much stronger, much better, it would be doping... *totally sick*

Adar It is already possible in the USA, that one can design their children

Teacher In the USA, it is much easier and much more permissive. The thing with sports, absolutely, they think it is something that can happen, to modify one’s genes. To become stronger. One does not know, there are some differences and all that...

Adar It starts with plants and then it is, we can say that then it’s okay. But it will just continue

The discussion after the nuclear debate was short, which did without question limit the possibility for other types of images. After the GMO debate and the climate negotiations, the class had more time to discuss and students stepped back or fell back into their roles as representatives for a country, expressing annoyance that they had not reached an agreement because they had been so sure that reaching an agreement would be easy. The teacher, however, had had his own agenda, which was revealed to the students afterwards—he had on purpose gone from one negotiation table to the next and interjected, adding counter-arguments that would hamper the negotiations. He had done so to show how difficult it is to agree on environmental issues because each country has a different context and, therefore, its own agenda when going into negotiations.

Images permeated with different discourses

The students' actions indicated how certain types of images got more space at the expense of other possibilities; which was clear when it came to energy consumption. No one raised the question whether human behaviour, in this case the consumption of energy, could change. How we live and consume energy today appeared to have been taken for granted. The nuclear debate appeared to enhance a depersonalised view of science, where what we call scientific facts faced other facts, with facts winning over emotional arguments such as anxiety. Both the nuclear and the GMO debates focused on facts and the students cited references. The GMO debate did, however, include more interdisciplinary arguments and included elements of ethics, which in terms of femininity/masculinity are viewed as an expression of uncertainty, that is to say, of femininity (Todd 2012). The climate negotiations had a clear emphasis on the use of economics as a tool, something often regarded as hard, depersonalised and calculating and thus masculine. But because a negotiation is only required when there is no obvious solution, going into a negotiation automatically entails insecurity: no one knows the end result. And insecurity, being as it is an emotion, is often regarded as feminine.

The students seemed to work from the premise that rich countries set the rules. They used forms of "us versus them", connoting "otherness" that present "the others" as a faceless mass. In several instances, "the others" were those facing the problems. In the nuclear debate, structural social conflicts of interests did not seem to be a conflict in the eyes of the students (Lundegård and Wickman 2007). But when the teacher made sure to disrupt negotiations, the students could not ignore social conflict between the countries, which contributed to their failure to reach an agreement. The teacher also enabled the students' affective emotions, especially in the discussions that followed the debates.

The manner in which the students played their roles showed what they felt or perceived to be important discourses in the present time and in the discourse of school science. Going into roleplay without a script, the students performed what they thought was expected of them. They had rehearsed their arguments before stepping into their roles, but the number of possible arguments were limited.

Ending remarks

Schools at times have conflicting goals. On the one hand is the goal of fostering independent citizens who think critically in a democratic society. On the other hand is to give the students' knowledge and then assess whether the students have gained that knowledge. When an issue is complex, such as the environment, there are no easy ways to determine how classroom instruction should be carried out (Kyburz-Graber et al. 2006). There are always risks with developing alternative visions of constructions of femininity and masculinity, or alternative teaching strategies that favour one over the other; it can easily lead to essentialisation and universalisation (Lykke 2009), which is a pitfall that this study wants to avoid. However, the risk does not diminish the need to discuss such situations and discuss the entanglement of opportunities and limitations in school activities.

Roleplay in a demanding issue

Roleplay, where students have to take a stand and argue that stand, is an attractive didactic approach to teaching. Jickling and Wals (2008) believe that showing different ways of thinking about sustainable development is important. In theory, the roleplay examined in this study could be seen as an opportunity to create space for a diversity of images and to view issues from different angles, allowing students to try out these angles without exposing their own thoughts and feelings. To act, to take on a detached role, could perhaps make it easier to deal with difficult questions. Embracing different viewpoints could allow the students to practice their democratic rights to free thought and free speech. There are challenges when teachers and students find themselves in unstructured and unfamiliar situations that contain pluralistic and controversial perspectives, but that type of situation does play a crucial role in society. While discussion and reflection are central to this context, Kyburz-Graber et al. (2006) claim that discussion and reflection are difficult to achieve. Lundegård and Wickman (2009) have shown in an empirical study that students were asking for precisely this kind of difficult discussion. Thus whether they are difficult to achieve or not, we should not avoid trying. On the contrary, we should trouble our practices (Kumashiro 2001) to open up for new images. As the roleplay in this study showed, the images were to a big extent masculine. The girls and boys got limited possibilities to developed images of femininity.

Built-in limitations in the school subject

The different interest orientations, ideologies and their conflicts can be hidden or difficult to see when students are instructed to discuss the content using a scientific approach, as required by the curriculum. Kyburz-Graber et al. (2006) point out that society demands action, facts, visible impact and measurability in development, which contradicts the need for reflection and thoughtfulness to tackle these issues. Jickling and Wals talk about the “illusion of shared understanding” (2008, p. 14) and believe that schools often use texts that ignore the variations and uncertainties of knowledge, and ignore the value of sustainable development.

Above all, schools today are asked to rate the students and their activities are designed to help teachers to do so (Öhrn and Holm 2014). When examining a debate that demands arguments based on scientific evidence, the follow-up question is whether there could be another type of debate in which the teacher gives the students other types of instructions/rules/guidelines to foster a debate that favours images of femininity.

Which direction education should take is up for debate. For example, Biesta (2011) argues that there is a tendency to limit the commitment to the qualification, which is considered necessary for citizenship. Students may become aware of many possible approaches, but that does not guarantee that they learn to “critically analyse the dynamics of political processes and activities” (Biesta 2011, p. 31), even though the roleplay asks them to do so. The roleplay in this study demanded that the students supported their arguments with science, which therefore limited the students’ possibility to give voice to other directions. And by extension, showing emotions during debate was granted a low status.

From the perspective of the possible images (Irigaray 1985a, b) that are constructed in terms of femininity and masculinity in roleplay, this study showed examples of how school activities were limited to the contemporary current societal neoliberal masculine

discourses, such as economic terminology, marketisation and distancing (Connell and Wood 2005). This study also showed how difficult it can be to disengage from widely taken-for-granted beliefs and norms. Instead of giving space to diversity, students were socialised into a masculine marketing world order (Biesta 2011)—at least in the roleplay.

In contrast, the situations outside roleplay contained examples of the students expressing images of uncertainty and insecurity, regarded as affective bands of significance (Mouffe 2008). These acts are often seen as more feminine, which, when seen from historical perspectives, have often been less prevalent or been toned down to the point that they do not exist in science activities (Keller 1985).

The importance of the discussions

In line with previous studies (Gustavsson and Warner 2008), this study showed examples of how a student's conversation with the teacher can develop the content—from being solely for or against something to touching upon emotion and uncertainty despite factual evidence. The affective aspects (Mouffe 2008) became more prominent when the students stepped out of their roles, whereas affective aspects had not been seen as winning arguments during the actual roleplay. In spite of all their scientific knowledge, the students were still uncertain after the roleplay. The discussions after the debates showed that the students personally felt conflicts of interest, which were not based on fact. Students can find it hard to understand different perspectives on sustainable developments, and conflicts of interest, according to Marie Öhman and Johan Öhman (2012).

Critiques of norms

To help young people develop skills to analyse and reflect on the situation, and the conditions and values involved, students need to hone their ability to examine the content critically (National Agency for Education 2013), not least when it comes to sustainable development issues, which require students to develop an understanding of the issue's complexities (Kyburz-Graber et al. 2006). To counter a reproduction of existing structures, which in the above examples represented a masculine tradition, one could examine the roleplay from a norm-critical perspective. In order to discuss the presented perspectives and to help students develop critical thinking, we need to ask which norms were taken for granted during the roleplay.

The ability to evoke new kinds of images, in line with Irigaray's (1985a, b) reasoning, requires awareness of the structures that have been illustrated by this study. In action, the roleplayers including the teacher can struggle to see those structures; thus teachers need to learn how to become aware of involved structures and to think about how our teaching can position images of femininity and masculinity in a different way. Hopefully this study can contribute to that awareness.

Jickling and Wals (2008, p. 18) state that ESD is problematic because the content is a product and a carrier of globalised neoliberal forces that have shifted power from citizens to large corporations—which one of the students pointed out. Therefore, science education should discuss the possible ideologies, discourses and subjectivities that the teaching content includes (Bazzul 2012). The school discourse, with all its entanglements, brings forward specific images. A critical approach with the help from the teacher (e.g. through

highlighting openings in students' contributions) could expand discussions about the content in roleplay. And this could open up for new opportunities for meaning making and for new images.

In conclusion, what has this study contributed to? It has shown that feeling and concerns cannot be ignored, and that despite science, facts and reason, the students still felt doubt—"It feels wrong". The debate form excluded, or did not favour, concepts such as feeling insecure, scared, or the feeling that something was wrong. Teachers can bring up this contrast in the discussions after the roleplay. Contemporary discourses in society are powerful when it comes to images of the market economy, but the discussions could give the students the opportunity to expose or perform other kinds of images in the field. We could show the students political positions, conflicts of interest, even though this can feel tough, both emotionally and intellectually, for some students. There are values that are historically regarded as more feminine, and which in masculine narratives have taken second place to the images of evidence and the burden of proof. This study also demonstrates the importance of letting the students embrace and identify with images of uncertainty, instead of unambiguously celebrating rationality or the market economy as successes.

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