

CAN SCIENCE BE DANGEROUS? REFLECTION ABOUT ETHICALLY AND CULTURALLY SENSITIVE TOPICS IN THE SECONDARY SCIENCE CLASS

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Abstract

Culturally sensitive themes such as the theory of evolution or (homo)sexuality and ethically sensitive topics such as euthanasia or abortion elicit tensions in the science class for both students and teachers alike. These topics can induce resistance among students and even lead to polarization, especially in a context of super diversity where students of many different cultures share a classroom.

Although the interaction between natural sciences and society is part of the secondary science curriculum in Flemish schools, science teachers report difficulties to tackle these ethically and culturally sensitive topics related to science. However, not tackling these sensitive issues may lead to alienation of students who may feel less at ease in this science context and may tend to ignore or even repulse the sciences as a whole.

There is a need for a method supporting teachers and students when dealing with ethical and culturally sensitive topics in the science class. In this regard, we develop a method aimed at supporting students and teachers based on an Educational Design Research. The first part focuses on teachers. As the teacher's opinions influence his or her didactic approach, a reflection instrument is developed allowing teachers to reflect upon their views on society, education and the nature of science. Through the discussion of exemplary cases this instrument helps teachers reflect upon their own didactic approach with regard to these sensitive topics. The second part aims at stimulating dialogue among students about these sensitive topics. Students are encouraged to reflect about the values under discussion rather than to jump to conclusions. We also formulate didactic design criteria for such open dialogues to support teachers who guide these dialogues.

1 INTRODUCTION

Do you have to accept the theory of evolution? May one genetically manipulate organisms? Discussions on controversial themes reveal the close entanglement of science, society and world view. This social dimension of science also has a place in (science) education. After all, the citizens of tomorrow must be able to make well-informed and considered choices about ethical and cultural topics. This implies that science education has a broader focus than merely an emphasis on knowledge, research and technical skills [1]. Also in the Flemish final objectives of (natural) sciences [2] the interaction between science and society is emphasized. A 'Bildungs' vision also resonates in Flemish STEM (Science Technology Engineering Mathematics) [3] policy and echoes at European level in the emphasis on science education as a means of promoting participation in debate [4].

Attention to the social and ethical dimension of sciences appears to increase the involvement and openness of young people for science. This can be done through focusing on ethical (pre)judgements and ideas of young people [5,6].

Cultural and ethical topics relevant to the science class are topics that challenge students to take an ethical position on the basis of a substantiated consideration. This includes culturally sensitive topics, for example theory of evolution or (homo)sexuality, and ethically sensitive topics like medical applications. These topics are sensitive because they can lead to tension between the students and teacher, or among students of different cultural background or options and within students who have internal tensions. Attention to this requires scientific insight, but also requires students to think ethically. Jones and colleagues formulate indicators for successful ethical thinking such as: giving arguments for convictions, distinguishing descriptive and normative statements and understanding for other people's convictions [7-8].

The teacher plays a crucial role when these culturally and ethically sensitive topics are being treated in the science class. Since the didactic approach is to a large extent influenced by the view of teachers, it is crucial to get more insight in these views. We distilled three themes which are key determinants which influence the didactic approach of teachers: (i) teachers view on society, for example *'people who are religious are conservative'*, (ii) teachers view on education, for example *'every opinion is worth a conversation or research'*, (iii) teachers view on science, for example *'science excludes the existence of God'*.

The aim of this project is twofold. First, we investigate the current situation about sensitive science topics in Flemish school. This is done through a questionnaire with science teachers and teachers involved in religious education. Second, we develop a method including a reflection instrument for teachers and dialogue guidelines. This will help teachers to map their own opinions in order to clarify the link with their didactic approach.

2 METHODOLOGY

2.1 Questionnaire

We conducted a questionnaire to map the current situation in Flanders about teachers and pre-teachers views on society, education and science. The questionnaire was divided in five parts. The first part mapped the background of the respondents, such as *'how many years do you teach?'*, *'did you encouraged challenges regarding the relationship science and religion?'* The second, third and fourth part gauged on their view on respectively society, education and science. The last part tried to record the respondent didactic approach.

2.2 Educational Design Research

The development of the methodology to tackle these sensitive subjects is done in line with Education Design Research, where educational materials are designed, evaluated and adapted in several consecutive development-cycles [9]. In different steps the method is introduced in schools, evaluated and refined. This is done in co-creation with both science teachers as teachers involved in religious education. Group interviews of teachers and observations of the use of this method are used to improve the methodology.

3 RESULTS

3.1 Questionnaire

We interviewed students in teachers training for secondary school (pre-teachers) and teachers who currently teach in secondary school (in-service teachers). In total 42 pre-teachers and 70 in-service teachers responded. Of the former 20 pre-teachers study sciences, 3 Roman Catholic religion and 19 study other courses. Among the teachers were 29 science teachers, 31 religious education teachers, and 10 teach other courses. The questionnaire was answered in March 2018.

43 out of 70 teachers and 11 out of 42 preservice-teachers reported being challenged regarding the relationship science and religion, for example:

- *'Faith in God' is irrelevant in view of the progress in science, fundamentalist statements in which 'faith' is experienced completely apart from scientific findings.* (teacher Roman Catholic religion)
- *'Students have a hard time accepting that we are part of nature. They link the term animal to something negative, while that is just a scientifically defined concept and humans fall under this definition.'* (science teacher)
- *'Some students do not accept that homosexuality is not a choice.'* (teacher behavioral sciences)

A large variety of answers to the questions related to their didactic approach was found among the in-service teachers. With regard to the question whether or not they adapt their content and teaching style teachers answered with a large variety of answers, illustrated by the following examples:

- 'I adapt my teaching style to each class. Culturally diverse or not! Every class is different.' (science teacher)
- 'I personally ask them to explain their views. They fill in my lesson content from their individuality.' (teacher Roman Catholic religion)
- 'Curriculum is curriculum.' (teacher sciences)
- 'I'll stay who I am.' (teacher Roman Catholic religion)

Analysis of the answers shows no correlation between the teachers view on science and his/her didactical approach, see figure 1.

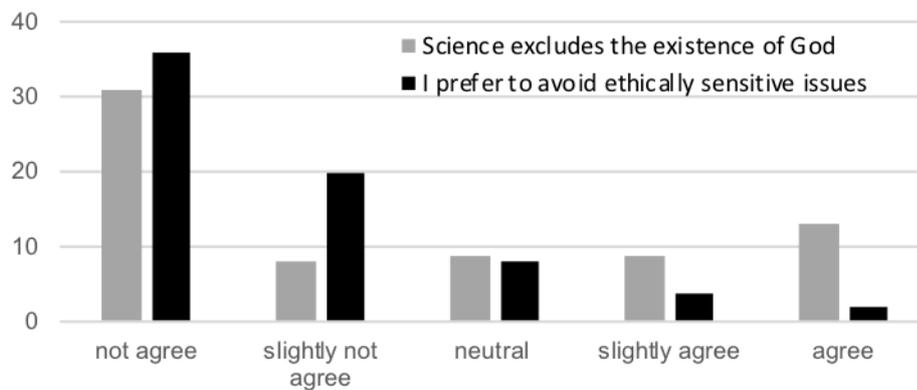


Figure 1. Answer to the statements 'Science excludes the existence of God' and 'A teacher must be neutral, which is why I prefer to avoid ethically sensitive issues such as abortion, euthanasia, the origin of the earth.' by 70 teachers.

Both in service and preservice teachers report a wide variety of themes that (may) provide tensions between the scientific worldview and the sociocultural convictions of students: the origins of life and the universe, homosexuality, the theory of evolution and the existence of complot theories.

3.2 Educational Design Research

Group interviews of education experts and observations of students and teachers teaching in a culturally diverse context suggest that the developed method focusing on reflection through challenging questions may be an interesting tool to overcome polarization and stimulate dialogue.

3.2.1 Reflection instrument

As the teachers opinion influences his or her didactic approach, a reflection instrument is developed allowing teachers to reflect upon their views on society, education and the nature of science. Through the discussion of exemplary cases this instrument helps teachers reflect upon their own didactic approach with regard to these sensitive themes.

3.2.2 Dialogue method

We developed an approach based on Socratic dialogue [10-12] and intercultural communication [13]. These approaches not only provide an understanding of dialogue in culturally diverse classrooms, but also provide a dialogue technique allowing students to investigate a shared question. The use of a key question such as 'Can a scientist be religious?', 'May we improve nature?' or 'Is Einstein morally responsible for Nagasaki?' allow students to explore the issues at hand in an open and trusted environment. The teacher acts as a dialogue facilitator taking the Socratic stance, which means that he or she facilitates without intervening with regard to the content of the discussion allowing students to discover and develop a shared language to explore these sensitive scientific issues.

3.2.3 General design criteria

Based on our preliminary research results, following design criteria emerge:

- create a safe environment, each answer is valuable;
- turn the classroom into a research community every opinion is worth a research;

- pay attention to sensitive subjects in the science class;
- apply Socratic attitudes to discussions about sensitive scientific themes (do not judge, focus on arguments and ask why-questions);
- be careful with words that can feed misconceptions or strengthen polarization (truth, evidence, right, wrong, believe,...);
- take the emotions of the students seriously.

4 CONCLUSIONS

Science classes and teachers are increasingly prone to discussions regarding sensitive subjects (e.g. evolution vs creation, homosexuality, genetic manipulation,...). These subjects, the subsequent discussions and reaction of teachers might turn some students away from science as a whole.

In this work we administered a questionnaire to 70 in-service teachers. Already in this small sample views on society, education and science vary widely.

In a second part of this work we develop a methodology that will allow an open and fruitful discussion of these sensitive issues in the science classroom. Recognizing and dealing with sensitive issues is not trivial. Several boundary conditions are needed on a classroom, teacher and school level for example allowing co-teaching by religion and science teachers.

We will further discuss our findings at the conference.

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