Chapter 13
Three Perspectives on the Science-Religion Issue in Science Education: Interdisciplinarity, Value or Ideology Orientation and Responsible Personalization

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What principles should guide the teaching of controversial, value- or ideology-oriented topics in science education? An answer to this question may provide a frame of reference for the science-religion-worldview issue in school contexts, as well as a necessary background for my main question: Is interdisciplinarity the way to go, and how important is responsible personalization (subjectification) in this context? References to selected sources aim to build connections between the literature on science education and educational theory of a more general character. This chapter is not simply one more contribution from the perspectives of theology, philosophy and science on the relationship between science, worldviews, ideologies etc. However, in the introduction, I summarize a knowledge base for the following discussion. The purpose is to highlight challenges and dilemmas by discussing a didactic model combined with ten theses, which relate to the claim that interdisciplinarity, value or ideology orientation and responsible personalization are necessary preconditions in science education. To concretize, I refer particularly to the debate on methodological versus metaphysical naturalism.

Introduction

What is the nature of reality and the human being? In the context of the science – religion issue, this big controversial question may be a starting point for a discussion about the identity of science education as a school subject. Terms such as ‘controversy’ and ‘controversial’ indicate that ‘significant numbers of people argue

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… without reaching a conclusion' (Oulton et al. 2004, p. 411). But, as Reiss adds, 'there are degrees of controversy', and 'what is controversial for one group may not be controversial for another' (Reiss 2011, p. 403 in reference to Hand).

Four groups of questions give examples of value or ideology aspects in science and science education in which religion also has something to say:

- Does the human embryo have a certain value different from the embryos of other species, regardless of its genetic equipment (e.g. with or without predispositions to impairments and diseases)?
- Does the description of the human being as a hominidae exclude specific human characteristics or values such as dignity, freedom and responsibility?
- Does nature, with all of its different areas and components, habitats and species, have value in its own right?
- Should theories from the natural sciences about the origin and development of the cosmos and of life exclude the idea that reality may include more than the natural sciences can study?

Obviously, different values and ideologies (idea systems) will open up premises for discussion on such issues, to which worldviews and religious views may also connect (Säther 2003). In an educational context, Eisner says that ideologies are 'beliefs about what schools should teach, for what ends, and for what reasons'. Ideologies are 'belief systems that provide the value premises from which decisions about practical educational matters are made' (1992, p. 302). He also underlines that ideologies can be 'tacit rather than explicit' and therefore need to be analysed, detected and perhaps criticized. Ideologies in education can therefore be 'located on a continuum from the most obvious, public and articulate statement of purpose, content and rationale to the most subtle, private, and latent view' (p. 305).

Science and its activities are ideology or value related in different ways, by practising (or not) research ethics, prioritizing certain themes and perspectives, providing new technological opportunities (e.g. gene technology) and giving people new self-understanding (Douglas 2009; Matthews 1999; Säther 2003). Science is characterized by certain methods, which are supposed to give scientific knowledge (i.e. beliefs that are true and reasoned). Examination of an introduction to the philosophy of science opens up the debate on what characterizes scientific knowledge. See, for example, the National Science Teacher Association (2000) and the American Association for the Advancement of Science (1990), for a short description. My very simplistic conclusion, based on such references brought into our context, is that the scientific underpinnings are usually quite solid, providing satisfactory scientific knowledge such as in cosmology, the theory of evolution and many socio-scientific issues. The fact that science is fallible and builds on a range of presuppositions, and sometimes even undergoes changes of a paradigmatic character, usually does not threaten the scientific knowledge basis of issues that also have political, religious, worldview or value aspects.

However, huge problems have arisen in the debate between methodological and metaphysical naturalism (Fishman and Boundry 2013). An example from a biology textbook can illustrate this point: 'You are an animal' (a reference to Sjøberg 2014,

p. 48). From a biological perspective, this is true (methodological naturalism/reductionism). Seen from a certain existential and metaphysical perspective, however, if the human being is nothing more, then this is a deeply controversial metaphysical stance. On the other hand, methodological naturalism/reductionism is a modest claim that acknowledges the possible limitations of science. The opposite view and its 'scientism' is an approach that does not see such possible limitations.

A recent example is Mahner's claim that '…science and religion … are metaphysically, methodologically, and attitudinally incompatible' (2014, p. 1829). This view is (of course) contested. Reiss, for example, says 'I embed scientific knowledge entirely within religious knowledge'. However, '[i]f there is any conflict about scientific knowledge between the teachings of science and those of religion … I am nearly always on the side of science. … 'nearly always' … because … science is fallible and it is not inconceivable, though most unlikely nowadays, that a particular instance of scientific conflict between science and religion might subsequently, and scientifically, be resolved in favour of the religious reading' (2010, p. 96). In his view, religious knowledge is indeed knowledge, but not scientific knowledge; it does welcome science, however.

The controversy of metaphysical naturalism is illustrated in the abovementioned references (Mahner 2014; Reiss 2014). In my view, this metaphysical naturalism represents metaphysical reductionism, which is highly problematic. Methodological naturalism, on the other hand, is a kind of methodological reductionism that is necessary in science; this is a broadly accepted principle among the central spokespersons of most Christian congregations worldwide. The classification of the human being as a species in the animal kingdom, seen from a biological perspective (methodological reductionism), is therefore not a problem. However, a deeply problematic and controversial stance is that of seeing the human being exclusively as an 'animal' to be understood only from the perspective of the natural sciences by rejecting other possible realms of meaning or dimensions in existence. For further references on the discussion on values, ethics, ideology, worldview and religion in science education, see, e.g. Matthews (1999, 2009), Reiss (2014, p. 1640), Säther (2003) and Zeidler and Sadler (2008).

To integrate values or ideological issues in science teaching we need a broader platform of educational theory, philosophy of science education (e.g. Schulz 2014) and, from the literature on teaching topics of a controversial, ethical or dilemmatic character (e.g., Geddis 1998; Levinson 2006; Nielsen 2013; Oulton et al. 2004; Patry et al. 2013; Saunders and Rennie 2013). In this context, the idea of interdisciplinarity is important, for example, in the fields of genetics and society (Kampourakis et al. 2014, p. 257).

However, Albert et al. claim that the humanities are not emphasized in interdisciplinary natural science research (Albert et al. 2017, p. 85). A look into the literature on science education discussing the nature of science (Lederman and Lederman 2014), socioscientific issues (Zeidler 2014) and interdisciplinarity (Czerniak and Johnson 2014; Develaki 2008) gives the same impression. Possible connections to the humanities are not emphasized. However, there are exceptions (e.g. Billingsley et al. 2018).

In this study, I emphasize the science-religion issue by focusing on three questions: What principles should guide the teaching of controversial value- or ideology-related topics in the context of science education? Is interdisciplinarity the way to go, and if so, is it the only way? How important is responsible personalization ('subjectification') in this context?

Three General Perspectives on Science Education

The content of school subjects depends on decisions about 'curriculum emphasis' (Roberts 1998, p. 5). In education, someone teaches something to someone else in some setting (Schwab, referring to Berliner 2006, p. 5–6), in an interaction between ideological, formal, perceived, operational and experiential curricula (Goodlad et al. 1979, pp. 59–64) to which external factors also connect. In this complex landscape, I would like to highlight three very general principles:

1. *Science education needs educational theory.* The knowledge base of science education comes from science, the philosophy of science, the literature on science education and 'education as an academic discipline in its own right' (Biesta 2011, p. 175).
2. *Particularly in teaching controversial issue, science education needs a balance between responsible personalization (subjectification), socialization and qualification*, as illustrated in Fig. 13.1.

According to Biesta, education is primarily about what he calls 'subjectification', i.e. prioritizing the enhancement of autonomy and independence in order to

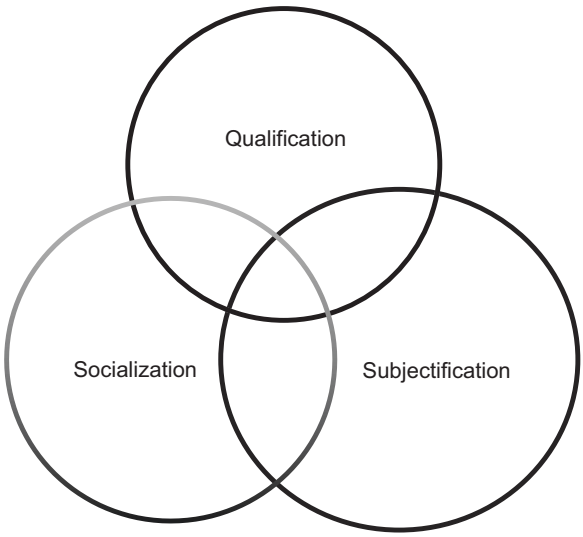

Fig. 13.1 Three educational domains. (Adapted by permission from Springer Nature. From Biesta (2017, p. 443). ©Springer Nature Singapore Pte Ltd. 2017)

strengthen a child or a student (2010, p. 21) and viewing pupils as 'subjects of action and responsibility' (2014a, p. 64). At the same time, certain knowledge, skills, attitudes and norms (qualification and socialization) are necessary:

> Because education is multidimensional, teachers constantly need to make judgements about how to balance the different dimensions; they need to set priorities – which can never be set in general but always need to be set in concrete situations with regard to concrete students – and they need to be able to handle tensions and conflict and, on the other hand, be able to see possibilities for synergy (2013, p. 40).

Parallel to this is Pring's focus on the 'whole person' in education, although it seems like Pring is mostly arguing for socialization with an emphasis on the range of qualities necessary for an activity to be called 'educational', i.e. not only promoting knowledge, understanding and intellectual skills but also intellectual virtues, imagination, moral virtues and habits, social and political involvement, integrity and authenticity (Pring 2004, pp. 19–20). A third reference in this context is Reindal's critique of the qualification framework of the Bologna Process, which seems to accept knowledge acquisition (competence) as sufficient for the claim that education has occurred without personal, i.e. 'subjective' commitment (Reindal 2013).

3. *In practice, education is a compromise between different traditions.* Therefore, the search for principles to guide the teaching of controversial issues should be enlightened by an interplay between various curricular traditions (e.g. Biesta 2014b; Eisner 1992; Klafki 1998; McNeil 2009).

Models for Teaching Controversial Issues in Science Education

Figure 13.2 illustrates three selected dilemmas or possible choices in the teaching of science-religion-worldview issues.

Figure 13.2 displays three dimensions of dealing with controversial topics in science education, that is, *interdisciplinarity* (A) combined with various degrees of focus on *values or ideological aspects* (B) and *the personalization dimension* (C). By talking about (C), i.e. *the personalization dimension*, I make reference to Biesta's concept of subjectification, the overlapping idea of personal commitment and meaning (Reindal), and a focus on 'the whole person' (Pring).

How, then, can the complexity of the science-religion-worldview issue demonstrated in Fig. 13.2 be taken into science teaching? To illustrate different options in educational contexts, I combine both interdisciplinarity and value or ideology orientation into one dimension by showing four positions, see Fig. 13.3. According to Fig. 13.3, the science-religion-worldview issue may be handled on a continuum, with different weights placed on interdisciplinarity and collaboration between teachers or school subjects, value or ideology aspects.

The general picture may look like this: In some cases, a lack of resources, competence, time and willingness prevents movement towards interdisciplinarity.

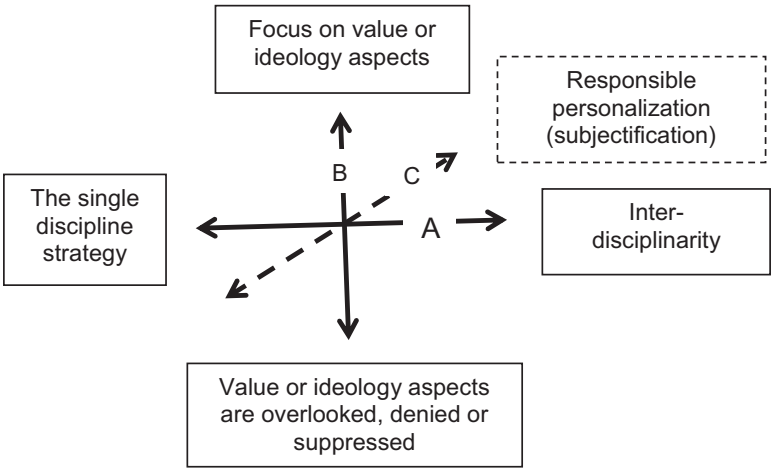

Fig. 13.2 Interdisciplinarity, value or ideology orientation and responsible personalization. (Adapted from Sæther et al. 2018, p. 54. By permission of ©UOWM, Faculty of Education, Greece)

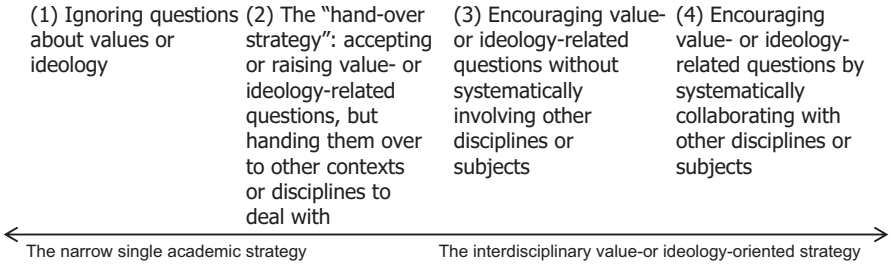

Fig. 13.3 Four strategies in science education for the handling of value or ideology issues in teaching and learning processes. (Adapted from Sæther et al. 2018, p. 50. By permission of ©UOWM, Faculty of Education, Greece)

Curricular constraints of various kinds, i.e. the complexity of the topic; the character of the controversy with various and sometimes conflicting expectations of colleagues, administrators and parents; the lack of an ideal speech situation, etc. make it difficult to defend strategy 3 or 4. The 'ideal speech situation' (Habermas), which is to some extent necessary for these strategies, can be achieved only partially in educational contexts. Wikipedia's presentation may summarize a popular understanding of Habermas' 'utopian' dialogue:

> In an ideal speech situation, participants would be able to evaluate each other's assertions solely on the basis of reason and evidence in an atmosphere completely free of any nonrational 'coercive' influences, including both physical and psychological coercion. Furthermore, all participants would be motivated solely by the desire to obtain a rational consensus. (Wikipedia 2017)

The aim and structure of different programmes give various opportunities for collaboration with other subjects, and it is often not realistic to expect much from integrative approaches (Sæther et al. 2018): Science educators often lack degrees or university credits in fields such as ethics, philosophy, the social sciences or religion, any of which could help them to discuss the ideology- and value-related questions raised in their science courses. Therefore, if Strategy 4 is unrealistic, how could one lay a foundation for honest intellectual discussions? The most radical answer is to say that Strategy 2 is the only alternative to guarantee that teachers do not stray from their areas of competence in their teaching. Science education should therefore indicate what other disciplines, subjects or realms of meaning are relevant when value- or ideology-related questions are raised. A minimum claim is that science education should explicitly indicate what science primarily is and is not about, and which questions science cannot answer by itself. Strategy 4 expresses an ambitious idea about collaboration and integration that is seldom realistic. I therefore contend that Strategy 2 should not be categorically abandoned. Nevertheless, Strategy 2 does represent a narrow approach that seems to veer too far away from giving students opportunities for spontaneous discussion and gathering information from various perspectives. Is Strategy 3 best, then? Perhaps, this approach best reflects actual teaching conditions. Furthermore, the literature on scientific literacy and socio-scientific issues in science education seems to correspond largely with this strategy. However, by practising this strategy, the teacher may lack the competence necessary to contribute relevant knowledge. Therefore, science teachers need an understanding of the limits of their competence, because such an insight is necessary to understand when to deploy a 'hand-over' strategy (Sæther et al. 2018).

We should also problematize the idea of responsible personalization, combined with a focus on education as personal formation 'in its widest sense' (Pring 2015, p. 30). For example, in a situation where students, teachers and parents have competing ideologies, I suggest that the best strategy in some cases might be to withdraw to a certain extent from existential discussions laden with religious aspects.

Theses on Handling the Science-Religion Issue in Science Education

To fill the models (Figs. 13.1, 13.2 and 13.3) with more content, I will introduce 10 rather normative and common sense theses by presenting an idealistic image. Each of them contains issues for further discussion. It is not possible to present a final list, and my proposal is definitely not the last word in this context. My claim is that practitioners should discuss the principles and attitudes necessary for handling controversial issues in science education. An example from Stephen Hawking (1942–2018) may give a point of reference for our reflection, and I therefore refer to this quote in the following discussion:

> When people ask me if a god created the universe, I tell them that the question itself makes no sense. Time didn't exist before the Big Bang, so there is no time for God to make the universe in. It's like asking directions to the edge of the earth; The Earth is a sphere; it doesn't have an edge; so looking for it is a futile exercise. We are each free to believe what we want, and it's my view that the simplest explanation is; there is no god. No one created our universe, and no one directs our fate. This leads me to a profound realization; There is probably no heaven, and no afterlife either. We have this one life to appreciate the grand design of the universe, and for that I am extremely grateful. (Hawking 2017).

The first thesis presents a general and obvious basis:

1. Although influenced by and embedded in values or ideologies, science education should always be knowledge-informed

The debate in the fields of philosophy and science education on criteria for talking about knowledge and truth is ongoing. Although incomplete, the clarification efforts of the National Science Teacher Association (2000) and the American Association for the Advancement of Science (1990) may provide a summary that teachers could refer to. The above paragraph on Hawking's thought process should challenge us to discuss what science is, and what it is not, as well as Hawking's personal stance on the matter. As has been said, science education should be knowledge-based in science and knowledge-informed by educational theory. At the same time, science education is value- or ideology-laden in many ways: in its rationale as a teaching subject, in the selection of topics, in the provision of new opportunities to understand and handle complex personal and social issues and in the formation of young people as individuals. However, science education should not be a school subject with its primary focus on worldviews, values, ethics, ideologies and religion. A minimum claim is that science education should explicitly indicate what science primarily *is about* and *is not* about, and which questions science is unable to answer (by itself). The concept of knowledge has to be discussed in the light of criteria for scientific knowledge, without rejecting possibilities for other realms of meaning. Methodological naturalism/reductionism should therefore be promoted and metaphysical naturalism rejected as a scientifically based approach. However, at the same time, 'the new atheists' and creationism could be introduced where appropriate (according to age level, the student group and the situation) to demonstrate the nonscientific basis these approaches have.

2. In a particular school system, the values and ideologies of science education should be clarified in light of the relevant regulatory documents (school laws, curriculum documents, etc.)

Educators should ask: how can a holistic view of the aims and values of science education be described that also includes the overarching ideas in national and local regulatory documents? '[A]ll subjects need to relate to the full spectrum of educational goals', Holbrook and Rannikmae say (2007, p. 1351). These fundamental ideas and aims may to a certain extent be integrated into one harmonious entity, or be seen as a collection of more or less conflicting discourses, etc. (Bybee and DeBoer 1994; Pedretti and Nazir 2011; Roberts 1998, 2007), named as different

ideologies (Eisner 1992; Säther 2003). Educators should, as far as possible, aim to interpret curriculum guidelines as holistic units expressing ideas and intentions that are not necessarily in conflict with one another but instead complementary. For example, the Hawking excerpt mentioned above could raise the opportunity to discuss metaphysics and science: what is science and what personal ideological claims have scientists published (i.e. Hawking's metaphysical naturalism)?

3. The science teacher should be challenged to reflect on various value and ideology traditions in the curriculum guidelines, educational resources and science education practices

Parallel with the struggle to identify and practise holistic thinking, we should acknowledge that educational guidelines, resources and practices might represent different traditions, which either are in tension with each other or complement each other fruitfully. In the vast literature on this issue, there have been many examples of efforts to name traditions and aims (see, e.g. Pedretti and Nazir 2011; Roberts and Bybee 2014; Reiss 2007). The science teacher should have elementary (not advanced academic) competence in describing traditions as, for example, Bybee and DeBoer (1994) have done. They differentiate between three major goals in the history of science education, mentioned as 'understanding scientific knowledge', 'understanding and using scientific methods' and 'promoting personal-social development'. Throughout the history of science education, 'a balanced program has been difficult to achieve' (1994, p. 385). For example, the quote from Hawking above would challenge teachers to discuss the fundamental aims of science education from these three perspectives.

4. The science teacher should be familiar with and able to discuss the strengths and weaknesses of at least one method used in teaching controversial issues

There is broad agreement in the literature on science education that contested topics should be handled by stimulating dialogues and reasoning processes. But dialogues may also have affective components: 'to suggest that a person's stance may be changed by rational argument is simplistic' (Dewhurst 1992 in Oulton et al. 2004, p. 417). A look into an introductory book on the social psychology of attitudes easily shows that a change in attitude depends not only on academic arguments and persuasion, but on a range of factors, for example, whether one likes and trusts the person with whom one is in dialogue. The science teacher should know some principles in the teaching of value- or ideology-related topics, e.g. Kolstø (2006), Levinson (2006), Oulton et al. (2004), Patry et al. (2013), Sadler and Zeidler (2004), and Saunders and Rennie (2013).

5. The teaching of controversial issues should be based on principles that strengthen students' participation

There are several reasons for this: it may enhance learning outcomes; it reinforces children's right to speak; it stimulates personal development and prepares students for future participation in society. However, the provision of equal opportunities to participate is not easy to practice for many reasons, including the

inequality of power, status and roles along with differences in speech competence, motivation, self-confidence and feelings of safety. To promote participation, the science teacher should establish trust and strengthen the possibility of an emotional climate in order to stimulate participation in dialogues, particularly supporting 'the weak voices' in the classroom. We should be aware of the intellectualism that might be embedded in dilemma- and dialogue-oriented education. However, I still claim it to be self-evident that our heritage from the Enlightenment focusing on knowledge, rationality and autonomy should be emphasized. This message has consequently the obligation to allow students to participate in efforts to discuss and decide on value or ideology issues.

6. The science teacher should have an appropriate understanding of the rights of children, parents, the authorities and the teacher as a professional agent in education

Our focus on subjectification, existential meaning and responsibility, versus a more restricted view, emphasizing academic learning isolated from focusing on values, ideologies and personal involvement, challenges our thinking, not only on what aims education should have but also on how to give proper attention to the rights and obligations of the different groups involved:

(a) Children's right to education and their right to speak, participate and be involved
(b) Parents' rights to choose the kind of education that should be given to their children, which may imply a right to organize private schools
(c) Teachers' rights and their obligation to not violate their professional knowledge and ethos
(d) States' rights and their obligation to organize educational institutions.

See The Universal Declaration of Human Rights and the Convention on the Rights of the Child, e.g. Article 29.

A challenge is to find the proper balance between home and school in cases of value or ideology conflicts. Engen argues for what he calls 'integrating socialization', which 'cannot correspond fully with the preference of any single group' and in which 'only a partial commonality of interests will be functional' (Engen 2009, p. 260).

7. Science education should promote the critical investigation of knowledge and value claims without falling into the trap of relativism and scepticism

Some values are thought to be universal, such as freedom, equality, dignity, respect for the natural environment, the full development of the human personality in education, peace, tolerance, friendship, responsibility, cultural identity and children's and parents' rights (thesis 6). The concrete implications of these values may be disputed. Value claims should be investigated in a dialectical process of collaboration and exchange between different disciplines or fields of knowledge, where none are excluded from contributing (Afdal 2004; Føllesdal 2005). They should not be deemed irrational, even though they do not have any direct scientific basis.

Despite different philosophical convictions and worldviews, diverse groups may (often) reach agreement on fundamental values.

8. *It is not appropriate to expect students to take a stand in every value or ideology conflict*

I have argued for the criterion called 'subjectification', or 'responsible personalization', as a fundamental characteristic of education. However, personal involvement should not be overemphasized. If necessary, a disinterested approach taken by students should be respected and might even be encouraged in certain cases. Because of the complexity of the issues under discussion, conflicts of interest between the school and parents, and the fact that not every topic is attractive to all students, it should not be expected that every controversial issue will result in a personal stance.

9. The fact-value issue: science education should discuss the naturalistic fallacy

There is no direct link from 'is' to 'ought' ('the naturalistic fallacy'). On the other hand, this traditional view is disputed by the idea that values indeed can be discussed rationally by bringing the whole range of beliefs and knowledge based on sciences, the humanities and human experiences into the discussion (Afdal 2004; Føllesdal 2005). However, different value or ideology convictions may result in disagreement, which dialogues may be unable to solve.

10. The science teacher should, if possible, promote interdisciplinarity and collaboration between school subjects and be able to see when 'hand-over' strategies are necessary in areas of value- or ideology-laden controversies

Interdisciplinarity and responsible personalization are necessary if education aims to meet students' existential need for meaning and wholeness. My stance is that interdisciplinary collaboration and engagement should, if realistic, be an ideal of science education. However, it is not always possible or desirable to reach common decisions in areas of controversy.

Conclusion

It is not possible to present a final list of principles capable of leading science education out of all dilemmas in the handling of controversial issues, to which the science-religion-worldview debate belongs (at least sometimes). In this context, I have presented some fundamental ideas that need further clarification in concrete situations, e.g. the quote above from Hawking.

Although influenced by and embedded in values or ideologies, science education should always be science-based and informed by educational theory. Honest science education should not overlook topics related to religion, without any primary focus on worldviews, values, ideologies and stances influenced by religion. Science education should indicate what other disciplines, subjects or realms of meaning exist when these domains are discussed. A minimum claim is that science education

should explicitly indicate what science is (or is not) primarily about, and which questions science cannot claim to be able to answer by itself. In a given school system, the values and ideologies of science education should be clarified in light of the relevant regulatory documents in respect for the child's right to speak and be educated, parents' rights to choose the education of their children and teachers' rights to practise according to their professional ethos. Interdisciplinarity and responsible personalization are necessities if education is to meet students' existential need for meaning and wholeness. There is no exact answer as to how much interdisciplinarity and personal existential development there should be in the science education classroom. This depends on teachers' competence, available time and resources, the degree of tension caused by the issue at hand, etc.

This normative and common-sense conclusion should be further discussed, e.g. by asking the following questions. What are the aims and values of education? What is scientific knowledge compared to other realms of meaning? In what sense are science and education value- or ideology-laden activities? Where does/should the knowledge, values and ideologies in education come from? How should educators promote critical thinking while avoiding relativism and scepticism? How can the rights and authorities of different interest groups in education be described? When is interdisciplinarity a useful principle? How should the principle of participation be applied in education, and what are the preconditions? How can the teacher manage to combine traditions in teaching controversial issues?

The science-religion-worldview issue, and its bearing on metaphysical and value aspects in science education, necessitates a renewed focus on the importance and limitations of interdisciplinarity, value or ideology orientation and responsible personalization. I think that teachers' attitudes towards the principles sketched above would give some directions for practice. The next step should be an illustration of these principles by discussing more cases from educational practice. However, to prescribe the didactical consequences in detail without contextualizing them seems, to me, impossible.

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