The challenge of involvement in reflective teaching: Three case studies from a teacher education project on conducting classroom discussions on socio-scientific issues

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Abstract

The purpose of this qualitative study was to learn more about how teachers deal with a reflective teaching approach aimed at developing their competencies in analysing and facilitating classroom discussions on socio-scientific issues. Three cases of teachers’ journeys through the project are reconstructed and characterised. We posit that each teacher benefited from the project according to his or her individual situation, needs and learning style. A number of modifications to the project design are proposed and can be summarised by the idea of assisting teachers more closely and more individually as they pass through the reflective teaching process.

Keywords: Reflective teaching; Teacher education; Professional development; Socio-scientific issues; Discussion (teaching technique); Natural sciences

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1. Introduction

Students acquiring scientific literacy are not only able to understand and explain basic scientific concepts, but they also learn to draw conclusions from empirical evidence, to interpret outcomes and, not least, to reflect on the nature of science, its capacity for and limitations in explaining phenomena, and its influence on society and the environment. Socio-scientific issues (cf. Sadler & Zeidler, 2004, 2005) are learning topics which motivate students to explore the nature of scientific knowledge and the interdependence between science and society. A concept similar to socio-scientific issues is the socio-ecological approach (Kyburz-Graber, 1999; Kyburz-Graber, Rigendinger, Hirsch Hadorn, & Werner Zentner, 1997). This approach invites learners to explore environmental issues in depth, not only as facts revealed by scientific inquiry but also as social constructions which are shaped by interests, value judgements and epistemological approaches. Socio-ecological or socio-scientific issues are most often controversial and open-ended problems which need to be negotiated by different stakeholders. Appropriate learning situations within both the socio-scientific issues approach and the socio-ecological approach should therefore offer space for critical reflection on the way in which scientific knowledge is produced and displayed, and how it relates to social contexts by engaging in argumentative exchange. Our previous research has shown that classroom discussions may offer a platform for dealing with socio-scientific issues. At the same time, we have noticed that the way in which teachers initiate and manage classroom discussions is an essential factor in promoting rich argumentative discourse in the classroom, and that there is a need for professional development in this area. According to a range of approaches in teacher education which can be subsumed under the label of ‘reflective teaching’ (for an overview, cf. Jay & Johnson, 2002), teachers’ professional development is enhanced most when they are given the opportunity to ask their own questions regarding their practice and to critically reflect on their theories-in-use and the
values underlying their understanding of teaching and learning. In this paper, we present and discuss outcomes of a study that adopted a reflective approach aimed at promoting teachers’ competence in analysing and managing classroom discussions on socio-scientific issues, and we try to identify paths of professional development which may meet the individual needs of teachers, respecting their values and beliefs related to their profession.

2. Theoretical context: reflective teaching as an approach to science teachers’ professional development in conducting classroom discussions on socio-scientific issues

The background to this study is the shift in science education from the transmission of scientific knowledge and experiment-based learning to the more comprehensive concept of ‘scientific literacy’ (cf. Gräber, Nentwig, Koballa, & Evans, 2002; Laugksch, 2000). In connection with this concept, the questions arise as to what teachers need to know in order to teach for scientific literacy, and in what way this professional development of teachers may be promoted.

Since the first appearance of the scientific literacy concept in the late 1950s (cf. Hurd, 1958), its definition has undergone several changes (cf. Laugksch, 2000). Today, scientific literacy not only comprises a knowledge of science but also implies knowledge about the nature of science. That is, it also requires one to look at science in the light of the production, interpretation, communication and negotiation of scientific knowledge as well as the impact of science on society and the environment (cf. Kimball, 1967; Kolstø, 2001; Meichtry, 1993; Organisation for Economic Co-operation and Development, 2006). In this context, learning about socio-scientific issues has become more and more important. Socio-scientific issues are open-ended, ill-structured problems that are ‘based on science concepts or problems, controversial in nature, discussed in public outlets, and frequently subject to political and
ethical influences’ (Sadler & Zeidler, 2005, p. 113). Since the negotiation of socio-scientific issues ‘can be characterised by the process of informal reasoning’ (Sadler & Zeidler, 2005, p. 113; Osborne, Erduran, & Simon, 2004), we claim that classroom discussions on socio-scientific issues are conducive to the development of scientific literacy. By critically exploring socio-scientific issues in argumentative classroom discussions, students will gain insights into processes of knowledge production, the nature of science and the discussion of the role of science in society. They can also refine their ability to interpret information, to judge the meaning and significance of scientific knowledge and to form and put forward their opinions.

Our previous research indicates that the development of rich argumentative classroom discussions depends on various factors such as the specific learning arrangement, the beliefs and value judgements of those who participate in the discussion, as well as the teacher’s ability to reflect on the students’ reasoning. One important factor in promoting rich argumentative discourse among students is the way in which teachers initiate and manage classroom discussions. We have come to the conclusion that there is a need for professional development in this regard (cf. Kyburz-Graber, Hofer, & Wolfensberger, 2006; Wolfensberger, 2008; Wolfensberger, Hofer, & Kyburz-Graber, 2006; Wolfensberger & Kyburz-Graber, 2005).

In teacher education, two major paradigms can be distinguished: technical rationality and reflective rationality. According to the reflective paradigm, the simple transmission of educational research findings normally does not contribute to the teachers’ professional development unless they ask their own questions linked to their practice and profoundly reflect on their own tacit theories and constructions on teaching and learning as well as on their school context (Argyris & Schön, 1974; Schön, 1983, 1987). Furthermore, teachers have to be involved in the research process, not only as teachers but also as researchers (cf. Altrichter et al, 2008; Carr & Kemmis, 1986). Following Calderhead (1989, p. 44), we agree
that teachers ‘[…] gain greater professional self-determination through the heightened awareness and understandings that accompany research on their own situation’. The reflective processes involved in deepening one’s awareness are summarised in the reflective teaching concept.

John Dewey is considered an early key theorist of reflective approaches to professional development. He defines reflection as ‘active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends’ (Dewey, 1933, p. 9). He then characterises reflective thinking as follows: ‘Reflective thinking, in distinction from other operations to which we apply the name of thought, involves (1) a state of doubt, hesitation, perplexity, mental difficulty, in which thinking originates, and (2) an act of searching, hunting, inquiring, to find material that will resolve the doubt, settle and dispose of the perplexity’ (p. 12). According to Dewey, reflection is a cyclical process that begins with a state of perplexity and then entails five phases which need not necessarily occur in any particular order, or which need not all occur: (1) suggesting a possible solution. If the solution seems feasible, none of the following stages take place; (2) transforming the perplexity into a specific problem to be solved or question to be answered; (3) developing hypotheses; (4) making the conditions and consequences of the problem in question explicit; and (5) testing the hypotheses, either by action or by thought experiment (pp. 107ff.). Three attitudes are essential if one is to engage in a reflective process: open-mindedness, responsibility and wholeheartedness (pp. 10f.). Other authors have added to Dewey’s thoughts the linkage of reflection with practical experiences, interaction with others and intuitive action (Lee, 2005, p. 700).

Schön (1983), drawing on Dewey’s ideas, refines the characteristics of a reflective teaching process, which, according to him, starts when there is some puzzling, troubling or interesting phenomenon. This reflective process, which Schön calls ‘reflection-in-action’, is constantly optimised by analysis, testing, restructuring and redefinition. Schön distinguishes between
espoused theories and theories-in-use and describes a form of professional training called the ‘reflective practicum’, where students examine their tacit theories or theories-in-use. Learning a new competence often requires unlearning deep-seated theories-in-use. ‘Often we are unable to describe them, and we are surprised to discover, when we do construct them by reflecting on the directly observable data of our actual interpersonal practice, that they are incongruent with the theories of action we espouse’ (Schön, 1987, pp. 255f.). Similarly, Dubs (1981) points out that gaining new knowledge for future teaching and learning situations means that teachers have to compare their individual experiences with those of others, but also with the results of educational research and their theories-in-use in order to achieve a deeper personal understanding. In addition, it is important that teachers exchange their experiences in order to develop a professional language in articulating teaching and learning phenomena. Zeichner and Liston (1996, p. 9) point out that ‘reflective action is also a process that involves more than logical and rational problem-solving processes. Reflection involves intuition, emotion, and passion and is not something that can be neatly packaged as a set of techniques for teachers to use’. Thus, reflective teaching has both cognitive and affective components and is characterised by a cyclical spiralling process of action and reflection (Villar, 1995).

The aim of our study is to analyse how individual science teachers work with and benefit from a reflective approach aimed at developing their professional knowledge in analysing, planning and managing classroom discussions on a socio-scientific issue.

3. Method

Given the aim of our study, we opted for a multiple-case study design and we applied qualitative methods. In accordance with this methodological decision, our research did not start from narrow research questions or theoretically derived null hypotheses (cf. Smith-
Sebasto, 2000, p. 18) but from open-ended questions allowing us to reconstruct in detail how each teacher deals with the reflective approach, and to identify distinctive ways of doing so.

3.1 Participating teachers

In this study, we chose to work with in-service teachers. The main reason for this is that our goal was not to have teachers test a predefined specific pedagogical setting we deemed ‘effective’ in terms of promoting critically reflective classroom discussions. Rather, we entered the field with assumptions emerging from our previous research on classroom discussions on socio-scientific issues. Thus, we wanted the teachers to develop their individual lesson goals, teaching material and pedagogical settings. We assumed that in-service teachers would be able to accomplish this task more easily than pre-service teachers, since they can draw on a richer body of professional knowledge.

Teachers were invited to participate by announcing the project to the professional associations of biology, chemistry, geography and physics teachers in the secondary schools of the German-speaking part of Switzerland. The benefit for the teachers was to participate in a cost-free in-service course. Initially, 15 interested teachers participated in a pre-workshop. In this meeting, we gave an overview of the research project, briefly introduced the concepts of socio-scientific issues, socio-ecological environmental education, reflective teaching and our hypotheses on the nature of critically reflective classroom discussions. We also collaboratively agreed upon ‘global climate change’ as the common frame topic for the classroom discussions the teachers would have to conduct later in the course of the two-year project. On the basis of this information, five upper-secondary science teachers, one woman and four men, decided to join the project. The sample provided for adequate variety with regard to subjects taught and teaching experience: the subjects covered were biology,
chemistry and geography, and teaching experience at the beginning of the project ranged from 6 months to 15 years.

3.2 Design of the project and collection of data

Between April 2005 and May 2007 the teachers and the research team met six times individually or as a group. This process can be described as a spiral sequence of individual and collective reflection, input from the research team in workshops, teachers’ action, and reflection on action again. Teachers thus played an active role in the project, not only by preparing and managing classroom discussions, but also by analysing themselves the discussions with respect to their own research questions. Analysing the classroom discussion and subsequently discussing this analysis with the research team was the most important reflection task for the teachers involved in the project.

In the first stage, each teacher met individually with two researchers for an initial interview. In this interview, the teacher was first invited to freely comment and reflect on a videotaped sequence of a classroom discussion on a socio-scientific issue, namely cloning, taken from a previous research project. This excerpt of about 10 minutes in duration was chosen because it showed lively interaction between students as well as interventions by the teacher and teacher-student dialogue. An additional reason for selecting this sequence was that it was quite rich with regard to content, as the participants drew on a relatively wide variety of arguments. Teachers were asked to refrain from immediately judging the sequence, and to substantiate possible normative judgements with arguments and by referring to their observations. In order to minimise any prior influence on the teachers’ interpretation of the selected sequence, we also introduced it as being neither an instance of best practice nor a particularly bad example of a classroom discussion. In a second stage of the interview, the teachers were asked to elaborate on some of their previous observations, on their own
experiences with classroom discussions and on their views on goals, possibilities and limitations of this teaching method in general.

In the second stage of the project, the teachers were invited to reflect on the same videotaped sequence in a semi-structured group discussion. We then presented our interpretation of the sequence, thereby also drawing teachers’ attention to possible fields of analysis related to classroom discussions in general. These were the content of the discussion, the argumentation, the participation in the discussion, the processes of interaction, the pedagogical setting, and the style of managing the discussion. We also introduced a range of methods we considered helpful for analysing videotaped classroom discussions. Among these were Toulmin’s argument pattern (cf. Erduran, Simon, & Osborne, 2004; Toulmin, 1958) which can be used as a coding system or as a sensitising concept for the analysis of argumentation; the display of discussion content and turn-taking patterns in the form of diachronic tables; the recording of speaking time; and the writing of summarising and structuring texts. However, teachers were not requested to use a predetermined standardised approach to their analysis of the classroom discussions since frameworks and methods were expected to vary with the teachers’ individual research questions.

The third stage consisted of a workshop, in which teachers first discussed their ideas on pedagogical and content-based aspects of the classroom discussions they would be conducting themselves. Teachers also presented and discussed the research questions under which they intended to analyse their own teaching project. The greater part of the workshop, however, was dedicated to training in managing classroom discussions. In this training, using practical exercises, teachers were encouraged to clearly define their role prior to the discussion and to communicate it to the students. Regarding their role, teachers were asked to distinguish between the process level and the content level of a discussion, to confine their action primarily to the former, and to restrict intervention on the content level to e.g. recapitulating, drawing attention to open questions, or giving factual information upon request by students.
Moreover, we invited the teachers to establish rules of discussion (e.g. that they make clear to
the students whether or not they have to raise their hands before speaking; that they listen to
each other and do not interrupt the person who is speaking; that they address criticism to
someone’s ideas and not to person itself; that claims be substantiated with arguments).

In the fourth stage, teachers then conducted a discussion with one of their classes. These
discussions were to last between 60 and 90 minutes and focus on an issue related to the
common frame topic, which was global climate change; the lessons were videotaped by the
research team. Video films and full verbatim transcripts were handed out to the teachers as a
database for their analysis of the lesson. Teachers were asked to document their analyses in a
case study report of 10 to 20 pages in length.

In the fifth stage, the research team scanned the videotaped classroom discussions and
analysed teachers’ case study reports, thereby agreeing on a set of questions for individual
interview guides. Two researchers then met with each teacher for a second individual
interview, this time focusing on teachers’ reflections on their classroom discussion.

In the sixth stage, a questionnaire consisting of open-ended questions invited the participants
to describe their reflection process, the use of the different project stages and their impression
of the overall impact of the project on their professional development.

The last stage consisted of a final group meeting in which selected cross-case hypotheses
about the reflective teaching process of the five teachers were discussed with the participants.

As can be seen from the preceding description of the project design, multiple techniques of
data gathering were used: data were collected through open-ended and semi-structured
individual interviews and group discussions, by videotaping classroom discussions, in the
form of teachers’ written case study reports, and by means of a questionnaire. As with the
classroom discussions, we also videotaped the interviews and group discussions. Recordings
were then turned into full verbatim transcripts which were used as the main data basis of our
analysis.
3.3 Data analysis

As mentioned above, the data were analysed by adopting a case study approach (Stevenson, 2004; Yin, 2003), and using analytical methods described by naturalistic inquiry (Lincoln & Guba, 1985) and grounded theory (Glaser & Strauss, 1967). The specific procedures varied slightly with the particular data. For example, we used emergent categories to code the first series of interviews and the first group discussion, but did not code the classroom discussions, teachers’ case study reports, the second series of interviews or the second group discussion. Regardless of these differences, the analysis of data always involved several repetitions of close interpretive readings aimed at identifying key themes and interpretive patterns in teachers’ reflections. For each stage and each teacher, the results of our analysis were documented in written reports. Interpretations had to be substantiated by data in a traceable manner. Finally, the findings from the single stages were integrated, the reasoning and practical decisions of the participants being displayed in the diachronic form of a summarising and structuring case history. On the basis of the case history, each teacher’s way of handling the reflective approach was characterised.

In order to enhance the trustworthiness of our research, we used a number of techniques postulated by qualitative research approaches (cf. Lincoln & Guba, 1985): we employed investigator triangulation to make our interpretation of data more credible. In each stage, data were either analysed independently by two researchers, diverging interpretations then being revised collaboratively; or, alternatively, the analysis performed by one researcher was reviewed by another member of the research team. Secondly, member checking was also applied at two points in the research project: during the second interview, participants had the opportunity to comment on our interpretation of their classroom discussion as well as on our interpretation of their case study report. Additionally, in the final group discussion, teachers
were asked to validate our cross-case hypotheses about their reasoning on classroom
discussions and their ways of dealing with the reflective approach. Thirdly, the methods of
data collection, the raw data, the procedures of data reduction and interpretation, provisional
results and working hypotheses were carefully documented so as to maintain an audit trail.

4. Results: three case studies

In the results part of this article, we will present case studies of three teachers, each of whom
had his or her specific experience with the reflective teaching process. After presenting the
data from the different phases of the project, we propose a characterisation of each teacher’s
way of dealing with the reflective process.

4.1 Taking the most familiar path: the case of Vicky

Vicky was the most experienced teacher participating in the project. When the project started,
she was thirty-nine years old and had already been teaching geography and sports almost full-
time for fifteen years.

Confronted with the videotaped discussion sequence shown at the beginning of the project,
Vicky was clearly surprised about the low level of participation of the students in the
discussion. ‘I’m not quite sure if this is a classic classroom discussion’, she stated. Referring
to her own experience with classroom discussions, she reported using a set-up in which the
students were asked to adopt complex roles embracing a range of partly divergent interests.
This type of role-play made it easier for the participants to put themselves in the position of
another person with different interests, Vicky said. At the same time, her students had to

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1 For reasons of anonymity, all names have been changed.
explain a specific viewpoint based on expert knowledge. Assigning complex roles seems to be Vicky’s formula to attain what she considers to be a successful classroom discussion, characterised by broad participation among the students and aimed at reaching ‘consensus’. Even if she never defined or circumscribed the terms ‘compromise’ and ‘consensus’, which she seemed to use interchangeably, her primary concern with regard to classroom discussions can be summarised as follows: less polarisation and more consensus.

Classroom discussions were perceived by Vicky as an appropriate and valuable teaching method that allowed students to prepare themselves for social and political participation as is practiced in the system of direct democracy in Switzerland; that is, a system in which citizens have the right not only to elect their political representatives but also to vote regularly on a broad range of national, regional and local political issues. Possibly due to her recollection of positive experiences she had had with classroom discussions in her own schooldays, she was also convinced that, because of the emotionality of classroom discussions, subject knowledge would ‘stick longer’ in the minds of the students. Despite maintaining that any influence on students’ private opinions should be avoided, Vicky felt the wish that the students – as a result of her lessons – should turn from ‘classic consumers’ into individuals who acted ‘in the interests of sustainability’. Besides the assignment of complex roles, Vicky considered it important to link the subject of conversation with the students’ lives and interests in order to involve them more actively in the discussion.

Vicky’s conceptions concerning the characteristics and goals of a classroom discussion remained constant throughout the course of the project. Only once, when reflecting on the first group discussion among the participating teachers, did she question her original idea of having the students take up predefined roles, by reconsidering whether the students might gain deeper insights into the issue under discussion if they were given the opportunity to express their own personal beliefs. However, this idea was quickly abandoned again.
In accordance with her previous experiences with classroom discussions, Vicky staged her classroom discussion as a role-play with complex roles. The setting was a local citizens’ assembly in a mountain resort which had to decide on future strategies concerning the development of winter sports infrastructure. Vicky’s initial strategy of having a student, rather than herself, manage the discussion – in order to minimise the hierarchic gap between teacher and students – lasted only for a short time. In fact, in playing the role of the town mayor, Vicky chaired the assembly in a very tightly controlled manner: the students had to indicate that they wanted to make a statement or a comment by raising their hands, and in order to attain her ideal of broad and even participation, Vicky sometimes actively called on students she wanted to say something.

From the research team’s point of view, Vicky’s way of reflecting changed during the course of the project. In the first interview, she reflected in a very structured manner: she first described what she had observed, then criticised the episode, and finally proposed alternative solutions. In the second interview, however, when talking about her own classroom discussion, her attitude seemed to be rather defensive: her statements were rarely substantiated with data, but seemed rather apodictic. Nevertheless, reflecting on her discussion was helpful to her, especially because of the detailed nature of the video material, she said. On the other hand, she also pointed out that ‘everyday teaching is a different matter’, and that in the future it would be difficult for her to reflect on her teaching as she did during the project. Asked to assess the use of the interview about her classroom discussion with the research team, Vicky criticised the research team for being too descriptive and pointed out that, for her own professional advancement, more critical statements would have been helpful, particularly an assessment of her style of managing the classroom discussion.
Vicky’s case is illustrative of a teacher who implemented a formula which she already knew worked. Looking for affirmation and consolidation, she referred, so to speak, to herself as an example of best practice, an attitude which made it difficult for her to question and reconsider her concepts in an open-minded way. Only twice – regarding the ideas of doing without predefined roles and of letting a student manage the discussion – did she hesitate briefly and then decide to take the path she deemed most reliable, and which she called a ‘classical setting’. In the second interview, she fended off our observations regarding the hierarchic gap between herself and the students which she created in the classroom discussion. At the same time, she criticised us for not being critical enough and reproduced a hierarchic gap between herself and us by casting us in the role of experts who should give an authoritative assessment of her teaching. This behaviour might mirror an element of insecurity resulting from a feeling of pressure of expectations. A number of statements might support this interpretation: In the second interview, Vicky seemed to be concerned about a comment on her teaching she had recently read in a student magazine saying that ‘she just let us [i.e. the students] discuss’. To her, this comment implies a criticism in the sense that ‘she did not have much to say, while we [i.e. the students] actually expected more of her’. In the final group discussion, Vicky explained why she had decided to manage the discussion herself instead of assigning this task to a student: first, two lessons which, according to her, would have been needed to train a student in managing the discussion had unexpectedly been cancelled; second, she wanted ‘to do better’ than the teacher in the scene shown on video at the beginning of the project; and third, she did ‘not like the idea to hand over control’ of the discussion to the students because she wanted ‘to guarantee a high-quality standard of teaching’, all the more because a research team from the university was involved. According to her statements, the fact that she works in a private school, ‘on which opinions still remain divided’, seems to have even increased the pressure of expectations for her. This might explain why she avoided experiments and resorted to a classroom setting already familiar to her.
4.2 Becoming aware of hidden concepts: the case of Silvan

Silvan was the youngest of the teachers involved. When the project started, he was thirty-one years old and had just finished his university studies in geography and history, but had not yet obtained his teaching diploma. Parallel to taking teacher education courses, he had been teaching geography part-time (forty percent) for two years.

When Silvan viewed the videotaped sequence, he described the hierarchies in detail, mentioning, e.g., the powerful, controlling position of the teacher who was sitting at the back of the students and trying to channel the discussion in a certain direction. By contrast, Silvan interpreted the numerous side conversations between the students in a positive way – as showing active engagement on the part of students who wished to express themselves. ‘This,’ he said, ‘is the learning process: by verbalising something, one gets to know it, or learns more about it, or can express oneself, and is therefore more intensely engaged with it’.

Silvan pointed out that, to him, the main goal of a classroom discussion consists in a process of agreement (which he also calls a ‘learning process’) among the students, leading to a consensus about the problem in question. He added that ‘consensus’ need not mean that the dispute is settled by finding a solution to the problem, nor does it mean that the students’ opinions have to tally with the teacher’s credo. He maintained that such a learning process would develop automatically if students were given the chance to examine a problem without any intervention by the teacher, but by verbalising, questioning and discussing their own ideas. This, Silvan stated, also has the effect that the problem under discussion will remain in the students’ minds for longer, especially if it is discussed in an adversarial manner. Silvan assumed that it is easier to initiate an adversarial discussion if the students deal with different aspects of the subject (e.g. in groups) in preparation for the lesson, thus becoming ‘specialists’
in their particular field. This specialisation should make students more self-reliant and have a positive effect on their involvement in the discussion, Silvan stated in the first group discussion. At the same time, he also attached great importance to the social climate within the class: classroom discussions are not a suitable teaching method for every class, he warned.

With these ideas in mind, Silvan conducted his own classroom discussion with a very lively and outgoing class. The set-up he chose was inspired by a United Nations plenary session and was subdivided into three phases. His greatest concern was that he, as a teacher, could not avoid channelling the discussion in one direction or another, even if he actually only wanted to chair it and guarantee that everybody who wanted to say something would have the opportunity to do so. Consequently, Silvan arranged the first and the third phase of his classroom project as plenary sessions chaired by himself, confining his contribution to certain essential information regarding the course and the goals of the work during the following 90 minutes, namely an agreement on a new climate protocol. The second and most important phase, however, consisted of a series of so-called ‘secret negotiations’ between small groups of students who represented the stakeholders participating in the meeting (these were the European Union, the developing countries, the USA, Russia, and ‘business’), negotiations which were held without any intervention by the teacher.

From a diachronic perspective, the goals, concepts and pedagogical considerations Silvan had expressed during the first stages of the project did not change significantly. Thus there were, to mention only some of the most important ones, his appreciation of side conversations as being an important part of the ‘process of agreement’ among the students, and his concern that the teacher might influence the content of the classroom discussion by virtue of his authority. However, the importance Silvan attached to the process of agreement, which starts from an adversarial discussion and leads to a ‘basic consensus’ among the students, seems to have been put into perspective: in the case study report on his teaching project, Silvan more closely defined the crucial term ‘consensus’, which he had used before to label the most
important outcome of a classroom discussion. Compared with his reasoning in the first
interview, he now specified that the question of whether a consensus had been reached or not
was not appropriate to assessing ‘what has been learned’. Rather, he contended, one would
have to take the whole process of discussion into consideration. Looking at his classroom
discussion, he said in the second interview that taking up this perspective could lead to the
conclusion that the students had developed an understanding of the mechanism of a climate
conference.

Despite describing himself as a novice teacher who had not yet gained a lot of teaching
experience, Silvan already seemed to have clear and consistent ideas about the aims of a
classroom discussion and about the teaching arrangement conducive to achieving these aims.
His way of reflecting can be described as circling around his topic again and again, becoming
more and more aware of formerly implicit ideas by verbalising them – which is exactly what
he also expects to occur in a classroom discussion.

As a ‘novice’, Silvan benefited a lot from the ‘expertise of the other teachers’ involved in the
project, he said. Particularly, he emphasised that the input from his fellow-teachers in the first
group discussion had helped him to answer his questions regarding the appropriate setting for
a classroom discussion. In fact, he was the most active participant in this group discussion
and, while discussing, he already outlined the setting he later used in his teaching project.
However, further discussions with his fellow-teachers, not only about the setting but also
about questions of content and teaching material, would have been helpful, he wrote in the
questionnaire.

Silvan’s case is illustrative of a teacher who, in the course of the reflective teaching process,
became aware of formerly implicit ideas. His exchange of ideas and views with others –
fellow-teachers as well as the research team – did not seem to cause significant uncertainty.
As Silvan endeavoured to evoke, clarify and formulate his thoughts and to test his ideas in
teaching, it is not surprising that he did not mention having missed an example of ‘best practice’ that he could follow in his own classroom project. As a result of his analysis of the classroom discussion he conducted with his students, he not only closely defined the goal of reaching a ‘basic consensus’ but, in the second interview, also drew a number of practical conclusions aimed at improving his next classroom discussion. In the second interview, Silvan fully agreed with our interpretation that he benefited from the specific setting of the project, as he was able to use it as a field for exchange and experimentation.

4.3 Getting bogged down in fundamental reflection: the case of Linus

Linus, forty years old at the beginning of the project, is a career changer. After having finished his teacher education, for several years he had been working for international NGOs and the Swiss government on the politics of migration and development as well as on humanitarian aid. Not until six months before the start of the project did he start teaching geography part-time (fifty percent). Of the five teachers participating in the project, Linus had the least teaching experience.

Reflecting on the video sequence, Linus especially focused on the students’ qualifications and on the teaching arrangement, including the teacher’s discussion-management style. On the one hand, he admired the liveliness and ‘emotionality’ he perceived in the discussion among the students, and he asked himself if and how the teacher had ‘prepared’ this class for the discussion. On the other hand, he criticised the teacher for having set up what he called an ‘irritating setting’: On the one hand, the teacher intervened by insistently repeating his own opinion, which, Linus said, made him dominate the content of the discussion. On the other hand, the teacher was sitting among the students, thus signalling equality with them. This
setting, Linus concluded, impeded what he presumed to be the paramount goal of a classroom discussion, namely ‘a free discussion between students’.

Very soon, Linus’ reflections also touched upon the socio-political aspects of the discussion sequence shown, as well as on the wider context of school: he criticised the fact that, in the video-example, the social and political relevance of the topic discussed – cloning – was not being articulated enough. Linus perceived a tendency of teachers to present scientific theories as truth and as the ‘non plus ultra’, which he interpreted as mirroring the current social discourse, which is, according to him, marked by a widespread reluctance to question expert knowledge and well-established theories. He also declared that students nowadays – in contrast to the early eighties, when he attended school – were less motivated to examine and unmask social and political inconsistencies. Nevertheless, Linus expected ‘somebody who was going to get the entrance qualification to study at university to be able […] to form his opinion and to advance it in public’. At the same time, Linus reasoned that the uncertainty of scientific knowledge hampered us in basing our opinions on robust scientific evidence. In view of this, he asked himself if a classroom discussion in which ‘everything could be questioned’ would not inevitably ask too much of both students and teacher. This dilemma – the ideal of a free and critical discussion among students on the one hand, and the perception of not being given much leeway in the role of the science teacher (who is expected to teach robust scientific facts to his students) on the other – began to occupy Linus for the rest of the project.

In the first group discussion, Linus had vehemently opposed his colleagues’ idea of a role-play setting, arguing that this would impede authentic and independent thinking. In view of this, it was surprising to us that he nevertheless started his classroom discussion with a role-play. The setting was a conference of representatives from Swiss universities, political parties and other interest groups who were given the task of outlining research projects on climate change and of deciding on five projects which would receive government funding. In order to
‘avoid staging a theatre’, Linus deliberately did not give the students the opportunity to prepare themselves for the role-play. Like the role-play, the idea of letting students manage the discussion was also implemented only half-heartedly. At the beginning of the lesson, two students joined forces to act as conference co-chairpersons. However, Linus took over the role of manager soon afterwards, when it became clear that the two students were not prepared for the task the teacher had intended for them. In the second interview, when confronted with our hypothesis that assigning roles to the students without giving them the chance to prepare for acting these roles would disempower students, Linus fully agreed. He reported that, when trying to prepare his teaching project, he felt totally blocked and unable to take any decision regarding the specific setting until only a few days before the classroom discussion took place.

Linus is illustrative of a teacher whose participation in the project initiated a process of reflection leading to the discovery of fundamental dilemmas and, eventually, to a mental block. Linus explained the reason for this mental block in his case-study report: in a section entitled ‘preliminary pedagogical considerations’, he presented extensive reflections on the conditions and restrictions of the educational system and the role of the teacher in a socio-political context. Referring to his understanding of German sociologist Niklas Luhmann’s theory of social systems, Linus argued that ‘as a matter of principle, teachers and students within the subsystem of education contribute to the preservation of the structures of society in general and of the educational system in particular’. He came to the conclusion that this conservative function of the educational subsystem limits the opportunities for critical, independent discourse in school. Out of this consideration evolved Linus’ perception of a fundamental contradiction regarding the role of the teacher: in his case study report, he wrote that ‘the teacher, aside from transmitting subject knowledge, cannot help but also provide a value system. At the same time, he wants his students to develop independent thinking’. This
perception seems to have developed in the course of the project and to have had an inhibiting effect: although Linus was able to clearly identify contradictions and dilemmas and their impact, it was not possible for him to resolve them. In practice, the effect of the setting he chose for his classroom discussion was exactly the contrary of what he had intended. Instead of allowing what he called a ‘free discourse among students’, Linus deprived the students of the power to freely express their ideas. Despite feeling incapable of resolving the dilemmas and contradictions regarding his teaching project, Linus was very interested in the critical discussions of his teaching project with the research team. Yet, this discussion did not produce any change in Linus’ view that the possibilities of achieving the goals he associated with a classroom discussion are very limited in the school context.

In the questionnaire the teachers answered towards the end of the project, Linus referred to his limited teaching experience and, against this background, voiced regret at not having had the chance to get to know more and different examples of classroom discussions at the beginning of the project. From his experiences in the course of the project, he concluded that extensive classroom discussions over one or even two lessons are not a suitable teaching form when it comes to dealing with socio-scientific issues. This is, he claimed, because the curriculum does not provide enough time either for systematically and critically discussing scientific findings or for the development of students’ thinking and rhetorical skills necessary for in-depth discussions to develop. Therefore, Linus stated, he would – albeit ‘more consciously’ – continue with what he had already been doing before the project: calling students’ attention to important controversies involving scientific knowledge and spontaneously inserting short discussion sequences when he feels that students would be willing to engage in them.

5. Discussion
In the preceding chapter, we presented case studies of three teachers who were working with a reflective approach aimed at developing competencies in analysing and managing classroom discussions on a socio-scientific issue. As a result of our analysis of the case studies, we proposed characterisations of the distinct ways in which these teachers dealt with the reflective process. We labeled these ways ‘taking the most familiar path’ (Vicky), ‘becoming aware of hidden concepts’ (Silvan), and ‘getting bogged down in fundamental reflection’ (Linus).

The analytic aim of our research was to closely describe and better understand how teachers work with the specific reflective approach underlying the project described in this article. The normative aim of the project was teachers’ professional development in analysing and managing classroom discussions. The question thus arises as to whether and how teachers have benefited from the reflective approach employed here, and to what extent they have developed their professional competencies. Looking at our reconstruction of the individual processes the teachers went through and the answers they gave to this question, the following can be said:

*Vicky* mainly expected her teaching to be evaluated by the research team, followed by practical advice on how to improve future discussions. While she assessed the use of the interview about her classroom project critically, in that she perceived the researchers as being too descriptive instead of judging her classroom project, she described seeing herself on video as very useful. Together with the suggestions she received in the workshop on managing a discussion, viewing the video allowed her to assess her teaching performance by herself and to become more conscious as a manager of future classroom discussions, she said. She also said that she would continue to use video as a tool for reflecting on her teaching, but that she did not need outside observers to do so. All in all, the project encouraged her to continue using the discussion setting she had already preferred before the project.
Silvan said he came to the project as a ‘novice’. He wanted to learn how to initiate and manage classroom discussions which would meet the criteria and teaching goals he had already associated with this teaching method previously. In judging the elements of the project, he particularly highlighted the exchange among the teachers (which, he said, helped him design the setting for his classroom discussion), as well as the analytical categories proposed by the research team (which helped him to analyse his students’ argumentations and to discern the different ‘layers’ of a discussion). In the end, he put forward a number of specific suggestions for the improvement of the setting he tried out, as well as new criteria for assessing a classroom discussion. Accordingly, Silvan judged his professional development very positively.

Linus entered the project in search of a way to realise a discussion which would allow the development of a truly socially critical discourse among students. At the same time, he doubted from the very beginning if this was possible at all. Linus’ reflections differed from the reflections of the other teachers in the project, as they related to the educational system as a whole and its limitations with regard to critical discourse among students. Through becoming bogged down in this reflection, Linus lacked the time to develop a pedagogical setting which might have been supportive of his ideas of a good classroom discussion. He particularly appreciated writing a case study about his teaching project and discussing it with the researchers. These elements, he said, constituted the ‘main platform for reflection’ and offered stimulating observations. Nevertheless, his critical assessment of his teaching project and the subsequent discussion with the research team mainly seem to have confirmed Linus in his opinion that the school system sets tight boundaries to the development of critical discussions among students. He concluded that conducting extended reflective classroom discussions, as proposed in our project, would not change these constraints and could therefore just as well be replaced by less time-consuming, spontaneous short discussions of the type he had already been using in his teaching before the project.
In summary, it can be concluded that each teacher, according to his or her individual needs in the real-life situation, was able to make use of certain elements of the framework employed in this project while judging other less helpful, and, as a result of the reflective process, came to personal conclusions regarding the potential and the preferred setting of classroom discussions on socio-scientific issues. However, if we define professional development as a result of reflective teaching in a narrower sense – for example as ‘describing’, ‘reframing’ and ‘establishing a renewed perspective’ on the matter of reflection (Jay & Johnson, 2002, p. 77) and, in consequence, ‘implementing new and more informed actions’ (Orland-Barak & Yinon, 2007, p. 959) – Silvan seems to have benefited from the openness of our framework more than Vicky and Linus did.

Thus, if we want teachers with a broad range of needs and learning styles to benefit from a reflective approach and to develop professionally in the sense of the above definition, we might have to think of modifying the design of future teacher education projects. Following the concept of content-focused coaching (Staub, West, & Bickel, 2003), this could mean assisting teachers more closely on their journey through the reflective process. Teacher trainers/researchers and teachers would exchange more frequently and at shorter intervals, thus gaining more opportunities to clarify teachers’ specific needs, interests and questions emerging during the project, and to coach teachers while they are designing and analysing their classroom projects. Within such a framework, teacher trainers/researchers should encourage teachers more strongly to search for and try out new solutions to the questions they had at the beginning of the project, thereby assisting them more strongly with practical advice with regard to both teaching and analysing their lessons. Moreover, extending future projects over more than just one cycle of reflection and action might have several positive effects: for the teachers, it might become easier to engage in trying out new ideas in the classroom when they are given multiple opportunities to do so instead of being restrained by the fear of
missing the first and only occasion to demonstrate their teaching competence, as was particularly illustrated by the case of Vicky. Moreover, from the research perspective, the analysis of a series of lessons as opposed to just one teaching episode would allow researchers to identify changes in teaching that occur throughout the project. Finally, also bearing in mind the workload and time-pressure many teachers report (for Switzerland, see Forneck & Schriever, 2001), implementing the above modifications would, in turn, call for smaller teaching projects and less time-consuming reflection tasks.

We would like to conclude this article with a few speculations on possible effects that the above suggestions might have had, especially, in the cases of Vicky and Linus. In the case of Vicky, the changes proposed might have lessened her feeling of pressure of expectation. Perhaps she would still have started with the discussion setting familiar to her; but in the next teaching episode, we would have had the chance to encourage her to try out a new or modified set-up and to propose more practical suggestions in this regard. In Linus’ case, a more frequent exchange between the research team and the teacher could have enabled us to note his being bogged down in reflection much earlier in the course of the project. While appreciating his thoughts, we could also have tried to collaboratively find a first approximation to a discussion setting – perhaps only a few elements to be tried out in a short discussion sequence – which might then have been extended over the following teaching episodes.

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