Chapter 8

Ethical challenges of symmetry in participatory science education research – proposing a heuristic for ethical reflection

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Abstract

The advancement of participatory methodologies and educational action research has raised challenges of research ethics that concern the relations between different actors. Different forms of participatory research rest on cooperation between teachers, researchers, and students in different forms of relations. The ways in which these relations are enacted are often related to research objectives, epistemology, the people involved in the study, and the context in which the study is carried out. In this chapter we seek to disentangle some ethical challenges emerging from three different teacher-researcher collaborations in science education research. What values are at stake and what are the potential tensions in attempting to secure different values? This includes the ethical implications of requiring shared responsibility between teachers and researchers in development of educational practices and knowledge generation. We discuss how different forms of teacher-researcher collaboration transform ethics and epistemology and how the ethics and epistemology become intertwined. In addition to standard ethical reflection, an ethics of participatory research in science education has to include considerations of the ontological, epistemological, and methodological values at stake.

Keywords: Participatory research, principle of symmetry, collaborative research, research ethics

8.1 Introduction

The advancement of participatory methodologies and educational action research has raised challenges about research ethics that concern the relations between different actors. Different forms of participatory research rest on cooperation between teachers, researchers, and students in different forms of relations. The ways in which these relations are enacted are often related to research objectives, epistemology, who is involved, and the context in which the study is carried out (Wagner 1997). Sensevy, Forest, Quilio and Morales (2013) have proposed a symmetry principle as a device for guiding enquiry in teacher-researcher cooperation in mathematics education design-based research. According to this symmetry principle, all participants in a design-based research project should share responsibility for the intervention, even if it is a teacher who carries out the teaching and thereby takes the minute-to-minute decisions in the intervention situation. Sensevy and his colleagues point to the value of a local, practical indistinguishability between the teacher and the researcher, where both the teacher and the researcher share responsibility for responding to the problem of teaching practice both in theoretical and

concrete ways. Thus, participatory methodologies and educational action research involve ethical challenges beyond the questions of informed consent and confidentiality in conventional university-based research where educational practices are regarded as fields for data collection. In this chapter, we draw on the principle of symmetry to argue for a research ethics in participatory science education research based on the ontological, epistemological, and methodological value commitments of participatory research.

We seek to disentangle some ethical challenges emerging from three different teacher-researcher collaborations in science education research. What values are at stake and what are the potential tensions in attempting to secure different values? This includes the ethical implications of requiring shared responsibility between teachers and researchers in implementation and knowledge generation. We will provide three examples of how the principle of symmetry may be extended to function as a device for ethical reflection on value commitments at play in participatory science education research. The three examples are studies that we have been involved in ourselves and reflect different ways of and different struggles in enacting researcher-teacher relationships. The first example involves the attempts of a university-based researcher (Andrée) to establish research collaboration with an in-school teacher. The second example involves a researcher who is school-based (Wiblom) working to establish research collaboration with science teacher colleagues at her school. The third example involves a researcher pursuing research in her own classroom practice (Danckwardt-Lillieström).

8.1.1 Values at play in participatory research

In research there are values at play that relate to ontology, epistemology, and methodology. The ontological commitments underpinning participatory action research include a democratic and egalitarian value base, a commitment to hold oneself responsible for how one tries to influence other people's learning, and acknowledging that one is part of the world connected to other people in an endeavor to undertake enquiry with others (McNiff 2017). In other words, participatory methodologies assume that the researcher is always part of the situation they are studying and that we as researchers need to negotiate our values and forms of living with others.

The epistemological values have to do with what counts as valuable in terms of knowledge and knowledge production (how truthfulness may be established). An epistemological value commitment in participatory action research is that knowledge is uncertain and ambiguous, and that knowledge about social situations is created through dialogue with one another (McNiff, 2017).

Methodology refers to how the research is conducted. A strong methodological value commitment in participatory action research is that all practitioners, in our cases all the teachers participating in the research, are agents and not objects of study, recipients, or onlookers (Newton & Burgess 2008; cf. Carlgren 2012). In educational research, teachers are commonly viewed as 'practitioners' "trapped in a practical relationship to their work, while researchers hold a theoretical stance" (Senseny, Forest, Quilio & Morales, 2013 p.1032). This view has implications for how the process of knowledge production is understood — as a process involving a distanced researcher, positioned as the 'thinker', and a teacher, positioned as the 'doer' applying scientific results to practice. Participatory research seeks to overcome the classical dualism between 'persons who think' and 'persons who do', and instead contribute to affirming teachers as professionals and opening up new spaces for teachers to explore instead of bringing in outsider knowledge (Price & Valli, 2005). Or, as Bradbury Huang (2010, p. 93) puts it, there is a striving to "take knowledge production beyond the gatekeeping of professional knowledge makers." Another methodological value commitment is the transformative orientation to knowledge creation (cf. Bradbury Huang, 2010). The aim

of the research is not just to seek understanding of a particular social situation but also to contribute to the improvement of it — in our case, science education classroom practices (cf. Elliot, 1991; Carr & Kemmis, 1986).

The ontological, epistemological, and methodological value commitments introduced above are foundational to the principle of symmetry. The principle assumes no practical or epistemic differences between different agents in the research. Sensevy and his colleagues (2013 p. 1033) write that “every agent plays ‘her game’, that is, proposes to the collective her first-hand point of view, what she ‘sees’ and what she ‘knows’ from her position, a point of view that is irreducible to any one other.” Such an arrangement may foster what Sensevy and colleagues have termed a local practical indistinguishability where the involved agents take collective decisions and share ways of responding to a problem in a teaching practice. According to Sensevy and colleagues, the principle of symmetry is both epistemological and ethical. We would argue that the principle of symmetry also adheres to the ontological and methodological values of participatory research.

In the following we provide three examples of studies that we have been involved in ourselves with different configurations of teacher-researcher collaboration. In light of the principle of symmetry the three cases are examples of imperfection and struggle. In writing about the three cases we use first person plural (we) and singular (I) to voice our experiences as individual researchers and members of research teams. We hope that, by sharing our shortcomings and ethical reflections with a wider audience, we will contribute to making science education research more responsive to the tensions of values that are inevitably part of any research process.

8.2 Maria Andrée: A university-based researcher attempts to establish research collaboration with an in-school science teacher

The first case is a project initiated by university-based researchers. The project involved the first author and a research colleague at Stockholm University (Associate Professor Lotta Lager-Nyqvist) who set up an action research project in collaboration with a primary school teacher who taught science in the first and second grades. The project was part of a larger externally-funded project on learning and narrative remembering where the research group worked with questions of how inquiry-based science education (IBSE) practices are, and potentially could become more responsive to students’ experiences and funds of knowledge. Prior to the action research part of the project the researchers had published two analyses of opportunities for learning in IBSE teaching practices. The first study focused on how IBSE teaching practices constrained students’ opportunities to draw on personal funds of knowledge (Andrée and Lager-Nyqvist 2012 a), and the second on how students engaged in informal spontaneous play in their work to transform the given tasks into something more personally meaningful to them (Andrée and Lager-Nyqvist 2012 b). With the new study the research team hoped to explore the conditions of classroom practice that previous studies had suggested were epistemically productive.

In the initial phase of the project, we contacted a local municipality to explore possibilities for developing a partnership with a couple of schools. After meeting with and presenting the ideas of our research group to the science teachers and the heads of two different schools, we decided to start working with one school. We were initially granted rapid access to a team of teachers and one of the teachers invited us to work more closely with her. She had substantial experience in teaching primary school although she was less experienced at teaching science since she had only recently completed a course on teaching science in primary school.

8.2.1 Challenges of symmetry

Although access was granted rapidly, the process of establishing a partnership took much longer than we as university-based researchers had anticipated. Our starting point in the project was that we wanted to engage in participatory research and establish a non-hierarchical relationship with the collaborating teachers. We did not, as in much of our previous work, want to set the agenda and the design of the intervention beforehand.

However, the participating teacher later admitted that for a long time she had been unsure about what we were after: What was the researchers' agenda? Over the first phase of four months we had several meetings with the teacher. However, our field work during this period became ethnographic work. After a while we started to get to know the school and the teachers and their worries and frustrations in relation to teaching science in primary school. At the beginning of the second semester we eventually started working as a team. We started to plan research lessons together, targeting issues such as how to create conditions for students to learn about inquiry in science education and how students' ability to talk about inquiry work could be developed as part of teaching. For the first time, as a group, at least to some extent, we came to share a research object and practical responsibility for the design and implementation. One of the inventions by the group was to use homework experiments to facilitate more explorative conversations about observation and interpretation among the students. In implementing the lessons, we divided the students into three groups and all three research team members took responsibility for enacting the intervention.

Although, as university-based researchers, we would subscribe to a democratic and egalitarian value base, we had no prior experience of establishing such a relationship. We first had to become part of the classroom situation, together with the classroom teacher and the students, before being able to engage in any kind of negotiation concerning classroom practice. In other words, we could not establish a symmetrical relationship with the classroom teacher before becoming part of the world of the classroom.

8.2.3 Divergent objectives

In the process of knowledge production a divergence in objectives emerged between us as researchers and the teacher. The group produced a working report on the project. Although there was an attempt at challenging asymmetry in knowledge production, the university researchers ended up acting as the primary analysts and writers, thus reproducing asymmetry. In the working report, which was not formally published, the classroom teacher contributed with a preface on her experience of the project. Being unaccustomed to participatory research, as researchers we had some difficulty discerning the values of the project in terms of knowledge outcomes. We presented parts of the study at academic conferences, and years later a publication presenting a theoretically motivated interactional analysis of remembering as instructional work in science classroom practices was published as Andrée, Wickman and Larger-Nyqvist (2018). The scientific publication was primarily written to satisfy the needs of the larger, externally-funded project of which ours was a smaller part.

In the end, the action research project functioned primarily as a learning opportunity for us as university-based researchers in attempting to engage in participatory research. The starting point of the project was determined from a university-based researcher position which was reflected in the difficulties establishing symmetric relations in setting up, conducting, and reporting on the research project. In the beginning there was a clear lack of local practical indistinguishability, although this relation was eventually, at least partially overcome during the second semester when the group engaged in the collaborative planning and design of research lessons. Throughout the project tensions of value commitments included the lack of

connectedness with the local classroom situation from the university-based researchers, challenges of epistemic ambiguity in the object of study, and difficulties achieving symmetry in the knowledge creation process. In hindsight, the team failed to reconcile the dualism of university-based researchers as ‘thinkers’ and the teacher as ‘doer’.

8.3 Jonna Wiblom: A school-based researcher establishing research collaboration with teacher colleagues in the school

The second case is part of my (Wiblom’s) PhD project on the use of digital technology in upper secondary biology education. The PhD project was part of a graduate school on school-subject didactics in a collaboration between the local municipal and the university. The project was supervised by Maria Andrée (the first author) and Carl-Johan Rundgren at Stockholm University. The graduate school aimed to create opportunities for practicing teachers to systematically examine and explore didactic challenges while working part time as teachers in school. During the PhD project I functioned both as a school-based researcher (working on a PhD thesis while attending courses at the university) and as an upper secondary biology teacher in a public upper secondary school in Stockholm. My PhD project was conducted as a two-year design-based research study. During the phase of planning and implementation I worked with two biology teacher colleagues at the school. Of the three, I was the only one participating in a PhD program while my colleagues taught biology and science full time (during the second year they received some minor reduction of their teaching load for participating in project meetings).

During our first planning meeting we started by framing challenges in biology teaching that might be worth engaging in the project. The challenge we agreed upon had to do with our use of digital technology in our classrooms. The school could be described as an ‘early adopter’ regarding digital technology in education. All students and teachers had access to individual laptops and everyday classroom work across school subjects involved both teachers and students’ use of digital technology. With digital tools (and not least the Internet) entering our classrooms, we needed to reinterpret and expand our understanding of the biology curriculum in relation to digitization. We asked ourselves questions about what knowledge of biology was useful for participation in contemporary societies. We were mutually frustrated with our use of digital technology as a means of facilitating canonical biology learning. For instance, we engaged our students in software-supported activities like taking lecture notes, writing lab reports, charting fieldwork data, or preparing oral presentations during class. The Internet was primarily used as a dictionary for the learning of biology concepts and as a resource for finding videos illustrating, for example, mitosis or photosynthesis.

We formulated the overarching aim of our research collaboration as an exploration of how to integrate digital technology with education so that it would facilitate students’ learning of biology in ways that made it relevant to their participation in society. More specifically, the research objective was to design and implement classroom activities that developed students’ capacity to critically and ethically examine science related information on the Internet, and further to produce science-related digital media themselves. Human physiology and health were chosen as curricular areas of content. The two interventions that followed were implemented as part of the regular biology teaching in the second year science classes of my colleagues (I was teaching first year students at the time). During the implementation my colleagues taught their classes and I was responsible for video documentation and for taking field notes. Throughout the implementation period we had weekly meetings to plan lessons, evaluate learning outcomes, and reflect upon student learning. After the implementation

phase, I wrote and published the resulting research paper with my two supervisors without the involvement of my two teacher colleagues.

8.3.1 Challenges of symmetry

Although we were all teachers in the same school and to some degree shared responsibility for the research there were different risks at play in terms of symmetry-asymmetry throughout the project.

During the two cycles of implementation, my colleagues and I were continuously confronted with contradictory demands that put our roles and work relationships at stake. My colleagues were responsible for the biology course, to ensure that the students were provided opportunities for reaching the prescribed learning objectives, and to assess their achievements. Their participation in the study put their trust and relationships with the students at stake as they were about to teach the rest of the biology course after the intervention had come to an end. It also turned out that the introduction of new digital activities challenged some parents' expectations and conceptions of school biology. At the end of the first intervention a parent contacted one of my colleagues and questioned how 'chatting' and 'producing websites' could possibly be part of students' learning science in school. My colleagues were also the ones confronted with students' questions and anxiety regarding examination. The following was part of a conversation that took place between one of my colleagues and two of her students as the new digital activities were introduced in biology class.

Teacher: You are going to discuss ethical aspects of health and evaluate health-related resources on the Internet.

Student: Is it like...in the social science program?

Teacher: Yes, but we will focus on issues that are extremely scientific.

In Swedish upper secondary biology curricula, students' ability to critically examine science-related issues in media from ethical standpoints is expressed as a central learning goal. The question as to whether they would be working "like... in the social science program," points to tensions between the introduced activities and the activities commonly associated with science education in school. My colleague answered that they would learn about "issues that are extremely scientific" emphasizing that the ethical discussions (and critical examination) would focus on the areas of human physiology and health. Her answer pointed to a view that the main value of engaging in critical and ethical examination of health issues in science education had to do with students' learning about human physiology. However, our research objective was formulated the other way around, namely to examine how students' engagement with health issues in media could support their development of subject specific capabilities in terms of critical and ethical examination of science. From the research perspective, I as a researcher was interested in expanding the notion of knowledge in science education. Rather than a strict focus on students' knowledge about "scientific issues", the research focus was on qualifying students' capabilities to engage critically and ethically with health-related issues in ways informed by science education practice.

Towards the end of the above lesson my colleague announced that the upcoming digital activities involved students' conversations about health-related ethical dilemmas over a chat forum, which would constitute grounds for assessment.

Student 2: Will you assess the websites?

Teacher: We will assess the chat [about health ethics dilemmas], *that* is the examination; a discussion on the internet.

Student 2: Are you serious? A chat?

[...]

Student 3: But how should we chat then?

Introducing website production and chatting as part of biology class caused confusion and anxiety among the students. As illustrated in the transcript above, one student even questioned whether the teacher was serious, and another student asked, “but how should we chat then?” Then and there, we were puzzled by the fact that these sixteen-year-olds (presumed digital natives) would ask us as teachers how to communicate on social media. Looking back, however, the students’ questions may be interpreted as expressions of uncertainty concerning what was to be expected from them as students of Biology when communicating online in the context of formal biology education.

Engaging the students in new digital activities such as website- and podcast production, required us as teachers and teacher-researcher, as well as the students, to reconsider and renegotiate existing epistemological value commitments regarding what counts as school biology. It also contributed to challenging the establishment of a symmetrical relationship in conducting the research since both students and parents made it clear that it was my colleagues who were to be held responsible for any risks associated with the implementation.

8.3.2 Divergent objectives

Over time, divergent objectives regarding my and the teachers’ engagement in the project evolved. The episode that follows is part of a conversation held at one of the research-team meetings in the first cycle of intervention during which forms for assessing students’ achievements were discussed.

Teacher 1: Maybe we should have like one research objective and one objective regarding students’ learning? There is no problem to relate to the curriculum regarding ethical perspectives and source critique. That renders great discussions, to become substantial and to practice those abilities at the same time. To be critical and to reason about ethical issues at the same time. Perfect! But relating that to their digital competences? That is problematic.

[...]

Teacher 1: I mean when we assess their capabilities to search for information, participate, and interact online, that doesn’t really correspond to curricular learning goals. Their participation. That becomes very vague to assess. Exercise is good, but perhaps not assess. Interesting from a research perspective though.

The above utterances exemplify how tensions between different roles and interests in the research collaboration gave rise to uncertainty about how the project would contribute to improving the biology teaching practice. When my colleague distinguished between an interest in developing students’ learning and a research interest, she pointed out that we had not succeeded in establishing and upholding a shared research objective. From my perspective, however, the student learning was not separate from the research objective, in fact, the student learning was the focus of the research. However, my colleague expressed a concern that renegotiating the biology curriculum learning goals in relation to digital activities would be problematic and not necessarily compatible with students’ discussions about ethics and health. Based on the epistemological assumption that learning is situated and developed by participation in social practices, I advocated that students’ achievements should be assessed *as* they engaged in the digital activities. As illustrated above, my colleague found such a perspective interesting; however, challenging to reconcile with established assessment practices (based on written assignment such as exams, reports, and short papers). To reconcile

the tensions between the established teaching practice and the exploratory research objective, my colleague suggested that the students could be given the opportunity to “exercise” critical examination and ethical reasoning while engaging in digital activities. However, she also concluded that such an activity “becomes very vague to assess.” In the end, the students’ achievements were assessed by means of a written assignment where the students were asked to reflect on their own learning process.

In this case, the difference in risks involved for me as a researcher (although school-based) and the teachers, contributed to the emergence of an asymmetric relationship. We did share local responsibility in planning and engaging with the students during the lessons during the implementation, but we did not share the consequences in terms of accountability for assessment and in relation to students and parents. We also did not share accountability for outcomes in terms of publication.

8.4 Kerstin Danckwardt-Lillieström: A school-based teacher researcher conducting interventions in her own practice

The third case is an example of where I (Danckwardt-Lillieström), the researcher, was not only school-based but also the teacher responsible for conducting the interventions in my own practice. I have extensive experience in teaching science in upper secondary school (over 20 years) and participated in a science education graduate school at Stockholm university with combined financing from the local municipality and the Swedish Research Council. The purpose of the graduate school was to strengthen the link between research and school development and to expand science teachers’ didactic knowledge base and capacity for didactic analysis of school practice. The core activities of the graduate school program included developing and testing models for teaching science in school (Wickman, Hamza and Lundegård, 2018).

This study focused on teaching chemistry; the choice of subject grew out of experiences in upper secondary school of chemistry being a subject that students often find challenging, abstract, and hard to grasp. In collaboration with my two supervisors (the first author Maria Andrée and Margareta Enghag), I investigated ways in which creative drama could be used to support students’ chemistry learning in upper secondary school. The study was framed as design-based research focusing on how creative drama could be used to afford students’ learning of abstract, non-spontaneous chemical concepts. Theoretically, the study was framed within social semiotics, exploring what kind of semiotic work the students were engaged in in different enactments of creative drama in chemistry education; for example, how the students used their own bodies as semiotic resources to make sense of the concepts of chemical bonding and electronegativity. The study was conducted in three cycles during 2015 and 2017. The first and second cycle were enacted by me acting as a teacher and researcher in my own practice. The third cycle was later implemented in collaboration with a chemistry teacher in another school. In this chapter I will focus on the challenges of symmetry as both researcher and teacher in my own classroom.

8.4.1 Challenges of symmetry

The first two cycles of the design-based study of creative drama were conducted as part of my ongoing chemistry teaching. During these cycles I was both teacher and researcher and, thus, related to the students both in their roles as participants in daily classroom life and as participants in research. In this context there is no asymmetry in terms of a hierarchical relationship between researcher and teacher or dualism between the thinker and doer in the research. However, new ethical challenges are invoked in terms of the values at stake in

conducting the research and I had to deal with these challenges in both my roles. To conduct a study as a researcher where my own students were participating required careful reflection on the responsibility and values at stake. The challenges of symmetry concern the balancing of interests relating to me as a researcher and me as a teacher and risks pertaining to the entanglement of these interests.

One fundamental ethical challenge has to do with student-teacher dependency. In a situation where a teacher is also a researcher there will be dependency related to assessment and future grading. In the following I reflect upon an episode in the classroom a week before the intervention of the second cycle. Prior to the start of the chemistry lesson, the students had been informed that the next lesson would be part of a research project aimed at contributing to the development of learning in chemistry. The students were given information about the project and written consent forms were handed out to the students. The students were invited to read the information and decide whether to provide written consent to be filmed during the research. As I was walking around the classroom, I overheard one student asking another if she was going to participate in the research and the student answered that she wanted to help me with the research. The student thus expressed that she is giving her consent to participate in the research in order to help me. In other words, the consent becomes an expression of support for me as a teacher. Would the student have given her consent to an independent researcher with whom she had not had a relationship? Does the student agree because she is dependent on her teacher and fears that the assessment of her skills could be adversely affected if she declines to participate? Or, does the student agree because she is sympathetic towards her teacher? According to the Swedish national regulations on consent, the participants in a research study have the right to decide for themselves about their participation, and in an investigation with active contributions from the participants, consent shall always be obtained (Swedish Research Council, 2017). As a researcher you have an obligation to ensure that participation in research is voluntary. One challenge here is to find ways to circumvent dependency. This will have implications for when, how, and possibly by whom students are informed about participation in a research study. To avoid undue influence, the researcher would commonly present a study to the students and not their teacher, but in this case I was both.

8.4.2 Divergent objectives

To me as a teacher and researcher there have been different objectives at play. As a chemistry teacher, my primary objectives have to do with student learning and the development of my local school practice. As a researcher, my primary objective has to do with the production and sharing of new knowledge about chemistry teaching. In hindsight, the research project has influenced both the actual teaching and the ways of talking and thinking about teaching in the local school. As a teacher, I have been able to take the newfound insights generated through research directly into teaching practice and to share these insights with colleagues who do not participate in research but still indirectly transform and develop their teaching as an outgrowth of the research process. There is thus an added local transformative value to conducting research as a teacher (cf. Newton & Burgess, 2008).

This design-based study was conducted as part of the ongoing teaching. Hence, transformation involved both students and teachers. Careful consideration has been given to those students who were in the classroom but who, for different reasons, did not want to participate in the study. Regarding this issue of participation in the research, there are clearly divergent objectives. In relation to the objective of teaching chemistry, I as a teacher was accountable for the learning of all students and great caution was given to designing the intervention so that the students not participating in the research were guaranteed an

equivalent instruction. In contrast, the objective of my research project focussed on the participation of the students participating in the research intervention.

As a teacher I also have an ethical-moral obligation to provide students with equal learning opportunities. Thus, it becomes important that the students who do not give consent are provided equal learning opportunities, particularly when interventions are conducted as part of the ordinary chemistry teaching. Throughout the three cycles of the study, the students who did not consent to participate in the research study were placed at a table beyond the reach of the audio and video recorders. Thus, these students could participate in all learning activities. The rationale for this was that the teaching activities were designed to the best of our knowledge and the activities were expected to contribute to the understanding of the students. It is of the utmost importance that the teacher, from an ethical perspective, ensures that the students who chose not to participate in the study are treated equally. I emphasized that the students should not be left out and I made sure to address this group of students during whole-class interaction and, as the teacher, to listen to their discussions and provide them with opportunities to ask questions. Thus, I strove to be attentive to their participation in the classroom conversation. The problem of the participation of students who do not give consent presents in all interventionist research; however, the difference for me as both teacher and researcher was that I had overall responsibility for the learning of all students, whereas an independent researcher would be accountable primarily to the participants of the study.

Another issue of concern relating to divergent objectives, given my dual roles as both researcher and teacher, had to do with how I dealt with sensitive information during the process of analysis of the collected data. Through the process of data analysis, a researcher is given a unique opportunity to peek into the social micro-dynamics of the classroom. As a teacher you normally do not gain access to private student conversations. For a teacher-researcher, listening to these recordings not only provides insights related to the object of study — in this case conceptual learning in chemistry — but also into the social micro-dynamics of the classroom, including tendencies towards abusive behaviors and bullying. In this study, I was made aware of several examples of such demeaning social micro-dynamics. In one group, the analysis of video data displayed how a girl, who was often very silent in the classroom, participated in other nonverbal ways in the group work. The film also revealed that she had very low status in the group. On one occasion she clearly signaled that she wanted to visualize an atom with her body, but the group ignored her and chose another group member to participate in the dramatization. In another group, one student uttered racist comments about another student on several occasions. Being able to gain insight into the behavior of group members towards each other can enable the teacher to consciously change the group composition and pay attention to the silent students in a way that promotes learning. This may also be part of the development of the educational design.

In comparison with a researcher who is temporarily in the classroom, who does not really know the students, and is not able to follow up on the research with the students, the teacher-researcher finds herself in an ethically delicate situation. The teacher-researcher is bound to the students' consent to participate in the study, which in this case had to do with the use of drama in chemistry education and its potential for conceptual science learning. The students had also been informed that the data collected would be used for research purposes only. On the other hand, the teacher-researcher is the adult teacher in the classroom responsible for ensuring that the classroom environment is free from abusive behavior in all forms. If abusive behavior had caught my attention during the activity it would have been common practice to act on it as a teacher. The situation becomes somewhat different when the covert abusive behavior is first recognized weeks or months after the teaching activity, when I, as a researcher, listen to and transcribe the recordings. One way to resolve the tension between values would be to say that the teacher-researcher should not begin analyzing data before the

end of the school year. On the other hand, this would be a way of concealing the tension regarding the responsibilities one has as a researcher not to go beyond the given consent and the responsibilities one has as a teacher to care for the students.

In relation to the objectives of research, a common objection to conducting research in my own teaching practice concerns my own bias — whether the results may have been influenced by my own opinions, backgrounds, and values. This might be interpreted as an issue of divergent objectives, involving tensions between goals of producing knowledge and goals of developing educational practice. For example, Barab (2004) emphasizes that the role of the researcher in the design experiment may endanger the validity. If the researcher is personally involved in the design, development, and implementation it is challenging for the researcher to ensure the accuracy of the results. On the contrary however, we maintain that the researcher's participation has been beneficial in this study. Anderson and Shattuck (2012) and Coe (2013) recognise that the participation of the researcher presents a well-known challenge for many forms of qualitative research where it is difficult to ignore the bias of the researcher in the research process. However, Anderson and Shattuck (2012) argue that the researchers themselves, with their bias, insight, and deep understanding of the context, are the best research tools. In this design-based study, I have been not only the teacher and researcher in the same person, but I have also conducted the study in my own classroom with my own students, as a teacher-researcher. Therefore, I have a deep knowledge of the context in which the interventions are conducted, which may be a great advantage in terms of validity in the analysis. For example, the importance of background knowledge in observing students made it possible for me to compare how the students participated in chemistry teaching during the intervention compared with how they participated in the traditional teaching context. Thus, when it comes to the question of bias and deep understanding of the context, I argue that this does not really have to do with divergent objectives but is rather a question of epistemology.

8.5 Conclusions

These cases of teacher-researcher collaboration illustrate how participatory methodologies involve a transformation of ethics and epistemology and how the ethics and epistemology become intertwined. In the different forms of research, the start and the end of research, as well as the aims and roles of teachers and researchers are blurred in different ways. The scrutiny of these three examples of research collaboration reveals the limitation of traditional ethical considerations that focus on the integrity and consent of the individual — like those provided in guidelines from national authorities (such as Sweden's Vetenskapsrådet 2017). In addition to the standard ethical reflection on informed consent and confidentiality, an ethics of participatory research in science education has to include considerations of the ontological, epistemological, and methodological values at stake.

8.5.1 Ontological values

The ontological values include a commitment to hold oneself responsible for how one tries to influence other people's learning and acknowledging that one is part of the world connected with other people in an endeavor to undertake enquiries with others (McNiff, 2017). Thus, acknowledging and reflecting upon the transformative potential of participatory research becomes a necessity. There will always be issues of hierarchies and dependencies between participants in an interventionist research project even if the principle of symmetry is a highly-held value. This includes dependencies and hierarchies between university-based

researchers and teachers, between researching teachers and other teacher colleagues, and between researching teachers and students.

For the different actors there are different issues at stake in participatory research that will need negotiation regardless of the configuration of the actors. For example, assessment will be at stake in an intervention for students and teachers. For any interventionist study in a natural setting the question of assessment requires ethical reflection. Teachers have obligations in relation to the assessment and grading of students, whereas researchers will not necessarily, for example, prioritise questions of assessment in the design of an intervention targeting student learning. For science teachers, the science content may also be at stake if the research intends to challenge established practice. This was very much the case in Wiblom's PhD project. For a teacher-researcher participating in a PhD program, one issue will be about maintaining working relationships with colleagues and students in the school beyond the PhD program and, not least, making sure sufficient data is produced to write up a thesis. For a university-based researcher there are similar issues at stake — for example, issues relating to expectations of publication.

8.5.2 Epistemological values

The epistemological values assume that knowledge is uncertain and ambiguous; created through dialogue with one another (McNiff, 2017). In particular, the question of validity of the results of a specific study is a question about what counts as data and what data will be sufficient for making an epistemological claim.

The second case illustrates how participatory research may involve epistemological tensions including researchers, teachers, students, and parents. Using participatory research methodologies to transition from a Vision I of science education in terms of mastering a set of concepts and educating professional scientists to a Vision II of science education as a citizenship education may be challenging both in terms of design of teaching and assessment practices (Roberts & Bybee, 2014). Epistemological tensions revealed through participatory research may be difficult but of fundamental importance to negotiate in that the tensions may correspond to objectives of transforming education practice by means of research. In the second case, the research object had to do with developing students' capacities for critical scrutiny and ethical examination of science in media through science education. The research was premised by an objective of transforming educational practice in line with a conceptualisation of science education within Vision II. Thus, it would have been valuable to have stated the epistemological assumption of what may count as biology in order to open up for dialogue with the participating teachers, students and parents. Unless some shared sense of epistemology is negotiated it is difficult to imagine how symmetry and a shared object of research might be established at all.

8.5.3 Methodological values

A transformative orientation to knowledge creation is foundational to participatory research (cf. Bradbury Huang, 2010). This includes a commitment to transforming, improving local science teaching practices, and to transforming and expanding the professional knowledge base of the teaching profession. Traditionally, important methodological considerations have included informed consent, confidentiality, and protection of participant integrity. Participatory research becomes even more delicate.

The research is embedded in social practice with social relations of dependency and loyalty between participants and different issues are at stake for participants in different positions. When it comes to the question of informed consent, reflection is required on the conditions under which consent is provided: what are the power-relations at play and how can

such power relations be managed to minimize damage to the participating students and teachers? When it comes to the question of confidentiality and integrity there are delicate issues of how to deal with richness of data and, for example, what to do with information about abusive behavior.

Finally, participatory research also requires ethical reflection on anonymity versus credit. If research interventions are designed and conducted in teams of university-based researchers and school-based teachers, it becomes problematic from an ethical point of view if only the university-based researcher is credited in the publications that stem from the intervention.

8.5.4 A heuristic for ethical reflection on participatory research

Based on the principle of symmetry as proposed by Sensevy *et al* (2013) and our experiences of conducting participatory research in science education, we propose a heuristic for ethical reflection on participatory science education research expanding the principle of symmetry in the dimensions of ontology, epistemology, and methodology (see Figure 1). To function as a device for ethical reflection on the value commitments at play in participatory science education research, we have formulated reflective questions in relation to the dimensions of ontology, epistemology and methodology. The ontological values demanding reflection includes holding oneself responsible for how one tries to influence other people's learning in relation to acknowledging the embeddedness of research in social practice as well as acknowledging the values at stake for participants in different positions. This ontological reflection will be as relevant for a university-based researcher collaborating with an experienced teacher as for a teacher taking on both the roles of researcher and teacher in her own classroom practice. The epistemological values demanding reflection concerns what is required to make epistemological claims. Central aspects to the epistemological reflection concerns the negotiation of a shared (valid) research object as well as shared objectives or visions for science education. In this chapter we have provided examples of how such negotiations might be challenging. The methodological values demanding reflection concerns the social relations of dependency between researchers, teachers, students, parents and others, questions of what to use as data (and what not to use), how data should be analysed and interpreted but also how to reconcile potentially contradictory values of a symmetric relationship in relation to ownership of the outcomes of the research and requirements from conventional ethical standards of integrity and anonymity.

Figure 1: A heuristic for ethical reflection in participatory science education research

8.5.6 Concluding remark

Engaging in ethical reflection on our work has provided us with opportunities for becoming more responsible about how we conduct research. We hope that sharing our shortcomings and reflections with a wider audience will contribute to making science education research more responsive to the tensions of values that will inevitably be part of any research process.

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