

EXPERIENCES AND THEIR ROLE IN SCIENCE EDUCATION

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Abstract. *This study focuses what role re-actualized experiences may have in a school science setting. Observations were done in two Swedish schools with emphasis on teacher centred lessons. Data consist of field notes, recordings and documents. Two major themes of the results can be highlighted. First, the teachers' and pupils' mutual interest in pupils' re-actualized experiences. Second, the limited elaboration of those. These issues are discussed due to teachers' work with different purposes. We call that teachers' orchestration of multiple agendas in science education. Re-actualized experiences appear to become means for motivating pupils in their work with different tasks in order to make them cope.*

Key words: *experience, learning science, science education.*

Introduction

The research interest in this text deals with how we talk and act in school science. The features of school science that we aim at do not only include certain tasks and habits but also a particular language and special tools as well as documents, pictures and symbols used for certain purposes. Wenger (1998) uses the phrase “community of practice”, implying a framework in which for example certain issues are tacit while others are expressed. What makes the science classroom a community of practice is the ongoing activity to reach shared goals. The particular language of school science is here seen as a part of the school science language game, which constitutes our frame for analysis. A meaning of a word is, according to Wittgenstein (1969/1992), one of its applications, which is framed by the language game. In different language games, different meanings of a word might be construed. A word that is used inappropriately falls outside the scope of the language game and the statement might seem meaningless. However, language games change and so do their concepts and meanings.

Science education might stand out as a very special language game when introducing pupils to science. For example Delamont, Beynon and Atkinson (1988) report on students' first encounter with laboratory science in secondary school. They show how school science can be introduced to students and how it can be represented. In their study, school science was pointed out as an “esoteric domain of experience which dealt with dangerous objects and substances“ (p. 325). Their example can be said to show some features of a science classroom and the introduction of science in secondary school. The features they bring about as well as those we intend to bring about are not to be seen as valid for every science classroom, yet they can describe school science to some extent. These issues that Delamont et al address, imply an ambiguity of school science. That ambiguity is based on school science as esoteric (dangerous and different) and at the same time referring to the mundane (based on anyone's everyday experience). Bergqvist (1990) describes how students are asked to pose questions in order to answer them on their own. The purpose of that task was that the students would understand a phenomenon when having found the answers with the help of laboratory equipment. Bergqvist questions the usefulness of such inductive learning and points out that students have difficulties posing relevant questions when not being familiar with the context. Schoultz (2000) discusses the use of so-called “everyday questions” for testing scientific knowledge. The pupils in his study had difficulties in using scientific knowledge to answer the questions, because it is not obvious that pupils apprehend the science content in an everyday question, he

claims. In that case, as well as Bergqvist's example, the problem can be seen as a difficulty in knowing the proper context of the question. Schoultz argues that a question in an everyday context naturally gets an everyday answer. According to Szybek (2002), that would be signs of the everyday stage of events, in contrast to the science stage of events. Bergqvist (1990) gives another example when she shows how a teacher compared a scientific phenomenon with another phenomenon with similar features from children's everyday context. She shows how difficult it was for the pupils to grasp meaning of the comparison. Making such a comparison could be one way of changing stages. Szybek (2002) talks about making translations between the everyday stage and the science stage of events. But a translation of for example an everyday difficulty into a scientific problem implies a second translation, according to Szybek. The second translation serves as a re-translation of the solution, making it a remedy of the original everyday difficulty, he continues. The two translations are features of the school science stage of events. The need for dealing with the everyday difficulty in a scientific way becomes apparent if the solution shows to be a relevant remedy of the original difficulty, that is, the advantage of the science stage of events becomes clear.

Pupils are expected to participate in the language game despite difficulties of for example different stages of events. In a community of practice, such as the one studied here, the participants form a heterogeneous group whose community is co-constructed by different ways to participate. The most obvious ways to participate can, in this case, be seen if looking at the teachers' expert way of participating and the pupils' apprentice way of participating. The teacher plays a crucial role in the reconstruction of the community. Mercer (1995) mentions that one of the teacher's intentions can be to guide the learning activity. There are certain techniques for such guidance. Teachers might for example "elicit relevant knowledge from students" (p. 25) or give students feedback in order to generalize meanings. He also emphasizes teachers' descriptions of classroom experiences to create a joint experience of educationally important features of the activity.

Our point of departure is that differences of meaning making between school science and pupils' lives in general terms can involve difficulties (Bergqvist, 1990; Schoultz, 2000; Szybek, 2002) for pupils. The issue we intend to study is how pupils' previous experiences, originating for example in everyday contexts, might come to function and have meaning in a science classroom, despite of difficulties. We regard previous experiences as something we cannot observe or study directly. Rorty (1991) considers habits and actions for coping with reality and calls that an anti-representationalist account. That is, experiences can be considered in our habits and actions. We interpret actions for coping with reality in a broad sense, also including utterances (According to Wittgenstein 1953/1992, p. 169). Our concern is consequently to study accounts of experiences, that is, the way of talking about previous experiences. However, accounts of experiences appear in situations when new experiences are made and therefore we find it appropriate to talk about re-actualized experiences (Östman, 2003). Thus, a re-actualized experience is situated but brings about continuity with the past at the same time. The concept of re-actualized experiences includes different previous experiences, despite their origin.

In focus for this study are the re-actualized experiences and the tensions that might occur between for example the personal experience and the shared activity. The role that the specific re-actualized experience gets is due to the language game as well as our habits connected to that situation. In some situations, different ways of acting or even different habits may be incompatible. Multiple purposes of the activity might explain some tensions between different ways to act. We will refer to such different conceivable courses of actions as to different agendas. The research interest is summed up in the following research questions.

- What role may re-actualized experiences have in a school science setting?

- What is the impact of different agendas on re-actualized experiences?

Research methodology

To learn about the role of pupils' re-actualized experiences, observations were done in four classes in two Swedish schools. In one school (school A), the pupils were 11 – 12 years old (school year 5-6) and in the other (school B) they were 13 years old (school year 7). The classes at each school were studied with their teachers. The classes were chosen because of their interest in participating in the study. The two classes of school A each had one class teacher in most subjects but now forming a number of mixed small groups. The pupils of school B were divided into two groups taught by two different teachers. In both cases the theme of lessons dealt with physics.

Data collections were made similarly at the schools, nevertheless data is complementary to some extent. The data from school A consists of field notes and documents (teachers' planning, pupils' documentation & students' textbooks) and less audio recordings (no video), whereas data from school B consists of video recordings (10 hours) to a greater extent. The teachers occasionally commented the presence of the video camera in the first lessons but not the pupils. All recordings concerned teacher centred lessons. Recordings were transcribed and the excerpts are our translations from Swedish to English. The transcriptions were studied several times until the relevant parts where re-actualized experiences are prominent were found. Next, the selected parts were analyzed as samples of a language game (Wittgenstein, 1953/1992). In some cases we also have made use of Wickman's and Östman's (2002) operationalization of language games as it provides means for an in detail analysis of the language game. Utterances can be immediately intelligible, or put in other words, directly meaningful to the participants in the conversation, they claim. Such utterances stand fast. Relations can be made between meanings that are standing fast in two different ways, implying a difference or a resemblance. Until a relation is established, it is possible to talk about a gap. A gap that is not filled with a relation lingers. As a language game goes on, an increasing number of relations is established. The change in talk and action can be regarded as learning.

Research results

We will here present the role of re-actualized experiences in two science classrooms. We will also show how re-actualized experiences are acted upon due to different agendas. The results are attributed to different sections that should not be seen as exclusive categories but instead as a way of highlighting features of the findings. The results of the two research questions are presented integrated and continuously.

Re-actualized experiences as a foundation

Call for experiences are prominent in science textbooks. The idea seems to be to found-in pupils' experiences into the topic. The following example comes from the textbook of school A. "Have you had to step into a car that has been too long in the sun a summer day? In that case you know, that it is even warmer inside the car than outside." (Rydstedt, 1990, p. 48) The example seems to be designed to call for pupils' experiences of hot cars. An agenda of considering pupils' experiences and interests can explain the approach of the textbook. One reason for founding-in experiences into the topic might be to facilitate the following discussion on the subject matter.

When the teachers (school A) planned the lessons, pupils' previous experiences were emphasized, for example, they claimed, "It comes natural for them (the pupils) to deal with thoughts & ideas that they have in their surroundings." In the teachers' assignments to pupils' it is also

possible to see that experiences indeed were included. The pupils were given an assignment to discuss a number of questions and in co-operation make a mind-map. The pupils used neither textbooks nor other media to answer the questions, according to the teachers' instructions. Consequently, we regard such assignments as ways of re-actualizing experiences and make an inventory that forms a *common* foundation for the following lesson.

Re-actualization of experiences made to a school task

In school A there were also other occasions when questions were dealt with. In those occasions the questions seemed to be used as an individual introductory task. When the pupils had formulated questions, they were asked to write what they believed were the answers. The pupils sometimes referred to the task as writing hypotheses to the already made questions, sometimes they talked about expressing their belief about the answer to a question. However, the task of writing one's belief can be described as a way of re-actualizing experiences due to the question. One question was: "Why can't we see at night". The belief was expressed: "It is too dark". As a third step, the pupils were supposed to answer the questions by means of various information sources (Internet, textbooks or with help from the teacher) and at that point the inductive feature of the task becomes clear. To the above question the pupil's final answer was: "Human eyes are not made for night". We regard the task a way to promote the re-actualization of experiences. Writing 'what you believe' about an issue sometimes appeared to be a very difficult task. We could see that at times when pupils expressed that they perceived a lack of relevant experiences. Under such circumstances it can be hard to grasp meaning of a task. There appeared to be a tension between the task and pupils' perceived lack of relevant experiences. Below is an example of what one group of pupils expressed as a hypothesis (as a statement of what they believed was the answer to their own question). The "hypothesis" dealt with the visibility of different kinds of light. "We believe that you can see laser and X-rays but not infra- or UV-light" (school A). The pupils' statement could only be based on previous experiences and was never explored with any equipment. Looking from a teacher's perspective, the task of re-actualizing experiences completed the questions to be more than a task to find answers. That is, writing 'what you believe' implies guessing, trying to remember – activities that can be seen as a task to establish relations between a previous experience and issues at stake in the questions. The agenda of promoting pupils' awareness of experiences, that is, re-actualizing experiences appears in connection to the task of writing so called hypotheses.

Experiences as means for making pupils participate

Teachers might pursue the dialogue; try to make students participate in a new topic, which is the case in the following conversation.

- | | |
|----------|----------------------------------|
| Teacher: | when do you use electricity? |
| Pupil: | E:h if listening to music maybe? |
| Teacher: | ye: |
| Pupil: | watching TV or something? |
| Teacher: | yes (2 s) more occasions? |

- Pupil: put on the lights so it wont be (dark).
- Teacher: okay ye ((The teacher points at the lamps in the ceiling. Another pupil enters the classroom. The lesson continues in a moment.)) put on the lights (.) yes for how long have we been able to do that do you think - in our houses?
- Pupil: ((inaudible))
- Teacher: what?
- Pupil: ((inaudible))
- Teacher: a:h no it wasn't Einstein who invented it (.) it was some other also famous person - somebody know his name?
- Pupil: e (5 s)
- Teacher: what was his name? ((The teacher makes a circular movement with his/her fingers and looks at the pupil.))
- Pupil: edison.
- Teacher: edison yes (.) from what country did he come?

(School B)

In the previous dialogue the teacher went on asking for more occasions when electricity is used, until the use of electricity was related to “bulb”. At that point, the teacher turned around the dialogue and a new row of questions started. The questions went on until the inventor of the bulb was mentioned. The language game here seems to provide means for the teacher to guide the topic towards a specific point, the inventor of the bulb. Accordingly the re-actualized experiences seem to play an important role in the guidance of topic to the point where the inventor of the bulb was mentioned. Later on, the teacher and the pupils watched a video film about Edison and his invention. The example can be said to show how teachers can deal with two agendas at the same time. One of the agendas can be described as a consideration of pupils’ experiences and interests and the other as implementing a historical perspective in science education. We can see that many things are attempted to be included in this dialogue and all of those are not directly connected to experiences of electricity. In this last case the re-actualized experiences are means for reaching a topic that might be important from a teacher’s perspective. If not accounting the guidance of topic to the specific point, the approach still comprises questions for experiences. The teacher’s approach to experiences can consequently anyway be regarded as means to make pupils participate with for example everyday observations.

Re-actualized experiences to show what is relevant in different situations

Re-actualized experiences can be used by the teacher to show what is relevant in the specific situation. In the previous excerpt only some utterances were fully picked up by the teacher. Although pupils’ experiences were asked for, they were not elaborated. We can for example see how a “ye:” makes a brief response to the first proposition in order to give room for other suggestions

concerning when electricity is used, that potentially could be even more relevant. Another example when the teacher seemed to show what is relevant can be seen in the next excerpt.

Teacher: where do you usually connect batteries in series (3 s) ((points at a pupil))
Pupil 1: torch
Teacher: torch ((nominates another pupil))
Pupil 2: (walkman)
Teacher: yes (3 s) and other similar appliances, if you have some other =
Pupil 3: =in computers ((inaudible))
Teacher: eh no (.) well e:h you could have ((the teacher continues to discuss power supply systems for computers))

(School B)

The example shows how the pupil answered the teacher. The teacher though seemed not fully satisfied with the answer, because he/she turned to another pupil, who gave a similar reply when saying walkman. At that point the teacher broadened the meaning of the words to include all similar appliances. By doing such generalization no further similar answers became relevant in the changed context. We regard this last action as a way to guide the topic in an appropriate way, turning focus to relevant applications. We would like to point at two agendas in the excerpt, where the first deals with clarifying the everyday relevance of science and the second deals with time and the progress of lessons towards other content areas. The already mentioned generalization could be seen as a tool for such efficiency.

Pupils' attempts to fit their experiences into conversation

It seems clear that experiences become relevant and acted upon not only due to teachers' initiatives alone. Of course the results reported here should not be seen as valid for every pupil. Indeed, in the observed classes pupils' own initiatives originated from a minority of pupils. However, situations where pupils asked for the teacher's confirmation of the relevance of a previous experience are prominent. In the next excerpt the class was going to construct a battery. A liquid was required.

Teacher: Okay (.) e: h this is called a e:h tray (.) it is not very interesting but e:h a small beaker ((shows a tray)) that you can have a fluid in (.) for example water (.) we are going to have something else in it (2 s)
Pupil: soap
Teacher: tada (3 s) ((shows a bottle with a fluid in it)) sal-ammoniac ((stressed)) it is called ((opens the bottle slowly))
Pupil: it tastes good. (2 s)
Teacher: it is like this (.) one thing to keep in mind if you get it on your clothes (.) it will become stains from it and I believe it is not particularly corrosive but try to avoid getting it on your fingers and and wash your hands after your laboratory work please ((pours the fluid into the tray))=
Pupil: =is it dangerous?
Teacher: no not dangerous but you should always be careful with these kind of things I believe.
Pupil: can you drink?
Teacher: no: you shouldn't do that (.) so ((puts the cork onto the bottle))

(School B)

The phrase “It tastes good” is here seen as a re-actualized experience. The phrase seemed to stand fast (Wickman & Östman, 2002) in the language game because the teacher went on explaining how the fluid should be taken care of. A gap can be seen when the pupil asked for guidance by asking if the fluid is dangerous. The gap appears not to be filled because the teacher replied that you should be careful with those kind of things and it can hardly taste good at the same time. The lingering gap is supported by the pupil’s utterance in the last line where the issue was brought up again. Accordingly, the new question seemed to concern not only the suggested cautiousness due to the fluid but in connection to its good taste. We see how the teacher describes the fluid as dangerous with very few words: “not particularly corrosive but try to avoid ...” and “you should always be careful ...” The teacher finally replied that you should not drink it. The gap was still lingering, there was no relation established between “It tastes good” and the utterance, implying that you should not drink it. We regard the lingering gap an indication of a dual set of relevant agendas, here referred to as a safety agenda and an agenda of building classroom talk on pupils’ experiences. In this case the safety agenda seem to be superior. What also could be pointed at in the excerpt are the consequences of the pupil’s second turn (“it tastes good”). The latter is seen in the teacher’s following focus on safety. The pupil’s re-actualized experience can be said to make the safety agenda relevant.

In some cases the re-actualized experience that were attempted to fit into the conversation concerned the probable consequences of a certain action. The following excerpt refers to a demonstration of using different materials in a wire that was used as a conductor. The teacher showed how the electric current passes through a circuit containing a metal wire, a bulb and a battery. The excerpt begins with a pupil making a comment about what would happen if ...

Pupil: what happens then?
Teacher: e:h it ((the wire)) can become so warm that you might get burnt (.) but when we got such a small battery nothing happens.
Pupil: no, but if we connect a car battery?
Teacher: yes then you could=
(School B)

The phrases “get burnt” and “small battery” seemed to stand fast in the conversation. The re-actualized experience is seen when the pupil proposed connecting a “car battery”. The teacher’s “Yes” implies that “car battery” also stood fast. The re-actualized experience seems to concern car batteries as powerful batteries compared to those in the classroom. The pupil’s utterance also implies a gap between “get burnt” and “car battery”. The gap was filled with a relation when the teacher confirmed the similarity between the two utterances. In this excerpt, as well as the previous, it is again possible to talk about a tension between two agendas. Described from a teacher’s perspective those agendas can be referred to as considering safety on one hand and attend to pupils’ excitement of risks, on the other.

Discussion and implications

Before summarizing and making comments on the results we will briefly discuss some methodological issues. When dealing with what is said and done as a research interest, the data collection could preferably have been concentrated to recordings to greater extent. Since not only speech-acts are in focus, an emphasis on video recordings would have been appropriate. Maybe such changes could have brought even further. Our thoughts about developing the methods for a follow-

up also include a focus on one particular school subject field in the data collection. Such focus implies a uniting framework between different classes that might facilitate a deeper analysis.

The results of this study indicate a difference, compared to what Bergqvist (1990) reports on students posing questions. Here the immediate concern neither seemed to be inductive learning nor to find any correct answers, as in Bergqvist's study. Instead the task including writing questions and formulation of so called hypotheses promoted the re-actualization of experiences. The task connects the classroom activity to pupils' previous experiences. The ways of dealing with re-actualized experiences seem to have been appropriated in a way that a limited elaboration has become sufficient. Expressed in other words, we could say that an agenda concerning time and the progress of lessons towards other content areas, sometimes become crucial. In other cases an agenda of considering safety becomes crucial. Although time seem to be at stake, it has to be stressed that re-actualized experiences might become relevant in a not necessarily expected way. For example, we can say that the teacher's reply to "it tastes good" could be a consequence of the pupil's statement, even though the teacher's answer does not fill the gap we earlier described. To some extent, especially if looking at re-actualized experiences in relation to school tasks involving use of hypotheses, the dealing with re-actualized experiences can be seen as a social function connected to the accomplishment of lessons rather than material for shared elaboration. The results are in line with Mercer (1995) who points at the accomplishment rather than providing the potential material for shared elaboration. The teacher for example broadens the meaning of pupils' utterances (see heading 3.4) which correspond to what Mercer describes as students' getting feedback in order to generalize meanings. Here, again we can refer to an agenda concerning the progress of lessons. We have also mentioned an agenda of safety in contrast to an agenda considering pupils' excitement of risks. Teachers' orchestrations of agendas seem to be quite a task. The orchestration can be ambiguous, managing for example tensions between a historical agenda and the importance of considering pupils' interests as another agenda. It remains for further research to see whether it could be worthwhile to make different agendas explicit to pupils, that is extending the talk about different purposes of science education, for example by talking about the importance of historical perspectives in science education.

We have earlier referred to issues concerning different ways of relating to the world (Szybek, 2002) and translations between the different stages of events. Looking at the pupils' attempts to fit experiences into conversation, it seems that such translations are asked for in science classroom (see heading 3.5). We regard re-actualized experiences as suitable occasions for such linking. There might also be a possibility for teachers to take advantage of re-actualized experiences in an extended way. If school science can be seen as an esoteric domain (see Delamont et al, 1988), taking advantage of re-actualized experiences in an extended way might be a way of bridging the esoteric and the mundane.

We would like to sum up two major themes that have emerged in this study. First, accounts of experiences became relevant due to teachers' as well as pupils' initiatives. That is, teacher as well as students both contribute to the construction of their schoolwork. The second theme we would like to point at concerns the interest in experiences, but in connection to a limited elaboration. We can see that pupils might benefit from additional ways of dealing with re-actualized experiences, in addition to those already presented. Re-actualized experiences seem to become means for the accomplishment of lessons rather than ideas for elaboration. Here we have described the role of re-actualized experiences as part of a school task, for making a foundation, used to make pupils participate, to show what is relevant and as an attempt to fit into conversation. It is only possible to speculate on reasons for the features of the language game presented here. What we can see is that multiple agendas are orchestrated in some of the conversations where experiences are re-actualized.

The orchestration involves a consideration of different habits, in connection to the re-actualized experience. The agenda of considering pupils' interest is prominent, as well as the agenda of attending pupils' excitement of for example risks. However, it also seems that the agendas of safety considerations, efficiency of lessons and implementing for example a historical perspective to some extent can be competitive when orchestrated in science education.

Despite ambiguities, we suggest re-actualized experiences could be a source for extending the ways of talking about science issues. That is, not only to found-in re-actualized experiences into the language game but to share new ways of talking about them. The instruments and the outcome of such approaches are issues remaining for further research.

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Резюме

РОЛЬ АКТУАЛИЗИРУЕМОГО ОПЫТА В ЕСТЕСТВЕННОНАУЧНОМ ОБРАЗОВАНИИ

Маттиас Лундин, Матс Линдагл

Роль актуализируемого опыта учащихся в условиях школьного естественнонаучного образования можно охарактеризовать пятью взаимосвязанными чертами: актуализируемый опыт используют для создания основы дальнейшей работы в классе; актуализируемый опыт связывают со школьной задачей; его рассматривают как средство привлечения учащегося к участию или для демонстрации ему того, что охватывает предмет изучения; обращая актуализируемый опыт к самому учащемуся, стараются вовлечь его в беседу; иногда актуализация опыта проводится для того, чтобы вскрыть его возможные последствия или действия. В этой связи можно подчеркнуть полученные результаты двух видов. Во-первых, учителя и учащиеся обнаруживают взаимный интерес к реактуализируемому опыту. Во-вторых, тема этого опыта пока ограниченно разработана. Две этих

проблемы объясняются тем, что учителя работают с различными целями (мы называем это учительской оркестровкой множественных повесток дня). Таким образом, реактуализируемый опыт начинает становиться средством мотивации учащихся в их успеваемости.

Ключевые слова: опыт, изучение естествознания, естественнонаучное образование.

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