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# **AIM: TO PRACTISE SCIENTIFIC METHODS. RESULT: PERSONAL DEVELOPMENT.**

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*Abstract:* Field work in a teacher training program was focussed on the collection and presentation of data showing changes in the environment depending on variable factors. The observations should be possible to use as models for studies performed by children at school. The instructions were sparse and many of the observations from the first visit to the sites were impossible to repeat. The first four observations were made during autumn every month while the last was made in late spring sixteen months later. After this the students wrote short reflections on their impressions and experiences during the last visit compared to the earlier ones. These were analysed in order to reveal the impact on the students. Most of the students were very uncertain about what to do the first time. Almost none of them complained about this afterwards. Many were astonished over their own incapability of understanding or declared their lack of understanding general ideas. Many students wrote about strong emotions when returning to a familiar site that appeared to have changed and described how this created a strong attachment to the site. What was more surprising was that some students experienced their own development, in some cases towards becoming a teacher but also on a more private or personal level. They not only recognized themselves as the inexperienced student from the first visit and what was achieved later. They also realized how the relation between themselves and the site had a chronological development in accordance with their own development. The simple activity of field observations in combination with personal reflection created complicated processes beneficial for the student.

Thus, we achieved and observed unexpected results together with what was expected.

*Keywords:* personal development, fieldwork, teacher education

## **INTRODUCTION**

Teaching is rarely based on creativity rather than distribution of facts although knowledge is not merely cumulative but qualitatively transformational (Alters & Nelson 2002).

Learning and personal development are basic processes related to teaching and educational institutions. This is obvious for everybody who is working as educator in teacher training programs or other kinds of professional schooling, especially for those designing new learning situations adapted to new situations.

At Södertörn University there has been a process of development of courses in science within several educational programs since 2002. Theoretical fundamentals of this together with important observations, promoted a plan for development of

adequate pedagogic activities. This has briefly been described earlier for courses in evolutionary biology (Mattsson & Lättman 2004).

Out of our experiences as teachers of becoming teachers in the current pedagogic context we will here discuss some fundamentals of these processes and how they may be beneficial for students based on results of the visible learning of teacher students during a field course of less than 40 hours duration spread out over a time of about 20 months.

## BACKGROUND

Within a teacher training program one semester of 20 weeks, was focussed on all school subjects with the exception of language and mathematics. The students were trained to become teachers in primary school; years 1–6, where they are supposed to teach most theoretical subjects. An integrated approach was used all through the course with close connections between the core subject content and didactics as well as between the different subjects. The academic teachers participating in this course represented biology, chemistry, natural and human geography, history, and religion. The course included, in addition to traditional lectures and seminars, one long excursion in southern Sweden during one week and several shorter excursions, museum visits, laboratory experiments, and field work.

The aim of fieldwork training for students becoming teachers in primary school is to give them useful didactic tools. The knowledge requirements in the Swedish curriculum (Skolverket 2010) for grade E, which is the lowest requirement to pass, at the end of year 6 includes skills how to

“carry out simple studies based on given plans and also **contribute to formulating** simple questions and planning which can be systematically developed. In their work, pupils use equipment in a safe and **basically functional** way. Pupils can compare their own results with those of others and apply **simple** reasoning about similarities and differences and what these may be related to, and also **contribute to making proposals** that can improve the study.”

One part of the core content of, e.g., biology includes the methods and ways of working in biology including

”• Simple field studies and experiments. Planning, execution and evaluation.”

If we look at the aims of science in the curriculum one of them is to

”• carry out systematic studies in biology/physics/chemistry”.

These three types of factors have to be considered when planning learning situations in the compulsory school as well as in teacher training programs. In this case, based on the mentioned knowledge requirements, the core content, and the aims a field course for teacher students was designed with a simple structure. The primary instructions were: make observations of your own choice on specified sites once every month for four months and return 16 months later for final observations, assemble the results and write a short reflection of your learning and development during this time. Some fifteen students were primarily working together on the same site but usually they divided themselves into three subgroups of about five person size.

The field work was based on the collection and the presentation of data showing changes in the environment depending on variable factors. The observations made by the students should be possible to use as models for studies performed by children at school. During the field work the students should register observations of their own choice and present the results at the end of the course. The instructions given to the students were sparse and many of the observations from the first visit to the sites were impossible to repeat due to changed weather conditions or because of the development of the specimens studied.

The area was visited and studied at several occasions. The first four observations were made from late summer to midwinter every month while the last was made in late spring sixteen months after the last previous observation during another course. This latter course also had an integrated perspective but with chronologies as the main theme, mainly within history but also evolutionary perspectives in biology and cosmological perspectives in physics were included. In this context the field study in itself was a good example of a short chronology compared to those in the other subjects.

After this last visit the students wrote short personal reflections on their impressions regarding their study focussed on experiences during the last visit compared to the earlier ones.

## **THEORETICAL FRAMEWORK**

Teaching shall encourage transformation of the chaos of impressions to personally integrated communicable knowledge (Mattsson & Lättman 2004). It may be achieved by created disorder resettled to knowledge (Bruner & Postman 1973), was used in alphabetisation programs (Freire 1972, 1975) and is augmented by reflective relationships in inquiries of the students' experiences (Doll 1993). Processes and time are interrelated and it is not possible to describe a process without time and vice versa (Prigogine 1997). Here the chaotic situation was created by the absence of specific guidelines or instructions before the first visit to the study site. The students were not even introduced to scientific methods, observations, documentation, or what could be convenient study objects.

In order to make this process of transformation from the chaos of impressions to personally integrated communicable knowledge, successful reflection is a useful tool (Freire 1972). It helps the student to be aware of the gap between where she were at the start of the study and where she is now. At the start the level of knowledge normally is very low and the goal at the end, personally integrated communicable knowledge very distant. The gap between the state of being in the beginning and what should be achieved at the end may be diminished by feedback (Ramaprasad 1983). In this case we let time run its course between the observations and only participated in a presentation of the results of four months observations. A reflection of the students after a final visit more than one year later may act as a help for the students to realise the closure of the gap by (a) understanding the goal they are aiming at, (b) they can compare their actual level of performance with the goal, and (c) understand that they have been engaged in actions which have closed the gap. Sadler (1987, p. 121) describes this process in active terms and we wanted to test if it was possible to achieve similar results by a reflective process.

## METHODS

The reflections, from three different classes of students (n=131) from different years, were analysed in order to reveal the learning outcome of the field observations and the students understanding of systematic observations, repeated data collection, and didactic gains.

The analyses were primarily based on the students own mentioning of the learning outcome but we also tried to assess the quality of their reflections. In this case we used the four R's of Doll (1993), *richness*, *recursion*, *relations*, and *rigor* to assess the quality of their reflections. If the reflections had some quality based on these criteria, showing understanding of the specific aspects, we regarded this as an understanding of and skills in, e. g, how to make observations or use scientific methods. In addition, the students' own use of the four R's when reflecting, was assessed in order to see if they used these criteria although we never had used them earlier in their courses.

## RESULT

The analyses of the written reflections after the last visit to the site of the fieldwork training showed that a large part (67%) of the students had increased their knowledge of processes in nature, although a lower number showed accurate knowledge about how to make observation (55%) or how to use scientific methods (37%). In addition, 60% of the students could make reflections on, and assessments of, their professional development becoming a teacher (Table 1).

Table 1

*The learning outcome of the different aspects of the student's fieldwork. Percentage of students presenting qualified understanding of the different aspects. (Figures refer to citations of students in the text.)*

N	Observation (1)	Scientific method (2)	Process (3)	Personal development (4)	Professional development (5)
131	55%	37%	67%	27%	60%

We also found, which was more surprising concerning the type of the training, a fairly high number (27%) of students experienced development on a more private and personal level. They not only recognised themselves as inexperienced at the first visit but lights the skills achieved later. They also realised how the relation more or less personal relation between themselves and the site gave scientific development in accordance with their own development. The simple activity of field observations in combination with personal reflection created complicated processes beneficial for the student. We also found that some student used the four R's when they reflected over their own experience (Table 2).

Table 2.

*Percentage of students using any of the same four criteria for their own reflection as those we used for the assessment of their reflections.*

N	Richness	Recursion	Relations	Rigor	Use of any	Use of all four
131	27%	21%	18%	17%	31%	11%

These results may show that a number of visits to a site of field work during a short time (four months) together with a last visit after a long period (more than one year) and combined with reflections may cause personal development on many levels.

The average learning outcome concerning observation, scientific methods and processes was shown by a majority of the students (53%). Most also described how they had developed professionally. In addition we also found personal development (27%) and good quality reflections based on one or more of explicit criteria (31%).

Here we present a couple of examples of the reflections. The numbers refer to the figures of learning outcomes in Table 1. The first is focused on the field work:

“I realized that it is possible to have subject matter integration in school depending of what you observe (1) and the theme for the study. [...] At the first visit I didn’t understand the aims [...] but it was interesting to observe and compare with earlier visits to find recognizable patterns (3) or if the observations deviated from the expectations (2).”

The second deals both with the field work and more personal reflections:

“From the beginning I had a negative attitude and didn’t understand the aims but now I have got a better understanding for the use of field studies at school (2, 3). [...] Especially, I have become more critical to my own teaching activities and draw conclusions out of them. I have assessed my learning and the result of excursions with students at school. What did work? What did not? How could I do otherwise? (5)”

Finally we have an example of personal development:

“Now and then I got a feeling of not being in the same forest or the same mountain where I’ve been before. I could not observe the same plants and animals as before. It was a cool and funny feeling to experience when I focused on a number of observations and compared them over time. After performing these field studies several times during different seasons I am aware of my development and have got plenty of inspiration. I have learnt enormously by going out in the field and work, observe and measure (4).“

## **DISCUSSION**

We have analyzed the thoughts of teacher students concerning their own scientific, professional and personal development over about 20 months but related to single sites with repeated visits.

The result of the analysis show several interesting observations and reflections of impressions. Most of the students had been very uncertain about what to do when they

were at their observation site the first time, although they were accompanied by a teacher. Some were extremely distressed and asked for strict directions about what they should observe. Almost none of these students complained afterwards of not being properly directed. Instead many of them revealed astonishment over their own incapability to understand what they should have done from the beginning. Others declared their earlier lack of their own understanding of general ideas. For example, all observations should be made according to strict protocol, under similar conditions like the same hour of the day etc.

Other examples of reflections are shown in Figure 1.



*Figure 1.* Examples of different types of reflections. 1) Observation, 2) Scientific method, 3) Processes, 4) Personal development, and 5) Professional development.

Some were also surprised over their own inability to predict the consequence of the coming winter on the number of song birds or flowers. Most of these experiences were similar to those which may be expected when children do similar studies. We had predicted some impressions of the impact of returning to a place at a different season. Many students wrote about strong emotions when returning to a familiar site which now appeared so different. The impression created a strong attachment to the site and made some of them feeling being an important part or owner of the site.

What was more surprising were some students experience of their own development, in some cases towards becoming a teacher but also on a more private or personal level. They not only recognised themselves as the inexperienced student from the first visit and what was achieved later but also how the relation between themselves and the site had a chronological development in accordance with their own. Many declared a deeper understanding of the mission of the teacher combined with insights of what kind of a teacher it was possible to become. Here we can see similarities with the processes described by Freire (1970). We can describe this process of

transformation from the chaos of impressions at the first visit to personally integrated communicable knowledge at the final reflection. The primary event, the first visit to the field site without clear instructions, had a similar function as the “situations” used in culture circles in Latin America in the 1960ties (Freire 1969). It generated a confusion or chaos that later was handled in the group of students and transformed to knowledge.

This study also exemplifies of how it is possible by reflective thinking to visualise the process of diminishing the gap between the earlier low levels of knowledge to the present achieved goal (cf. Ramaprasad 1983, Sadler 1987). The simple activity of field observations in combination with personal reflection created complicated processes beneficial for the student, valuable processes usually difficult to create.

Garet et al. (2001, p. 936) made a point of the importance of focus on duration, collective participation and core features rather than type of activity to improve professional development of teachers. In our material many of the students stressed the importance of collective participation in the field studies both for their own development but also to get new ideas how to plan learning situations.

Sadler (1987) stressed that “the learner has to (a) possess a concept of the *standard* (or goal, or reference level) being aimed for, (b) compare the *actual* (or current) *level of performance* with the standard, and (c) engage in appropriate *action* which leads to some closure of the gap” [...] “between the state of being in the beginning and what should be achieved at the end. The focus is there on the importance of feedback to reach this goal. Here, in our case, the final reflection reveals the process of learning to the student. The learning outcome of this may not be of the same quality as if it is properly designed throughout the learning activities but indicates the possibility of posterior reflection of made experiences in order to enhance the learning in a longer perspective (Freire 1972).

Thus, we have achieved and observed unexpected results together with what was expected. As seen the results show a wide variation in the personal depth of the reflection ranging from uncertainty of the aims of the activities to happiness over achievement of methodological or theoretical understanding. This was expected but what we also found was the development of a deeper understanding of a personal development towards becoming a professional teacher often combined with strong emotions in relation to the study site usually created during the last visit.

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