

A SCHOOL-BASED PROFESSIONAL DEVELOPMENT PROGRAMME FOR SCIENCE TEACHERS: PARTICIPANTS' REPORTS ON PERCEIVED IMPACT OVER TIME

Bodil Svendsen¹ and Peter van Marion¹

¹ Norwegian University of Science and Technology

Abstract: In Norway, as in many other countries, there is a growing interest for school-based approaches to professional development which are sensitive to the context in which teachers work, and which are grounded in a coherent view of teacher learning and teacher professionalism. The present study focuses on how science teachers - who have taken part in a school-based professional development programme, perceive its impact, over time, on the growth of their professional skills and collaboration with colleagues. Science teachers from two schools participated in a one year school-based teacher professional development programme, under the guidance of mentors from the Norwegian University of Science and Technology. Subsequent focus-group interviews of these teachers form the basis of this study. From what teachers report, it seems possible to distinguish two effects of the programme on teacher development. Firstly, a direct effect on the teachers' mode of teaching practice and secondly a more long term effects on the teachers' ways of thinking about teaching science. In addition, we detected an effect on the teachers' attitudes towards collaboration. We discuss this further, paying particular attention to how professional learning communities were formed and to what extent this seems to have contributed to the teachers' professional growth.

Key words: Teacher professional development (TPD), science teachers, school-based, professional learning communities

INTRODUCTION

In the past few years, there has been an increasingly perceived need for a teacher professional development approach that moves beyond mere acquisition of new subject knowledge and skills (Darling-Hammond & McLaughlin, 1995; Hewson, 2007; Vescio, Ross & Adams, 2008). This shift is based on adoption of an expanded view of teacher learning and practice. Teacher professional development is about to become re-conceptualized; with perspective shifts from knowledge to teaching practice, from one-shot trainings to learning that takes place over time, and from individual to collaborative learning (Ball & Cohen, 1999; Bell & Gilbert, 1996; Borko, 2004; Loucks-Horsley, Hewson, Lowe & Stiles, 1998; Marx, Freeman, Krajcik & Blumenfeld, 1997, Putnam & Borko, 2000; Watson & Manning, 2008).

The existence of a marked gap between traditional approaches (which seem to fail to meet the needs of science teachers), and newer approaches, is a view supported by several others authors, such as Bybee and Loucks-Horsley (2000) and Ostermeier, Prenzel and Duit (2010). Tylter (2007) distinguishes between a traditional "skills and knowledge approach" and professional development approaches which are more sensitive to the context in which teachers work, and which are grounded in a coherent view of teacher learning and teacher professionalism. The perspective of a coherent view of teacher learning is also taken by Opfer and Pedder (2011), who based on their comprehensive review of current literature in the field

of teacher professional growth, describe teacher learning as a complex system, involving systems within systems.

Several authors have pointed out the importance of professional development being based on a perspective of situated learning (Borko, Jacobs & Koellner, 2010; Putnam & Borko, 2000; Ostermeier et al., 2010). We speak about situated learning when the teachers' learning and professional development is situated in their own practice, as close as possible to their daily work, their own teaching, their own classes and their own students' learning.

Another important aspect is a shift towards school-based approaches, where teachers in the same school engage in collaborative inquiry; they work in partnerships and support and learn from each other. Teachers working together with a focus on improved learning and teaching, and to generate new professional knowledge, may form what is called professional learning communities (Harris & Jones, 2010). Bolam, McMahon, Stoll, Thomas and Wallace (2005) describe professional learning communities as communities in which teachers in a school and its administrators continuously seek and share learning, and act on their learning. Furthermore, supportive leadership and school management is necessary for professional learning communities to be effective (Robinson, Lloyd & Rowe, 2008).

THE PRESENT STUDY

The Resource Centre for Mathematics, Science and Technology Education at the Norwegian University of Science and Technology has since 2008 been engaged in the development of a one-year school-based professional development programme for science teachers in secondary schools. Our TPD programme is conducted within a set of principles, chosen on the basis of current knowledge on effective teacher professional development, as briefly described above, and on the basis of years of experiences from working with science teachers.

In brief, the programme is based on the following key principles: (i) teachers' learning is situated in their own school and teaching practice; (ii) teachers are stimulated to reflect on and further develop their own teaching practice, rather than being told by external experts that they need to change their practice, (iii) teachers' learning is grounded in collaborative inquiry, and (iv) the professional development programme is externally supported and guided.

RESEARCH QUESTION AND METHOD

In this study our focus is on the impact *over time* of science teacher participation in the school-based professional development programme. The research question explored is "*How do teachers who previously participated in the teacher professional development program perceive the impact over time on their professional growth?*"

The study is conducted within the framework of a qualitative approach - based on fieldwork. Focus-group interviews were performed with science teachers from two schools, who had previously participated in the TPD programme.

The possible main outcomes of this study may simply be illustrated in Table 1. Positive impact is indicated by +, while – indicates that there is no impact.

Table 1

Predictions for possible outcomes of the study.

Possible outcome	Impact reported by teachers at the end of the TPD programme	Impact reported by teachers one year (school 2) and four years (school 1) after the end of the TPD programme
a	-	-
b	+	-
c	+	+

DATA

In this study we conducted focus group interviews with science teachers in two upper secondary schools. School 1 had been involved in the TPD program four years ago, while school 2 participated in the TPD program one year ago. In focus group interviews a number of informants are gathered to discuss various themes or focus` (Wilkinson, 2004, p. 177).

At school 1 we interviewed five teachers, at school 2 seven teachers were interviewed. All of the teachers` who were interviewed, had previously participated in the TPD- programme. The impact of the program was measured at two levels, that of the individual teacher, and that of the school department as a collaborative community. Although some of the teachers also referred to a third level, the school as a community (see Figure 1), this was not focused on in this study.

Table 2

The impact of the TPD programme at teacher level and science department level, as reported by the teachers of school 1 and school 2.

Teachers' reports	School 1		School 2	
	Impact at the end of the TPD programme	Impact four years later	Impact at the end of the TPD programme	Impact one year later
Reported impact on teachers individual teaching practice	+	+	+	+
Reported impact on development of collaborative culture among science teachers	+	+	-	-

Focus groups may generate spontaneous responses. Interaction between members of the group has a community forming aspect (Tjora, 2010, p. 18). This forms the basis for further interaction, socialization and development of standards. Furthermore, informants inspire each other and it is possible to reveal various aspects of the informants' experiences and points of view. The experience of the focus group itself can be a source of new ideas and reflections (Brandth, 1996, p. 149).

Table 3

The impact of the TPD programme as measured at two levels, in school 1 four years after the TPD programme, and in school 2 one year after the TPD programme, as reported by the teachers.

School 1	School 2
<p>Individual teacher</p> <ul style="list-style-type: none"> • Increased knowledge about IBST • Increased interest in literature on natural science • Implemented IBST in practice 	
<p>Community of practice</p> <ul style="list-style-type: none"> • Collaboration in the science department • Shared understanding of IBST 	<p>Community of practice</p> <ul style="list-style-type: none"> • No collaboration in the science department • No shared understanding of IBST

Teachers at both schools report that the TPD programme had an impact on their teaching practice, both as a direct effect on their teaching and as an indirect effect on their thinking about science teaching.

“I know what IBST is all about and I feel more confident about using IBST in my own practice. I've also become more aware of what my colleagues do in their lessons, and this often inspires my teaching as well.” (Teacher at school 1)

“I always try to think whether it is possible to use IBST in the courses I teach. I am more confident with this method now than earlier.” (Teacher at school 2)

According to the teachers, these effects are long-lasting. Several of the teachers pointed out that the TPD programme has a school development aspect: it led to a stronger culture for collaboration among science teachers. At school 1, this effect was clearly visible at the end of the TPD programme and, even after four years. At school 2, such an effect was not clearly visible.

“It is positive that teachers in the science department share a mutual understanding of IBST. This makes it easier to find common solutions to the challenges we need to solve.” (Teacher at school 1)

“We do not have the resources to get organized in such a way that we can focus on learning from each other. The daily tasks of school life give little room for reflection, together with colleagues, unfortunately.” (Teacher at school 2)

DISCUSSION

As mentioned by Bolam et al. (2005) and Harris and Jones (2010), the formation of professional learning communities is believed to play an important part in successful school-based professional development. In our discussion we will therefore pay particular attention to the development of learning communities and to what extent this seems to have contributed to the teachers’ professional growth. In our analysis of the results, we have chosen to divide the school as an institution into three different levels. This is illustrated in the bottom-up expansion model for professional development of teachers (Figure 1), where the individual teacher is in the center. The science department as a learning community is represented by the next level and the outer circle represents the school level.

In our discussion we will focus on the inner and the middle levels. This study was too short to explore the influence of the TPD programme at the third and final level, the school level, as illustrated in the model’s outer circle (Figure 1).

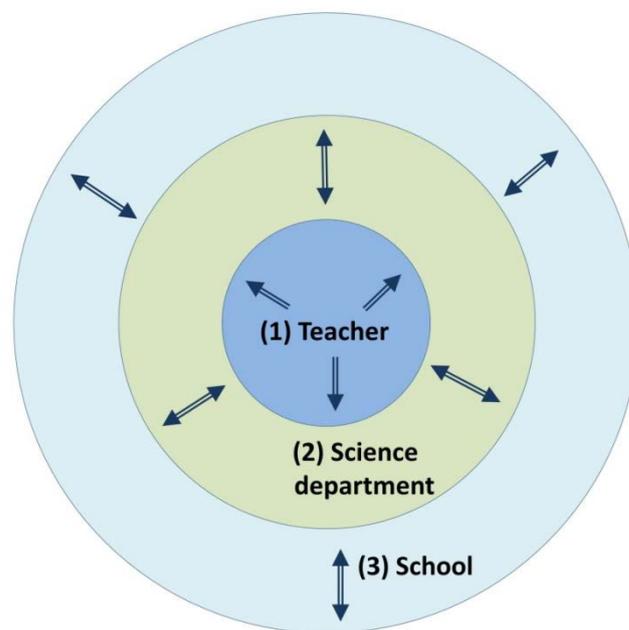


Figure 1. The bottom-up expansion model for professional development of teachers, illustrating different levels in school-based teacher professional development.

Teachers reported that after the TPD-programme, they felt empowered to participate more actively and more autonomously in collaborative activities in the science department at their school.

Empowerment is defined as being able to act autonomously, to participate actively, to take initiatives and to turn change into opportunities. Empowerment cannot be taught, delivered or imported into communities or individuals; it must come through struggle, through breaking out, through surprise, through failing, through trying things out and through taking action. The teachers in this study, in both schools, showed evidence of feeling empowered through the TPD programme. Through a process of empowerment, new structures of communication and collaboration seem to arise as a result of the emerging changed mentalities. From what teachers report this cannot be accomplished through top-down approaches, but rather through a bottom-up approach (see Figure 1). Interviews with teachers indicate that in order to achieve success in professional development, it is essential that the activities are located at the teacher level. This means that if the program is perceived as not relevant in practice, the teachers will be unlikely to adopt new ideas and will not see the value of reflecting on their own practice. Therefore, the inner circle of the bottom-up expansion model for professional development of teachers is of great importance. The study also reveals that if development is introduced successfully at teacher level, it will have implications for the learning community (the science department). The importance of a successful learning community is that it enhances collaborative teacher learning and empowers the teachers even further in a positive feedback loop.

A study by Fielding et al. (2005) shows that teachers expressed the need for mutuality in the continuous professional development (CPD) process and that it is important to see CPD as a learning partnership. The teachers in the study of Fielding et al. (2005) claim that, in order to engage them, and if CPD is to benefit the students, there needs to be content and a closely adapted mode of delivery.

Several authors have pointed to the importance of professional development being based on a perspective of situated learning (see e.g. Borko et al., 2010; Ostermeier et al., 2010; Putnam & Borko, 2000). In our study several teachers emphasized the importance of being in the situation and being able to see direct relevance to their own practical experience in the classroom.

Organizational structure may give support and stimulate teacher collaboration, thus preventing the privatization of practice. Respect and trust form the basis of motivation for collaboration between people (Morissey, 2000). Trust and respect from colleagues in school is needed if one wants to develop joint liability (Fullan, 2001). Respect may be expressed through appreciating other people's expertise and knowledge, and trust forms the basis of loyalty and commitment in terms of agreed goals and decisions (Kruse & Lillie, 2000). Trust can make a difference for being able to work together, and in schools where teachers increasingly feel more confident, teachers have a stronger sense of professional community and are more willing to try new ideas and take risks (Robinson, 2011). Professional learning communities can promote learning when the individuals inquire after opportunities to gain new understanding and new knowledge (Timperley, 2008).

CONCLUSIONS

The purpose of our study is to explore how science teachers who have taken part in a school-based professional development programme, perceive the impact it has on their daily work. The results of this study show that school based TPD requires that there is a shared understanding in the school, among its leadership and teachers, of TPD being a process. The aim of such a process is to develop the school's overall knowledge, attitudes and skills for

learning, teaching and collaboration. Professional development aims at giving teachers, at all experience levels, the tools they need to approach classroom challenges with confidence and access to a learning community that can support their activities (Elmore, 2002). TPD can lead to important qualitative outcomes such as the creation of a positive school culture, improvement in individual teacher skills, and development of opportunities for peer learning.

The results of our study suggests that a model of TPD in which individual teachers` own teaching practice (“what they already do”) is the starting point, may be successful in the short term perspective as well as the long term perspective. Successful TPD must thus be generated from the circles` center, i.e. it should aim at generating professional growth of the individual teacher. Teachers` growing confidence and reflective skills form the basis of the development of the school`s science department as a professional learning community, from which in turn, teachers are stimulated and empowered to develop their teaching practice in an even more reflective way. However, the development of a professional learning community requires time, resources and support from the school and its leadership. Without sufficient support being given from the school, the TPD program may stimulate individual teachers to develop new approaches to their TPD, but it may fail to have an impact when it comes to the development of collaborative teacher learning practices which will last and which may lead to school development.

REFERENCES

- Ball, D. L. & Cohen, D. K. (1999). Developing practice, developing practionaires: Towards a practice- based theory of professional education. In G. Sykes and L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco: Jossey Bass.
- Bell, B. & Gilbert, J. (1996). *Teacher Development: A Model from Science Education*. London: Falmer Press.
- Bolam, R., McMahon, A., Stoll, L., Thomas, S. & Wallace M. (2005). Creating and sustaining effective professional learning communities. *Research Report 637*. Bristol: University of Bristol.
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33 (8), 3-15.
- Borko, H., Jacobs, J. & Koellner, K. (2010). Contemporary approaches to teacher professional development. In P. Peterson, E. Baker & B. McGaw (Eds.), *International Encyclopedia of Education*, 7, (pp. 548-556). Oxford: Elsevier.
- Brandth, B. (1996). Gruppeintervju: Perspektiv, relasjoner, og kontekst”. In H. Holter & R. Kalleberg (Eds.). *Kvalitative metoder i samfunnsforskning*, (pp. 145- 165). Oslo: Universitetsforlaget.
- Bybee, R. W. & Loucks-Horsley, S. (2000). Advancing technology education: The role of professional development. *The Technology Teacher* 2000, 31-34.
- Darling-Hammond, L. & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, 76 (8), 597-604.
- Elmore, R. (2002). *Bridging the gap between standards and achievement: The imperative for professional development in education*. Washington, DC: Albert Shanker Institute.
- Fielding, M., Bragg, S., Craig, J., Cunningham, I., Eraut, M., Gillinson, S., Horne, M., Robinson, C. & Thorp, J. (2005). *Factors influencing the transfer of good practice*. Research Brief RB615. London: DfES.

- Fullan, M. (2001). *Leading in a culture of change*. San Fransisco: Jossey-Bass.
- Harris, A. & Jones, M. (2010). Professional learning communities and system improvement. *Improving Schools, 13* (2), 172-181.
- Hewson, P. W. (2007). Teacher professional development in science. In S. K. Abell & N. G. Lederman (Eds.). *Handbook of Research on Science Education*, (pp. 1179-1203). Mahwah: Lawrence Erlbaum.
- Kruse, S. D. & Lillie, T. (2000). Professional community: Fascilitating organizational cultures in support of inclusion. *Disability Studies Quarterly, 20*(4).
- Loucks- Horsley, S., Hewson, P., Love, N. & Stiles, K. E. (1998). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: Corwin Press Inc.
- Marx, R.W., Freeman, J.G., Krajcik, J.S. & Blumenfeld, P.C. (1997). The professional development of science teachers. In B. Fraser and K. Tobin (Eds.). *International Handbook of Science Education*. Dordrecht: Kluwer.
- Morrissey, M. S. (2000). *Professional learning communities: An ongoing exploration*. Austin, Texas: Southwest Educational Development Laboratory.
- Opfer, V. D. & Pedder, D. (2011). Conceptualizing teacher professional learning. *Review of Educational Research, 81* (3), 376-407.
- Ostermeier, C., Prenzel, M. & Duit, R. (2010). Improving science and mathematics instruction: The SINUS project as an example for reform as teacher professional development. *International Journal of Science Education, 32* (3), 303-327.
- Putnam, R. T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29* (1), 4-15.
- Robinson, V.M. J. (2011). *Student-centered leadership*. San Fransisco: Jossey- Bass.
- Robinson, V., Lloyd, C. A. & Rowe, K. J. (2008). The impact of leadership on students outcomes: An analysis of the differential effects of leadership types. *Educational Administration Quarterly, 44*, 635.
- Timperley, H. (2008). *Teacher professional learning and development*. Brussels: The International Academy of Education.
- Tjora, A. (2010). *Kvalitative forskningsmetoder i praksis*. Gyldendal Norsk Forlag AS.
- Tytler, R. (2007). School innovation in science: A model for supporting school and teacher development. *Research in Science Education, 37*, 189-216.
- Vescio, V., Ross, D. & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education, 24*, 80-91.
- Watson, R. & Manning, A. (2008). Factors influencing the transformation of new teaching approaches from a programme of professional development to the classroom. *International Journal of Science Education, 30* (5), 689- 709.
- Wilkinson, S. (2004). Focus group research. In Silverman, D (Ed.) *Qualitative research: Theory, method and practice*, (pp. 177-199). Thousand Oaks: Sage.