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PROFILES Networks: Three International Examples

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ABSTRACT: This paper explores the effectiveness of networking in promoting inquiry-based science education (IBSE) through raising the self-efficacy of science teachers to take ownership of more effective ways of teaching students, supported by stakeholders (Holbrook & Rannikmae, 2010). As PROFILES project (Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science) is based on 'teacher partnerships,' the project recognises the importance, not only of dissemination of developments for the benefit of science teachers across Europe and even worldwide, but also the need for interaction through a well-researched and effective networking system at the school, local, national and European/worldwide levels. The theoretical and practical approach of PROFILES networking is presented, including examples from Austria, Latvia and Romania. Research (evaluative) findings show that networking can operate at the school, local, regional and national levels and that networking is able to play an important role in the functioning of PROFILES. Evaluative findings show that networks offer goal-oriented exchange processes among teachers which support the professional development of teachers. Networking has the potential to create a culture of trust and supports self-efficacy and teacher ownership. Hence, networking is playing a significant role in the functioning of PROFILES in the presented countries.

KEY WORDS: Networks, community of practice, teacher training, inquiry-based science education, dissemination

INTRODUCTION

PROFILES (Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science) envisages the setting up of teacher networks (and interacting with other networks) to both maximise the dissemination and to make teachers more aware of the PROFILES project and its goals (Rauch & Dulle, 2012).

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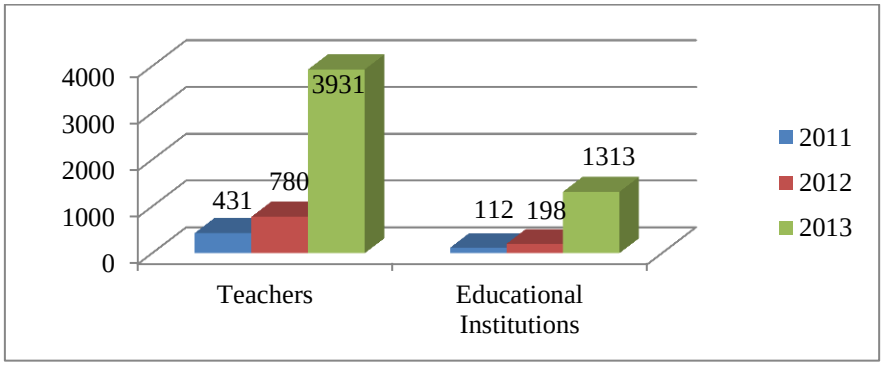
Within PROFILES, networks are distinguished with regard to their complexity, from networks at schools to inter-school networks and networks at local, regional, national and even international levels. Networks at the level of teacher-groups, schools and local structures are likely to be closely linked to instruction and may contribute the most to improvements in the regional structures (Altricher, Rauch & Riess, 2010). Examples of different levels of networks are:

- *Networks at school (teacher network)*
  A group of science teachers within one school co-operate towards the common aim of enhancing instructional and school development through science - (IBSE (inquiry-based science education) and ES (education through science). They are supported by the head teacher and set themselves up as a steering group in the school to guarantee the coordination and maintenance of the network.
- *Networks between schools (school network)*
  A school network consists of two or three schools; within this group of schools one leading school is established. Setting up further partnerships (i.e. with the community, partners from science or economy, personnel within the society, etc.) opens the school to the outside.
- *Local and regional networks*
  At the next level, schools within one school district/region work together, not only on the basis of joint projects among science teachers, but also by exchanging knowledge and experiences in network seminars. A local/regional co-ordination group facilitates the maintenance of the network and includes/supports teacher- and school networks. One important aspect is the involvement of local stakeholders i.e. education, administration, politics, business and NGOs.
- *National networks*
  Networks at a nation-wide level are structured in the same way as local and regional networks (co-ordination group; annual network conferences) but are more complex structure-wise.
- *International networks*
  The networking takes place at an international level, mostly as part of international projects i.e. PROFILES (www.profiles-project.eu), or existing structures like ICASE (www.icaseonline.net).

Although the initial situation differs in every partner country, all partners can build on already existing structures (Rauch & Dulle, 2012). After two years of PROFILES, progress is visible in all partner countries. In April 2013, PROFILES networks (in connection with other science education networks) include 3.931 teachers and 1.313 educational

institutions across all partner countries. Furthermore, 10 partners involve 26 non-educational institutions.

Based on the data of an annual network questionnaire, graph 1 shows the development of PROFILES Networks from 2011 to 2013. Within the past two years, all partners significantly increased the number of participants (teachers and institutions) involved in their network processes. There is no increase in the number of involved non-educational institutions during that time, and thus these can be regarded as an additional resource with development potential.



Graph 1: Development of PROFILES Networks from 2011 to 2013

Taking a look at the types of networks existing in PROFILES countries, we can see that 19 (of 21) partners already set up teacher networks (cooperation of science teachers in one school) and 18 partners include school networks (cooperation of two or three schools). Local and/or regional networks (partnership of schools within one school district/region) exist in 15 partner countries. 12 reported to have national networks (nation-wide scope of the programme), and 9 include international networks (collaboration at an international level).

The concept of the types of networks is not a step-by-step model. PROFILES networks exist in every partner country, but not all of them cover teacher networks. A school network for example, does not necessarily build upon a teacher network, and a local network can exist without teacher- and school networks. Georgia includes a national network of Biology teachers, but no local networks at schools. The partner, ICASE (International Council of Associations for Science Education), is an international network/association itself and covers only the international network dimension. At the moment, ICASE is about to build up a PROFILES teacher network in France. Spain covers all network types, except a school network, because the Spanish schools work independently. And some PROFILES countries, like Ireland,

Finland, Estonia, Austria and Germany/Berlin, include all types of networks.

Table 1: Types of Networks in PROFILES partner countries

PROFILES Partner	Teacher NW	School NW	Local/ Regional NW	National NW	Internat. NW
Austria	✓	✓	✓	✓	✓
Germany (Berlin)	✓	✓	✓	✓	✓
Germany (Bremen)	✓	✓	✓		
Cyprus	✓	✓	✓		
Czech	✓	✓			
Estonia	✓	✓	✓	✓	✓
Finland	✓	✓	✓	✓	✓
Georgia				✓	
ICASE (Nantes group)*					✓
Ireland	✓	✓	✓	✓	✓
Israel	✓	✓		✓	
Italy	✓	✓			
Latvia	✓	✓	✓	✓	
Poland	✓	✓	✓		✓
Portugal	✓	✓	✓		✓
Romania	✓	✓	✓		
Slovenia	✓	✓		✓	
Spain	✓		✓	✓	✓
Switzerland	✓	✓	✓	✓	
Sweden	✓	✓	✓		
Turkey	✓	✓	✓	✓	
Total	**19**	**18**	**15**	**12**	**9**

* ICASE is international and thus not country specific. The data given is for an operating group in Nantes, France. For additional data refer to Ireland and Turkey which also reflects ICASE data

To determine the supporting and hindering factors of networks, partners, in completing a questionnaire, show that PROFILES Networks are mainly supported by the following six factors:

1. **Information and Communication Technology (ICT):** The communication via e-mail, videoconference or an online forum/platform, as well as the distribution of information and news

via the project webpage, is mentioned by nine partners as an essential support in the networking process.

2. **Interest and motivation of teachers and participants:** Seven partners see the interest, motivation, and thus enthusiasm, of involved teachers concerning the content (e.g. new teaching methods, Inquiry-based Science education etc.) as an important support factor, because the participation in networks is voluntary.
3. **Support of institutions and other networks:** The facilitation and support of PROFILES networks by institutions, like ministries of education, universities as well as science education networks and programmes is valued by six partners. The support in this respect ranges from providing contacts to teachers, schools, municipalities and institutions and providing locations and experts for teacher trainings to promote the networking process.
4. **EU projects like PROFILES:** Five partners are of the opinion that the participation in EU projects like PROFILES supports the local networking process to some extent, mainly due to the international dimension (wide dissemination level) of such projects.
5. **Clear network concept:** To structure the networking process, two partners use a clear concept. Austria includes the experiences form the IMST project and Slovenia set up a concept based on the support of experienced consultant and leading teachers.
6. **Curriculum reform:** The change of educational framework conditions (curriculum reform) in the two partner countries Cyprus and Sweden supports the development of educational networks.

Evaluation data show that barriers to the networking process are located mainly in the fields of resources (lack of time and finance) and interest (lack of motivation of teachers and participants). Eight partners reported that networking does not only request time and administration from the side of the network coordinator in the sense of a steering platform (Dobischat, Düsseldorf, Nuissl & Stuhldreier, 2006), but also from the participating teachers to be able to attend network meetings and workshops. Moreover, teachers need additional time to implement the PROFILES modules in class. Another eight partners consider the lack of finance as a barrier. To assume travel costs of teachers is an incentive to enable their participation in meetings and workshops and thus, expand the network. Because networking is voluntary (Boos, Exner & Heitger, 2000; McLaughlin, Black-Hawkins, Mcintyre & Townsend, 2008), it depends strongly on the motivation of the participants. Seven partners report a low motivation of teachers and other participants to engage in the networking process. Moreover, partners mention the additional workload appearing due to the network process and the need to meet other obligations, like the regularly work for teachers in school or the participation in other projects. Five partners report constraints due to the framework conditions in their

countries. In Cyprus, Portugal, Slovenia, Switzerland and the Czech Republic, there is a lack of an existing network structure/tradition that can support the establishment of networks in science education.

Although there are these challenges, partners are optimistic about the future. An outlook to 2014 gives an insight into the planned activities and next steps of PROFILES partners to facilitate their network processes. Partners focus mainly on expanding the network, including new members and interlinking with other networks and associations. The activities need to be disseminated to a wider circle via the attendance of different national and international conferences. Furthermore, partners plan to conduct regional and/or national seminars and workshops. Some partners also intend to increase the use of information and Communication Technology (ICT) and include online and virtual networking sessions.

The following three chapters will give an insight in the development and implementation of PROFILES Networks in the three partner countries of Austria, Latvia and Romania.

DEVELOPMENT OF A PROFILES NETWORK AS A COMMUNITY OF PRACTICE IN VIENNA, AUSTRIA

Austria has a well-implemented structure of educational networks. The nation-wide 'IMST' (Innovations Make School Top) project aims at improving instruction in mathematics, science, IT, German language and related subjects. To put innovative instructional projects into practice IMST supports regional networks in all nine Austrian provinces, and three thematic networks which operate at national level. To some extent, they fill the gap of lacking subject didactic centres in higher education throughout Austria and provide research-based didactic professional development for teachers (Rauch, 2013).

Evaluation data from the project IMST focuses on self-evaluative measures, consisting of qualitative and quantitative surveys (Wenzl, 2012). A cross-case analysis of the annual IMST reports from all nine Austrian federal states (Rippitsch & Rauch, 2013) includes qualitative content analysis (Mayring, 2007). Furthermore, interview and feedback data (reflective papers) from PROFILES teachers are included.

The Viennese Network (VN)[§] was developed within the frame of the project IMST in March 2004. The steering group consists of science teachers from the subjects: mathematics, biology, chemistry and physics, informatics and geometry, as well as representatives of vocational colleges, compulsory schools and the teacher training college. Many

[§] Further information (in German) about the VN can be found under the following link: http://nawi.brg19.at/

steering group members also worked in other educational institutes, which offered additional synergies and co-operations.

A focal point is the improvement of quality as a new culture in education, including the concepts of sustainability, reflection, individualisation and the development of communities. Furthermore, the VN aims at establishing co-operations with other educational institutions, like AECCs (Austrian Educational Competence Centres) and other Austrian networks. The VN provides support for conducting evaluation studies and the implementation of innovative teaching methods, disseminated by different means, especially by presentations of good practice. Twice a year, teachers receive information about future events and training courses via a newsletter. The main aim of VN is the professional development of science teachers towards quality improvement in the classroom and visible improvement of pupils' performance. Thus, the VN initiates a broad range of training courses in science subjects and offers events for all types of schools, e.g. lab days, information events with AECCs, inquiry learning events and teacher training within the framework of educational standards. Furthermore, the VN offers training courses on the competence-based school leaving certificate, a new measure associated with the Austrian curricula, where teachers can deepen their knowledge in competence-based teaching methods (Wenzl, 2012). In 2012, the VN offered 18 events and workshops allowing participation by 1.450 teachers, students and pupils (Rippitsch & Rauch, 2013).

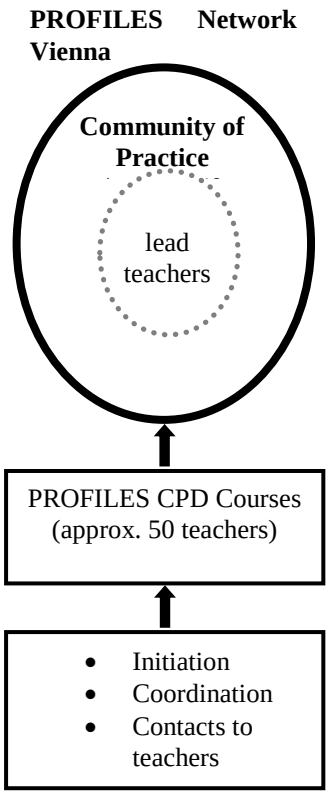
After five years, the VN has become established in the educational landscape of Vienna, not least because of its efforts in imparting pedagogical and didactical knowledge. "*Meanwhile the network has achieved a high level of awareness and reputation in Vienna. The public sees that it offers high-quality events. ... In Vienna we are perceived as 'the experts'*" (VN coordinator). The important position of the VN becomes particularly apparent as a platform for information and training, as well as a contact point for teachers. The VN coordinator (Ilse Wenzl) is together with the steering group responsible for the organisation of further education, networking and the establishment of co-operation.

The VN already participated in projects that focus on inquiry learning, one of the key principles of PROFILES, in the past. Thus, when introducing the PROFILES project, this learning method is already a topic of interest for VN members. In Austria science lessons rarely include inquiry learning due to time constraints and the lack of facilities like labs, which are not available for all schools. Furthermore, teachers need special training and preparation to be able to guide pupils through research units that are based on independent conduction of experiments.

Beside the development of inquiry-based teaching modules, PROFILES provides professional development for science teachers (CPD

courses) (Bolte et al., 2012). The PROFILES CPD courses support teachers in acquiring knowledge and skills necessary for inquiry-based science education (IBSE). To establish these courses within the frame of a PROFILES network in Austria, the coordinator of the VN, participated in the first international PROFILES meeting in Tallinn, Estonia, in November 2011, where aims and tasks were discussed. The next step was to structure and implement the projects' tasks so as to promote the project among Austrian teachers and motivate them to participate in the PROFILES CPD courses. The idea, to structure the participation of teachers in the form of a community of practice was developed. The term community of practice (CoP) actually stems from theories based on the idea of learning as social participation. Wenger (1998) states that learning is fundamentally a social phenomenon and is placed in the context of our lived experience and participation in the world. Learning is part of a more encompassing process, which places individuals as active participants in the practices of social communities. CoP are defined as "*a group of professionals informally bound to one another through exposure to a common class of problems, common pursuit of solutions, and thereby themselves embodying a store of knowledge*" (Hildreth & Kimble, 2000, p. 3), and as "*groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis*" (Wenger, McDermott & Snyder, 2002, p. 7).

The first PROFILES CPD course was announced via the Austrian Teacher Education College in Vienna in 2011. The course aimed at establishing a CoP to deepen the knowledge of science teachers and develop their expertise in IBSE. In Austria, the participation of teachers at CPD courses has been voluntary. The number of participants strongly depended on the attractiveness of the course and the interest of teachers. Finally, 25 teachers participated in the first CPD course. Special topics of interest were the issue of inquiry learning, as well as the international dimension of the PROFILES project and the possibility to get an insight into science teaching practices outside of Austria. The project, its aims and philosophy, as well as teaching modules from a previous project (PARSEL) were introduced to teachers. Teachers were asked to choose a module, implement it in the classroom, and jointly reflect on their experiences. In a next step, teachers developed their own teaching modules in groups according to the PROFILES principles. "You do not merely develop a module; you discuss it, read literature, do research, adapt and exchange materials, and finally you implement it in class and evaluate it" (teacher comment). Another 25 teachers participated in the second PROFILES CPD course, offered in the following year.



Graph 2 shows the development and structure of the Austrian PROFILES Network as a Community of Practice (CoP). The IMST Science Network Vienna acts as a basis by providing the contacts to the teachers and initiating PROFILES CPD courses, where approx. 50 teachers participated so far (by 2013). Out of these teachers approx. 40 persons showed interest and willingness to participate in the PROFILES CoP. These teachers are informed regularly and are invited to meetings in addition to the CPD courses. Due to time constraints, approx. 10 to 15 teachers participate in each of these meetings. Within the CoP eight so called *lead teachers* are very active and work intensively and independently to strengthen the professional development of further teachers and extending PROFILES networking.

Graph 2: The Austrian PROFILES Network

Out of these courses, interested teachers formed a CoP, a regular working group, characterized by cooperation and reflection. The CoP met several times per semester to develop PROFILES modules and reflect on their implementation in class. The meetings did not only cover the official time during the course, they also took place in informal settings, as one CoP-member described: "*The regular meetings of the working group take place either in our homes or within the frame of a working breakfast."* In 2013, the CoP consisted of approx. 40 teachers, who were regularly informed and invited to meetings. Out of this group, eight teachers were very active and worked intensively and independently. These eight teachers overtook the function of so called *lead teachers* (Hofstein et al., 2012), spearheading the professional development of further teachers at pre- and in-service levels, initiating workshops for key stakeholders and extending PROFILES networking. In this way, the PROFILES idea was disseminated. *"Our teachers multiply what they develop because they bring it to their own schools"* (VN coordinator).

According to Wenger (1998), a CoP defines itself along three dimensions (pp. 73–85) which are related to practice itself: Mutual engagement, joint enterprise and shared repertoire.

Mutual engagement means that the members of the CoP are engaged in certain common actions, ideas, in a domain of interest. The PROFILES project acts as the domain and frame of mutual engagement. Community members share the projects' ideas and philosophy: P – Professional, ROF – Reflection Oriented Focus, IL – Inquiry-based Learning, ES – Education through Science.

CoP-members engage in *joint enterprises*, activities and discussions, they share information and build relationships that enable them to learn from each other. The joint enterprise of the PROFILES CoP is the professional development of science teachers in courses, as well as in their daily practice as teachers. In CPD courses, as well as in individual meetings, CoP-members share information and reflect on their experiences in class, focussing on individual and mutual learning. One community member expresses the value of learning and individual development within the CoP as follows: *„The training programme enables me to increase my skills and competences. I have the feeling that I can contribute my ideas, and in return I receive constructive feedback. In this way I can develop myself."* Another teacher conveys the open discussion within the CoP: *"The harmonious co-operation enables constructive discussions about ideas concerning the modules, where even concerns and reservations can be expressed openly. ... Everybody fulfills his tasks in time."*

The third component is a *shared repertoire*. Members of a CoP are practitioners, who include *"routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has produced or adopted in the course of existence"* (Wenger, 1998, p. 83). The shared repertoire in our case is the development, adaption, implementation and reflection on the PROFILES teaching modules that act as a toolbox for the teachers. The following citation of a teacher highlights the work on the modules and the aspect of practice: *„I enjoyed especially the exchange of ideas and the competent feedback that was very helpful for the development of teaching modules. The work in small teams was supportive for the fast adaption of modules towards a suitable and practical form. Regular meetings of the involved colleagues showed progress and were an opportunity to reflect on various details critically."*

In the initial phase of establishing the CoP, challenges could be seen in the coordination and motivation of teachers. Because the participation was voluntary and based on personal interest, the CoP needed coordination to get teachers actively involved. For that reason, the VN coordinator oversaw the coordination of the CoP, which was supportive regarding the exchange of know-how between the PROFILES-CoP and

the VN. In that way, the CoP could be regarded as a loosely coupled sub-structure of the VN. But with time it developed dynamically and the participating teachers started organizing themselves. *„I have no leading role anymore; it [the CoP] has become independent to a certain extent"* (VN coordinator). The VN formed the base institution for the PROFILES network. The coordinator initiated the PROFILES network by providing contacts to science teachers and overtook the coordination role at the beginning, but the CoP developed independently from the VN (see Graph 2). Hovland stated, in this sense, that successful organizations are "*shifting from management based on compliance to management based on self-control and self-organisation*" (Hovland, 2003). At the same time, the VN profited from the PROFILES network, because it promoted the VN at an international level; *"It was like an advertisement for us"* (VN coordinator).

THE COLLABORATION NETWORK AMONG SCHOOLS IN LATVIA

In Latvia a teachers' collaboration network was created as a multi-level model that acts on the national, municipal and school level involving approx. 480 teachers of natural sciences and mathematics, school leadership, experts, municipal specialists, National Center for Education and the Center for Science and Math Education at the University of Latvia (CSME).

There was an obvious necessity to create a structure:

- that can achieve a particular goal – to disseminate innovative ideas of teaching science subjects and mathematics,
- is based on real-life school practice when teachers learn particular methods, ideas, etc. from each other,
- where teachers learn by collaboration and exchange of experiences,
- where teachers feel their colleagues' support,
- where teachers can learn how to reflect,
- that is coordinated but not hierarchical structured.

The experience given in the national project "Science and Mathematics" (2008–2011) and data obtained from PROFILES project teachers' needs questionnaire built the basis of the idea that dissemination of a inquiry learning philosophy and its professional application in school practice is one of the basic tasks of the developed teachers' network. A teacher is the key for inquiry learning to succeed; therefore he/she needs the necessary teaching skills, experience in teaching of inquiry elements and an awareness of the benefits that this kind of teaching brings to the students and him/herself as a professional. Accordingly one of the ways a teacher can improve teaching experience and skills is to create a system

which enables teachers to learn from each other and share their best practices of inquiry teaching. If a teacher lacks the skills to use inquiry type modules in the practice, students fail to experience meaningful and efficient learning in the classroom.

The national network was formed from schools teams that already had experience in the piloting of innovative science teaching within the national project 'Science and mathematics' and who had acquired practice based professional development training. The network included 22 schools supported by 19 municipalities all over Latvia. Each school that is part of the national network has a team (4–5 people) of science and mathematics teachers (one in each subject) and a leadership representative. Each team jointly plans, implements and evaluates different activities for further development and dissemination of ideas and examples of innovative sciences education among other teachers and pupils. Team members share mutual trust and support; the teachers learn together through workshops and seminars as well as lead workshops and master classes for their colleagues from other schools on municipal level.

Teachers involved on the national level study together with CSME experts aiming to share the experience with teachers in the local (municipal) network. Actually these teachers perform two roles – at the same time they are 'teachers as learners' and 'teachers as leaders' (Hofstein et al., 2012). The goal of the study program for the teachers participating in the national network was to learn from each other how to teach science elements and improve their reflection skills. The program involved the following elements: teaching skills and strategies for inquiry learning, the development of Higher Order Cognitive Skills (HOCS) and students' motivation through inquiry, formative assessment in the science classroom etc. Development of the reflection skills was based on the idea of a multiple activity cycle performed during joint lesson analyses – as described in the action research spiral „observe – reflect – write – discuss"(Eilks, Mamlok-Naaman & Rauch, 2012). The main focus of the practical workshops carried out in the study year was on the development of reflection and leadership skills by strengthening the analyses component in the practical workshops. Mutual exchange of experience was organized to follow up on the progress of the teachers involved in the network. Teachers of the national network admit that along with developing pupils' inquiry skills they have improved their own lesson planning and leading. Teachers assert that leading and analysing lessons has helped evaluate their strengths and weaknesses and improved skills to reflect on their performance with colleagues. Teachers confirm that they have learned how to reflect on the goal and efficiency of the lesson with other teachers. Among other benefits teachers listed that an insight into colleagues' performance encourages to think about their own, they gained ideas of how to trick students into thinking etc. CSME-experts concluded

that "*teachers have become better observers and analysts, teachers' self-confidence has grown as well as their ability to reflect on their performance and formulate success and aspects that still have to be improved."*

Those teachers who collaborated and developed mutual trust during the workshops came to a common understanding of teaching science and learning as well as disseminate it among other teachers. It is important to note that joint learning and collaboration among a group of teachers has been going on for a period of least four years already. In this model the relationship of trust among teachers and between teachers and experts is crucial.

Each school that is a member of a national network has started to work with several local municipality schools. Schools had freedom to choose the forms of work in the local network and were encouraged to jointly plan, lead and analyze lessons in order to help teachers acquire practical experience in doing things differently. A total of 480 teachers from 149 schools were involved in networking. According to the local needs and in collaboration with the local municipality at the beginning of the school year of 2011/2012 each school reached out and invited teachers of science subjects and mathematics as well as the school authorities from the respective municipality. This was a new form of work for the municipalities because so far a hierarchical model was in place which was based on teachers' methodological associations with a municipality's appointed person as the head. Although teachers' involvement was on a voluntary basis, there were few cases where school managers used some pressure to motivate and encourage the teachers which reflects the hierarchical culture in place.

All in all teachers from local networks highly value the opportunity to acquire a different kind of experience by lesson observation. According to the data, the best results were achieved where education experts from the local municipality joined the local collaboration network and personally participated in workshops and other activities. Asked about their future wishes, teachers from the local network wrote that they would like to continue learning together with other teachers "*how to successfully carry out scientific inquiry assignments in the classroom, how to lead group work, develop scientific modules, improve pupils' scientific inquiry in lessons, encourage cognitive skills in students, etc."* (cited from reflections of teachers).

The teachers' network is a new, successful, horizontal model for teachers' learning and for dissemination of innovative ideas (like PROFILES philosophy) and promoting a new teaching experience in Latvia. It has a strong impact on teachers' performance, however it requires substantial input from both experts and teachers.

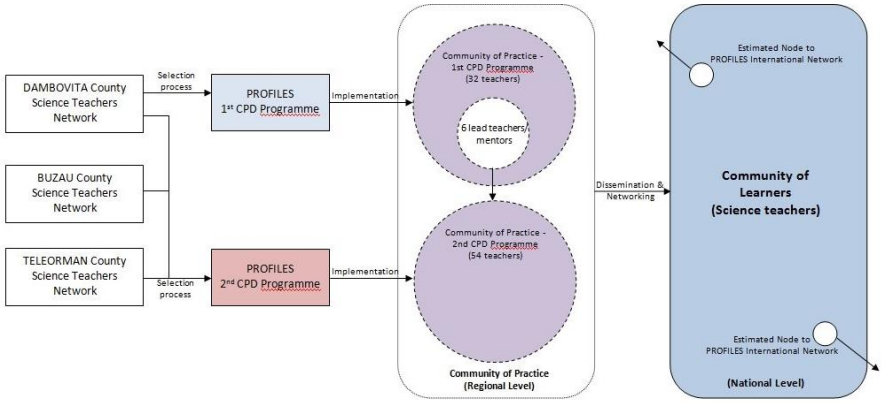
THE ROMANIAN PROFILES NETWORK

In Romania, the dissemination and networking activities are seen mainly in relation to the development and results of the national accredited teacher training/continuous professional development programme. Within the frame of PROFILES, a collaborative teacher network was established to provide teaching and research interest in the field of science, to offer opportunities to cooperate actively, and to promote exchange of ideas and materials for training, by disseminating best practices, seminars, workshops etc. Actually, the Romanian network is based on *lead teachers* within the PROFILES Continuous Professional Development (CPD) courses, which play an important role in the extension of the PROFILES Network at the national level.

The network was initiated on the occasion of the first workshop related to the PROFILES CPD Programme, comprising of more than 30 Science teachers, from 20 lower and upper secondary schools from Dambovita County. After the implementation process of PROFILES Modules in schools, more science teachers expressed their interest to join the network and to participate to the second PROFILES CPD Programme. In this respect, the local network was extended to a regional one, including participants and schools from 3 different counties (Dambovita, Buzau and Teleorman), in fact, developing the network in 2 different Romanian regions. At the moment, 86 science teachers from 69 lower and upper secondary schools are actively involved in the Romanian PROFILES network.

Graph 3 illustrates the development of the Romanian PROFILES Network, emphasizing its potential to become a national one, but also to be extended at international level, through specific nodes in which science teachers who become contact points with colleagues from other "PROFILES countries."

The main objective of the Romanian network to distribute the PROFILES philosophy to Romanian Science teachers, to raise their interest for new teaching methods, especially for promoting Inquiry-based Science education in the Romanian curricula. The goal is to establish a specific frame that allows the science teachers to learn from each other and to share the best practices achieved in the context of the PROFILES project. The network is oriented also on the effective dissemination of PROFILES concepts, modules and results of classroom implementations at different educational levels. Most of these actions are accompanied by debates involving teachers, educators, scientists and other educational stakeholders', and are related to how aspects of real life could be illustrated in the actual curricula. Teachers use the *3-stage model*, presented during the PROFILES CPD programme.



Graph 3. Development of the Romanian PROFILES Network

At the same time, the process of dissemination performed by the PROFILES network teachers included presentations in local and regional teachers' meetings and conferences as well as participation at national conferences dedicated to science teachers. In this respect, PROFILES new developed modules have an important impact as good practice at the stakeholders' and teachers' level. Anyway, the success of PROFILES in Romania is largely due to the concentrated efforts of promoters, trainers and teachers, who act together and try to propose methods that make the learning of science, more interesting, relevant and meaningful for secondary school students.

Reflection and Outlook

Social contacts are indispensable for the creation of structures and the transmission of information. In all three examples described here, the strategy of using and developing existing structures or contexts was successful. Such developments, however, can only happen in steps. Support from official bodies (i.e. province education boards, communities) is quintessential for the continued development of identities in networks. The networks carry out creative projects and thereby try to raise the attractiveness of natural science lessons. Networks are seen as a complementary strategy for disseminating innovations and reform. Based on the case-study presented, the following general findings can be drawn:

- Good practice cannot be cloned, but exchanging experience on a personal level promotes learning and innovation.
- Networks in education offer goal-oriented exchange processes among teachers *(information function)* which support the professional

development of teachers (i.e. fresh ideas for classroom teaching, interdisciplinary cooperation at schools) *(learning function).*

- Networks have the potential to create a culture of trust, with the effect of raising self-esteem and risk-taking of teachers (*psychological function)* and upgrading science at school *(political function).*
- It is necessary to maintain a balance of *action & reflection* (goal-directed planning and evaluation) and *autonomy & networking* (analysis of one's own situation, but also support by "critical friends") in order to set up a sustainable support system for schools.
- Evaluation and research need to be driven by an interactive link between an interest to gain new knowledge and a developmental interest. A culture of self-critical and collective reflection might flourish, but reflection should not hamper a project from being taken forward (see previous aspect).

The overall challenge might be described as keeping momentum between structures and processes or, in other words, between stability and flow to enable sustainable development of learning.

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