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Name of lead partner for this deliverable: Tina Seidel



Existing models of teacher professional development on IBST in seven European countries

Katrin Lipowski & Tina Seidel

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Department of Educational Psychology
Institute of Educational Sciences
Friedrich Schiller University Jena
Am Planetarium 4
07737 Jena
Germany
Mail:

tina.seidel@uni-jena.de
katrin.lipowski@uni-jena.de

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I) Introduction

Teacher professional development (TPD) in science education at secondary level is at the core of the Mind the Gap network group. In the network are partners from the following European countries: Denmark, Norway, UK, Hungary, Spain, France, and Germany. These countries represent a variety of educational systems and traditions in Europe. The Scandinavian countries represent traditions of student autonomy and cross disciplinary work in science education while in France, Germany and Spain models of conceptual understanding have been more important models. In contrast, England has a long tradition of activity based science teaching (Jorde & Klette, 2008). Models of science teacher professional development differ in each of these countries, and reflect differences in how teachers are educated as well as how structures of TPD are implemented

Currently, the knowledge on teacher professional development is fragmented and nonspecific. European countries lack knowledge and evidence concerning the efficiency of traditional approaches as well as new models for TPD. While traditional approaches to TPD often follow a top down strategy with sessions organized as stand-alone events, current practices of effective TPD follow the idea of teachers becoming members of a community of learners (Jorde & Klette, 2008). Empirically founded knowledge about different approaches to TPD is of high relevance in order to implement new models in European countries (Jorde & Klette, 2008).

In the following report we focus on summary activities of work package 6: dissemination and professional development in the Mind the Gap project. The aims of WP6 are, first, to systematically summarize knowledge about (TPD) in the network group and, second, to report on existing models of TPD. Based on this it is the goal to compare and analyse these existing models and to explore potentials of research based models of TPD (Jorde & Klette, 2008). Interviews with 16 experts from the seven Mind the Gap network countries together with collected information about the general conditions of TPD at a project workshop in Lyon, serve as the basis for this report.

Work package 6 is led by Germany with participation from all members of the network. All countries described their national models for use of Inquiry Based Teaching and Learning (IBST) in TPD. Of particular importance was the assessment of the German "SINUS" program as a possible and successful model for teacher professional development in other countries (Jorde & Klette, 2008). In chapter 5, we provide more detailed information about the SINUS-program and the possibilities for transfer to other countries.

II) Expert interviews and summaries of workshop

This report is based on data collected from a project workshop in France, organized by Andree Tiberghien, Matthias Stadler & Manfred Prenzel (Lyon, May 2009) and is built on summaries from the expertise of policy makers, stakeholders & teacher educators on TPD in seven European countries. Group discussions in which national particularities in teacher professional development and the possibility to transfer the SINUS model to respective countries were held. 31 participants from the Mind the Gap network took part at the workshop in Lyon.

In addition, experts from the participating 7 countries were interviewed as well as participants from the workshop in Lyon (2009). The guided interviews were conducted in period of June/July 2009 with 16 Experts who all are stakeholders in the area of European Science Teacher Education: teacher educators, active researchers in science education, members of teacher organisations and policy makers. The interviews lasted on average 40 - 50 minutes using a standardized form. For this report, we selected those interview questions which are relevant for work in work package 6. The following table shows the complete interview guide. The relevant questions for the report have been marked in italics.

Table 1: Guide for Interview Questions: *Teacher professional Development in Science Education in European countries.* (Lipowski & Seidel, 2009).

<p>General conditions of teacher professional development in science education</p> <ul style="list-style-type: none"> ○ <i>How TPD is in general organized in your country? (e.g. compulsory/voluntary, single courses or sets of aligned courses, with individual teachers or groups from the same school)</i> ○ Which main conditions are necessary to support continuous learning in the teacher profession? ○ How do you currently assess conditions leading to successful TPD in your country? ○ <i>Do you see the necessity for improving the way your country implements TPD?</i>
<p>IBST in Science Education</p> <ul style="list-style-type: none"> ○ How does TPD support the use of IBST in Science Education (Instruction)? ○ <i>In which way is IBST represented in science education in your country? (a) curriculum frameworks, (b) teacher education programs, (c) TPD</i>
<p>The future of TPD</p> <ul style="list-style-type: none"> ○ Which developments do you envision for teacher professional development in your country in 10 years? ○ Which kinds of TPD will teachers in science education need in future? ○ Which aspects of continuous learning in teacher profession do you consider to be successful in your country?
<p>Outstanding programs of professional development in science education</p> <ul style="list-style-type: none"> ○ <i>Please provide 2 examples of what you would consider as good practice programs in TPD in science education in your country.</i> ○ <i>Which criteria do you use to determine success of these examples? / Why are these good examples?</i>
<p>SINUS program /developed in Germany) relation to our Lyon meeting</p> <ul style="list-style-type: none"> ○ <i>Is the SINUS model for TPD one you could use in your country?</i> ○ If you are familiar with the SINUS TPD project developed in Germany, which ideas from the SINUS program do you find particularly fruitful?

TPD in science education; a European perspective

- Which European country (s) do you consider to be successful in their TPD programs? Why?

Professional biography

- Please provide your professional biography in some short notes.

III) General conditions of Teacher Professional Development in science education in European countries

Currently, the knowledge on teacher professional development in Europe is fragmented and nonspecific. Therefore it is essential to use the specific advantages of coordinated programs in the EU in order to summarise fragmented knowledge. Based on our gathered data it is possible to describe the actual state of teacher training in the seven EU countries. Our work does not summarize published reports about TPD in European countries, rather we choose to focus on inert and tacit knowledge of leading experts in this field. Using this approach we identified central basic conditions of professional development and in-service training in these countries. In the following chapter we provide an overview of teacher education, in-service activities and conditions under which these activities take place. Furthermore, we identify the need for development in this context from the perspective of interviewed experts. The role of IBST in the context of teacher professional development in the respective countries is also considered.

In part one, we describe general conditions of TPD in each involved country (sorted in alphabetical order). Interview statements from experts in each country illustrate country profiles. A summary outline is presented in Figures 1 to 6. For reason of data protection, each interview partner is attributed a number (see appendix I)

How is Teacher Professional Development in general organized in the participating countries?



Denmark

The Danish system can be characterized as decentralized, however the Ministry of Education has authority over education. Professional development usually is organized at university colleges in Denmark. At the present time there are five university colleges spread throughout the country. There is an ongoing process of improvement and change with regards to professional development and teacher training, including intensified support to in-service training in science education by the Ministry. However, the system is organized as a free market.

“Everyone was allowed to announce courses for teacher training. They could either apply for some money in the ministry to create courses or they could just put it in the market allowing teachers and schools to choose which courses they wanted to follow. So it is free market now

and that's interesting. This has also meant that we have seen large increases in the price of the courses" (3).

The participation in in-service training in principle is voluntary. However, the school principal decides in the end which teachers want to go to which courses. Similar to other European countries courses tend to be single courses where teachers typically attend for one day. Very few courses are organized over longer periods (e.g. one day weekly over a year). Some courses actually encourage and prioritize groups of teachers to attend. In others individual teachers are attending. *"It's very different from school to school and from subject to subject" (3).*

What is apparent in the Danish system is that most teachers who are teaching science do not actually have an education in science. Regarding the use of IBST, experts state that there is no systematic way IBST is reflected upon in teacher training or in-service training of science teachers. However, the Danish school system does have a long tradition of problem based learning which has strong relations to aspects of IBST.

"But it is not formulated as inquired based science teaching. It's very much likely to find for instance practical work in science or how can you investigate your local environment and such. We have a long tradition for doing that. We need to develop some programs and a national plan" (3).

Professional Development in Denmark

- The education system in Denmark is decentralized and TPD tends to be organized at the university colleges
- Process of improvement is ongoing with more support for in-service training
- Offering professional development courses goes on in a free market
- Participation in courses is voluntary
- Most courses are single, one day courses
- Long tradition for problem-based learning and project oriented learning, though not formulated as inquiry based science teaching

Main problems:

- Many science teachers are actually trained (pre-service) in science
- Many teachers take an in-service course in their free time and they may also pay privately for courses
- No systematic way to use IBST in teacher training and in-service
- Lack of cooperation between Ministry of Education and university colleges
- No official guidelines for teacher training

Figure 1: Professional Development in Denmark



In France, policy and teaching are considered by experts to be quite traditional. Professional development is provided mainly by local inspectors, with no mentioned systematic and structural approaches. Participation in courses is voluntary. Teachers can choose days of in-service activity from a domain of offerings.

Inquiry Based Science Teaching (IBST) is present in the curriculum:

“IBST is represented in curriculum at the level of middle school (11- 15 years). The curriculum is oriented towards scientific literacy.” (14)

The interviewed experts reflected on the gap between teaching and learning. For example the gap between in-service teacher and new ideas entering into the schools. IBST is indeed a subject in pre-service training of teachers. However teachers first learn how to carry out IBST activities only later when having attended in-service courses. Another difficulty pointed out by experts is the distinction between science subjects (physics, biology, chemistry).

Professional Development in France

- Policy and teaching are traditional
- Participation is voluntary
- Teachers can choose different types of in-service training

Main problems:

- Gap between theory and practice
- Distinction between science subjects
- No structural approaches to TPD
- Lack of collaboration between teacher educators, teachers and researchers

Figure 2: Professional Development in France



The education system in Germany is difficult due to federalism and the federalism reform. TPD is in the authority of counties, each more or less having their own system. There are basically three levels:

*“The **central level** is where teacher in-service training is organized for a whole region, mostly for a federal state. **The regional level** is organized by smaller unities. (e.g. administrative districts). The **school level** is where TPD takes place in the single school, internal teacher in-service training” (8).*

The Standing Conference of the Ministers of the federal states passed standards for teacher training in December 2004. The standards in educational sciences have been adopted by the federal states at the beginning of the 2005/2006 school year. Teacher in-service training is not systematically a pre-requisite for further qualification of teachers. In Germany traditional

concepts of in-service training dominate. The curriculum is mainly content driven. Just small shares of in-service training courses are offered from the universities. All universities have centers for teacher education. The participation in TPD is obligatory.

In science education, TPD is mainly oriented to individual participation in one day courses where content is not necessarily integrated. With regard to IBST, German experts indicate that:

“IBST indeed is represented in the curriculum, but not in a systematic way but rather as an idea, as a structured concept” (11).

Experts described a need for the development of TPD in Germany. For example, they refer to the need for allowing different subject teacher to work together with a stronger interdisciplinary approach. This would result in using time resources for inquiry oriented learning and teaching. Teacher education in Germany in general has an academic character and has little practical links. Furthermore, stronger cooperation between institutes which are involved in teacher education (universities, research and schools) is regarded as important for improving TPD. Future challenges are to improve the coordination of TPD activities.

Professional Development in Germany

- Standards for teacher training since 2004 – adopted at the beginning of school year 2005/2006
- Content driven curriculum
- TPD is obligatory - defined requirement of hours do not exist
- Education in general has an academic character with few practical links
- Typically taught as single courses

Main problems:

- Lack of cooperation between universities, schools and research (different phases)
- Lack of input from research in teacher education
- IBST is represented in curriculum but not in a systematic way
- Lack of interdisciplinary work in science subjects
- High degree of diversification per level and type of school
- Lack of autonomy for school – budget for in-service training

Figure 3: Professional Development in Germany



Hungary

Currently teacher professional development in Hungary is rather disorganized. There are many different stakeholders (e.g. training companies, school management, publishers, official boards, schools, universities). A problem is a lack of coordination between these stakeholders. For example:

“The universities and schools have lost their role as stakeholder which involving that the schools are abounded with their problems” (1).

Professional development courses are compulsory for Hungarian teachers. It is obligatory to

have 120 hours of TPD in seven years of time with the following exceptions: those over 50, those having a PhD or new degree. TPD is typically organized as single courses with the most usual arrangement as a one-week course. Individual participation in courses is most common. Groups of teachers from the same school attending courses together is not typical.

The interviewed experts in Hungary stated that they see future challenges with regard to funding, lack of courses and guarantee for participation. Because there are different systems of teacher trainings, all providing different content, systematic development of courses is difficult. There is a limited presence of IBST in science instruction at the present time, even though IBST is represented in the national core curriculum and also in the subject curricula. The experts see a need for development with regard to in view of official criteria for IBST or proposed methodology.

Professional Development in Hungary

- TPD is locally disorganized (independent organizations can start courses).
- Teachers are individually responsible for what they do and how they organize participation
- Lack of advice and no guarantee for course holders
- Lack of coordination between different stakeholders.
- Universities have lost their position as stakeholder.
- TPD is generally obligatory. (120 hours every 7 year with exceptions: new degree, PhD, age -over 50 years old.
- Usually single courses, most often organized as a one-week course
- Most often individual participation.

Main problems:

- TPD is expensive and needs a lot of administration
- Influenced by different interests
- No official criteria for IBST
- Lack of coordination and systematic development
- Lack of networking between schools
- TPD is not compulsory for older science teachers

Figure 4: Professional Development in Hungary



Norway

Norway makes a distinction between further education for teachers (providing credits) and in-service training for teachers (short courses).

“In-service training for teachers is the responsibility of each local educational authority. Each local education authority should have an overview of the types of in-service courses needed

for updating teachers and has the responsibility for organizing needed courses for all teachers” (9).

Norway has a national science centre with responsibilities for influencing the content of science courses designed for TPD. The centre represents the connection between the official national curriculum in science and how science is practiced in the classroom.

Whereas the system is common throughout the country, local educational authorities approach this task very differently. This situation is problematic since there tends to be a large degree of local variation, including contact with course providers (universities and state colleges). Norway has a national curriculum (2006) with local educational authorities organizing the educational system.

“Local educational authorities are mandated in many ways by the national level to provide TPD and are provided funding from the national authorities. Local authorities identify the need for In-service courses and then try to find appropriate courses for the teachers to take. So that they use the money to buy the courses” (13).

A bottom up strategy is now implemented in TPD system which means that individual schools have responsibility to plan their needs and then ask universities and colleges for courses. Professional development is voluntary. Each school/teacher has five days a year they may use for in-service training. Usually, teachers attend in-service courses in groups. In most cases teachers participate in single courses (one or two days).

TPD related to courses providing teachers with credits is typically mandated by the national educational system. These courses are taught at universities and state colleges and participation is voluntary. Recently mathematics and science have been prioritized areas.

IBST plays an important role in Norway:

“We are not sure about the implementation level, but at least within the national curriculum framework level it is very explicitly explained” (13).

Despite the fact that IBST is explicitly explained in the national curriculum, teachers actually do not use the term IBST:

“We use a different type of thing that has come into our national curriculum... and it`s all about how to teach science” (13).

As in many other European countries, teachers in Norway at primary and lower secondary seldom have an identity as science teacher. In view of IBST the gap between the stated curriculum and classroom practice is a problem. *“Our task for the future will be to implement IBST in the science classroom” (9).*

Professional Development in Norway

- New curriculum in all subjects (2006)
- TPD is voluntary
- Mostly organized as single courses (1-2 days)
- Bottom up strategy in TPD, starting at the school level
- IBST visible in national curriculum documents
- Long tradition of interdisciplinary work in science (integrated science)

Main problems:

- IBST represented in curriculum but not implemented in practice
- Missing an identity as science teachers
- Money for professional development comes from national budget, yet local authorities have responsibility for TPD
- Lack of relevance and quality in the teaching courses, large degree of variability throughout the country
- Lack of substitute teachers when taking TPD courses

Figure 5: Professional Development in Norway



Spain

In Spain, teacher professional development is administered by the different partners of education in the 17 autonomous regions (shared between central government and the 17 regions).

"Each community has some courses. These are normally design by the central office. And other courses are decided by the those in charge at the teacher centre" (5).

The stakeholders are the director of innovation in each Departments of Education, teacher education offices, science teacher associations (not in all regions) and assessment agencies. There are no systematic approaches for TPD but a high proportion of courses about scientific updating are offered. Professional development in Spain is voluntary however:

"In fact you need it for promotion. People need to have a certain number of hours or credits of the end of six years in order to apply for promotion" (5).

Most courses are organized as single courses; in some cases there are sets of courses. Usually, individual teachers are participating but there are also some special actions that involve a group of teachers of a school. Professional development only randomly supports IBST (some courses do, depending on teacher educators responsible).

In Spain there is less support for IBST, which means for example little emphasis and lesson time devoted to IBST due to the length of curriculum. In view of assessment it becomes clear that:

"There are a minimal proportion of questions related to practical tasks in external tests" (5). Furthermore a general problem is the perception of teaching as a profession with lower status than the sciences.

Professional Development in Spain

- TPD is shared between central government and 17 autonomous regions.
- No systematic approaches – high proportion of courses about scientific updating.
- TPD is voluntary but required for promotion.
- There are mostly single courses.
- Usually have individual participation
- Only randomly supports IBST (depending on teacher educators)

Main problems:

- Little emphasis on inquiry
- Length of curriculum (no time for inquiry)
- Perception of teaching as profession with lower status than the “sciences”
- Minimal proportion related to practical tasks

Figure 6: Professional Development in Spain



United Kingdom

Professional development in UK has a long tradition.

“It is organized at the level of the school. The schools themselves determine particular professional development agendas and there are in-service training days that they allocate to these courses” (15).

The schools themselves have professional development agendas and professional development as part of their time allocation. At the national level there are science learning centers (10 regional centers) which collaborate with the universities in this region in providing courses for science teachers, either at the centre or at schools. But the system is also complicated because there are many of different ways of doing in-service training for teachers.

“There are a number of institutions offering professional development and, in addition, schools may also provide TPD” (10).

For this reason it is sometimes difficult for teachers to choose course to choose. The issue is the balance between in school provision and the outreach provision. In UK in-service training is compulsory because:

“The in-service that comes in your school has been written into teacher contracts and schools have to provide at least five days. This goes back to some time long ago when there were a number of teaching days per year and there also was a number of what they call in-set days” (7).

The majority of courses are half-day, single day sessions. Some are longer term or multi-day programs. It is not easy to get the teachers out of school. Currently, the system is moving away from courses to a more long lasting structure. Sometimes it is just single teachers send out, but these courses actually cost money.

“So the schools have to provide them funding for the teachers to go. So it can be restrictive in certain ways to send several teachers at the same time.” (15).

The science learning centers evaluate their TPD activities. Teachers give an outline of the impact on their own learning and their own professional development.

What do the experts describe in view of further development of TPD in their country? For example, the experts see that most in-service training is actually based on a short term model. The perspective should be more long-term sessions. UK has a long tradition of activity based science teaching and learning. IBST is represented in the curriculum in the section named - *How science works*. This section is a key aspect of the curriculum and included all about scientific inquiry processes of science, serious explanations, models how scientific knowledge gets constructed and evaluated.

Nevertheless the Experts said that there is too little time for experimentation and investigation in lessons because the education system in UK is very assessment driven. In addition, the curriculum is content driven which undermines the pupil’s role at the same time.

Professional Development in UK

- Many opportunities for TPD
- Culture for Teacher Professional Development
- Long tradition of activity based science teaching
- Close cooperation between science learning centers and universities
- TPD is semi-compulsory
- Majority of courses are single day sessions

Main problems:

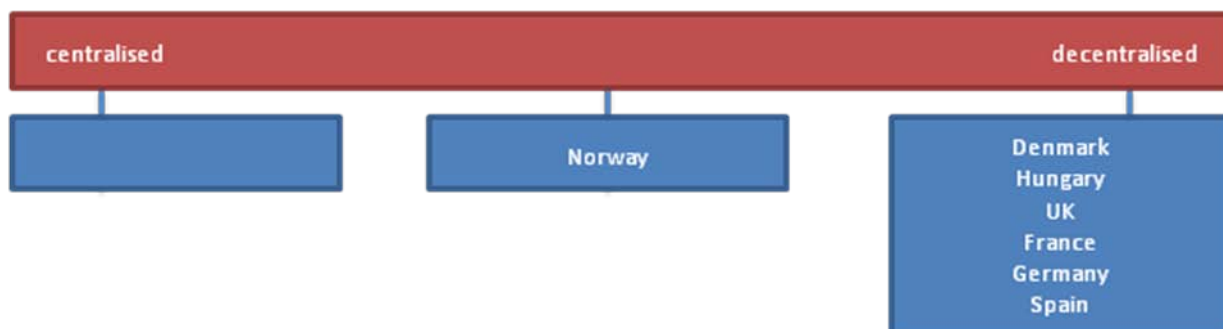
- Large number of institutions which offer PD; difficult for teachers to choose
- In-service-training is mostly based on the short term model
- Strong focus on content rather than practical work
- Assessment driven culture in UK
- Content driven curriculum

Figure 7: Professional Development in UK

Summary of professional development criteria:

In conclusion, there is a large degree of variation with the provision of TPD across European countries. In view of this we summarise the obtained results and compare several dimensions of professional development in the respective countries. In Figure 8 we classify the results of the comparison on the basis of criteria for professional development.

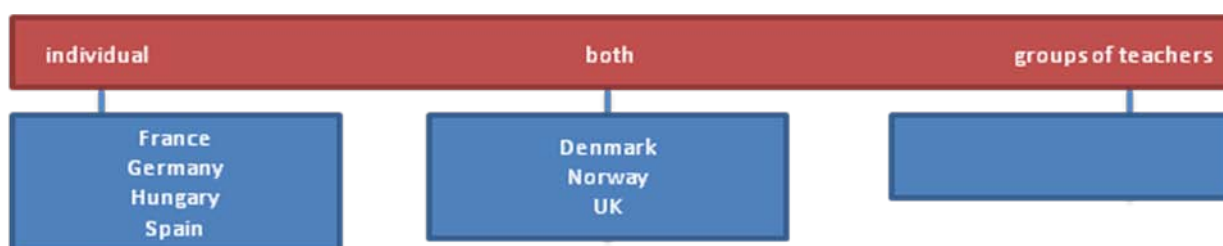
(1) Form of organization



(2) Obligation of TPD



(3) Participation



(4) Duration of TPD courses



(5) Content focus of TPD



(6) Strategy for implementation



(7) Role of IBST in TPD

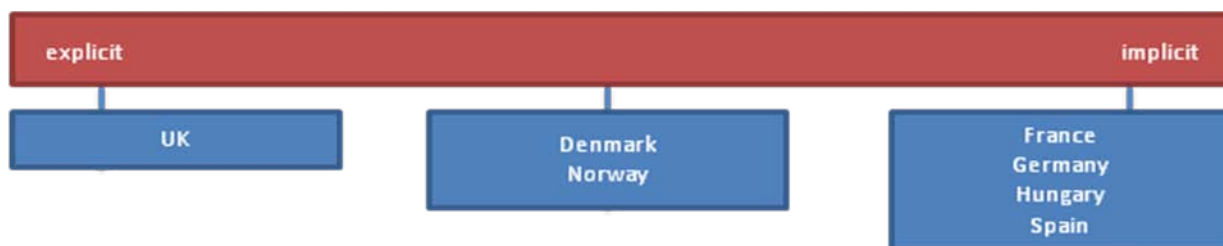


Figure 8: Summary of professional development criteria across countries

IV) Necessity for improvement of the implementation of TPD in respective countries

All partners in the Mind the Gap project are actively involved in science education and they represent a variety of educational systems and educational traditions in Europe. The involvement of teacher educators, active researchers, members of teacher organisations and policy makers in the project network allow working together, learning from each other, and reflecting on different practices and existing policies. So it is interesting to examine in which areas interviewed experts see necessity for improvement of TPD in their countries. In what way do commonalities or differences appear? Do all experts see a need for development? The following chapter illustrates the perception of interviewed experts whether they see necessity for improving TPD and if so, what needs to change?

How do the experts see the necessity for improving the way your country implements TPD?

The **Danish** partners attached importance to the necessity for improvement in their country. They express a need for greater involvement from the Ministry of Education to provide courses and in service training, as well as increased cooperation with universities. Furthermore, *“it would be nice with some kind of official guideline for teacher training”* (3). Because currently the *“teachers who have finished their education, are very often let alone by themselves and no one takes responsibility for their further development. When you have finished university you go to upper secondary as a teacher and in principal you can now teach for 30 to 40 years without any in-service training”* (3).

The **French** partner sees the necessity for improving the implementation of teacher professional development. *“We should think about the possibility of taking into account the teacher’s point of view, the trade union point of view and the state of school. The conditions should really take into account the actual situation”* (14).

German experts state that they also see the necessity for improving the implementation of TPD in Germany, basically in two areas: *“teacher training and teacher in-service training”* (8). Generally Germany needs a *“change from the classical idea of in-service to one where schools initiate professional activities”* (12).

The **Hungarian** experts emphasize the necessity for improvement in their country as well. *“So that teachers have a better starting point when they start their careers in science teaching”*(2). Another main point is that *“there is a need to have a kind of centre responsible for the coordination of TPD nationally”* (1). *“Furthermore we need a system, such as a portfolio or some kind of checking, to monitor what happens to people taking the courses”* (1). Finally it would be necessary to find a way to motivate teachers and schools to participate in professional development courses.

From the **Norwegian** perspective the conditions in Norway are not yet optimal. For example: *“There are still teachers who cannot take courses because there is a lack of substitute teachers or schools do not have money to pay for substitute teachers”* (9). Another way for enhancing of the situation in TPD is that *“The system in Norway should be more centralized. The teacher trainers at universities and teacher colleges know a lot about new strategies in science and the new curriculum and they could offer good in-service training courses, if only they received the government funding for TPD. So my assessment is that the structure in our professional development is not optimal* (4)”. The need for national control of TPD, including funding of long-term courses is another expressed priority.

The **Spanish** expert said, *“Definitely, we need to improve a lot”* (5). The biggest problem was described by the perception of teaching as a profession. Teacher professionalism is not supported with a framework for TPD and *“has a lower status than the sciences”* (5). In view of that there is definitely a need for improvement in Spain. Another aspect is that *“we need more emphasis for inquiry based things, more lab work and relation with practical tasks”* (5).

“We absolutely have the necessity for improvement in our country” was a statement from our partner from the **UK**. *“We need a change of the culture of professional development in this country in which we try to give teachers professional development at the same standard as expected for business or medicine”* (7). *“We have only been going for four years and we are just starting to make an impact in school”* (7). Furthermore *“We need more support and wider acceptance of longer-term and sustained models of TPD. In this country we need a space for teachers to develop their own professional learning experiences as a model of TPD”* (15). In addition it is unsatisfactory that *“there is no real long-term sustainable government-led professional development framework every teacher needs to participate in. Everything is just compulsory, semi-compulsory, and optional”* In my perception here we need desperately a change in the UK” (10).

In summary, all of the seven participating countries agreed on the necessity for improvement in the way TPD is organized, the way it is implemented and the content of courses. Conditions and cultural traditions of the different education systems were described as well as different starting points for improvement. In the following a summary outline is presented.

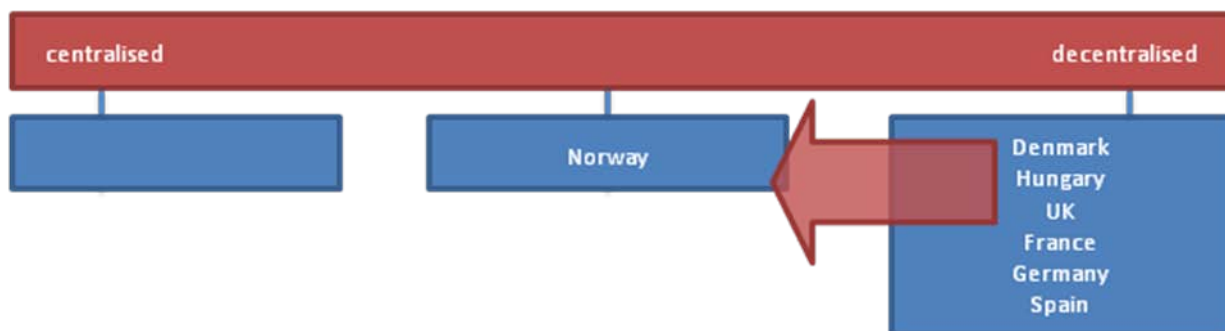
Summary – necessity of improvements

Denmark	<ul style="list-style-type: none"> • More cooperation between ministry of education and universities (e.g. provide in-service sessions) • Necessity of official guideline for teacher training • Continuous in-service training also for experienced teachers
France	<ul style="list-style-type: none"> • Implement TPD • Better conditions taken into account
Germany	<ul style="list-style-type: none"> • Need of development in teacher education and in-service training • Change from classical idea in in-service training to school based initiatives
Hungary	<ul style="list-style-type: none"> • More systematic coordination of TPD • Some kind of assessment of TPD (e.g. portfolio) • Increased motivation to participate in TPD
Norway	<ul style="list-style-type: none"> • More money for schools to pay substitute teachers • A more centralized system of TPD (national control) • Improvement of the general structure in professional learning • Need additional types of funding
Spain	<ul style="list-style-type: none"> • Need for increased emphasis for inquiry based teaching • Better status for teaching as a profession • More lab work and relation with practical tasks
UK	<ul style="list-style-type: none"> • Need of change of culture of professional development • Need a higher standard in this area (e.g. similar to medicine) • Need wider acceptance of longer-term and sustained models of PD • Creating a space for teachers to develop their own professional learning experiences (school based initiatives)

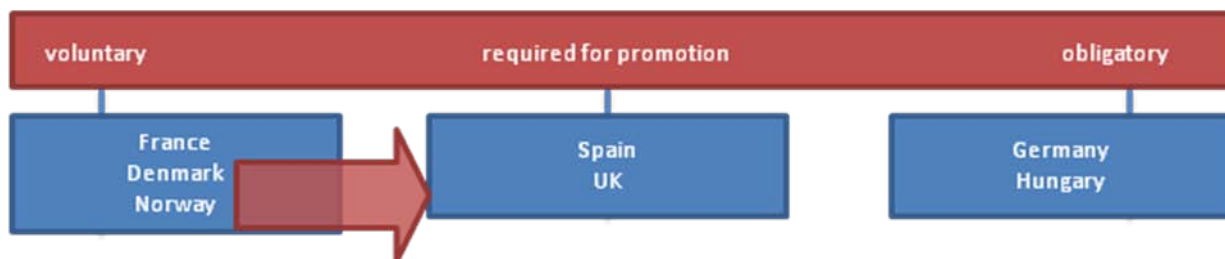
Figure 9: Summary – necessity of improvements

Figure 10 summarizes the results regarding the question, in which areas interviewed experts see necessity for improvement of TPD. Again, we use the diagram style of the previous section, but progress/transition is illustrated by red arrows.

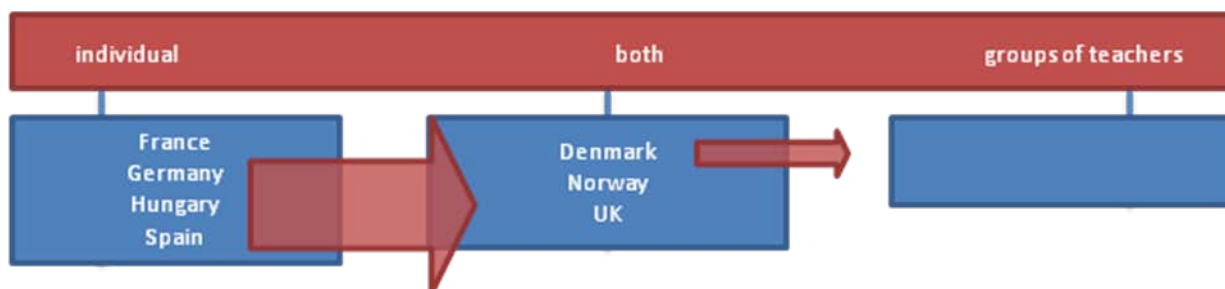
(1) Form of Organization



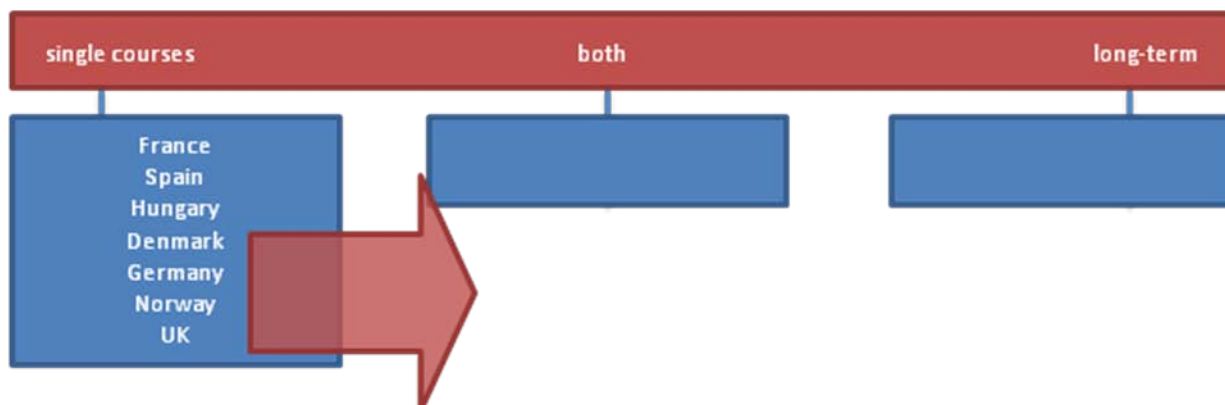
(2) Obligation of TPD



(3) Participation



(4) Duration of TPD courses



(5) Content focus of TPD



(6) Strategy for implementation



(7) Role of IBST in TPD

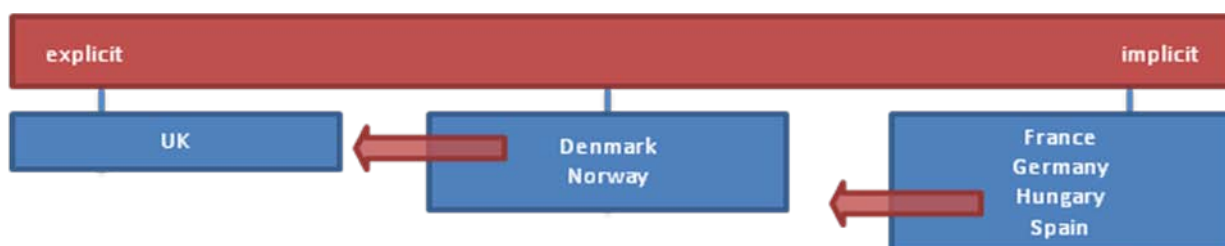


Figure 10: TPD criteria in view of progress

V) Good practice programs

Research provides evidence that intensive professional development can help teachers to increase their knowledge and change their instructional practices (Kubow & Fossum, 2007; Garet et al, 2001; Borko, 2004; Angrist & Lavy, 2001). When established and useful models of TPD in educational research are described, the question becomes whether or not they are exportable to other national or international contexts. In the Mind the Gap project we have been particularly interested in this question within European countries and contexts. It is important to explore how successful programs might be exported from one country to another, from one context to another. To do this, we need a broader knowledge about mechanisms for modification to meet cultural differences (Jorde & Klette, 2008), including the basic step of systematically summarizing knowledge about existing models and programs of teacher professional development in European countries participating in the network.

In the interviews all experts were asked to provide examples of what they would consider as good practice programs of TPD in science education in their country. Based on this question we have summarized the answers, providing an overview of existing national models or programs of TPD in the network countries. In the middle column we present the name of the program or project with the associated web link. The third column provides information about the language in which this information is available. A short description about the programs which are available in English is also provided.

Country	Good practice programs	Availability
Denmark	<ul style="list-style-type: none"> ○ <i>“Master course in science education”</i>, University of Aarhus ○ <i>“Master course in upper secondary education”</i>, University of Southern Denmark 	
France	<ul style="list-style-type: none"> ○ <i>“PEGASE – pour les Professeurs et leurs Elèves un Guide pour l'Apprentissage des Sciences et leur Enseignement”</i> http://www.inrp.fr/pegase-en/ ○ <i>“SESAMES- Situations d'Enseignement Scientifique:Activités de Modélisation, d'Évaluation, de Simulation”</i>, ICAR Université Lyon http://www2.ac-on.fr/enseigne/physique/phychi2/spip.php?rubrique27 	<ul style="list-style-type: none"> ○ English/ French ○ French
Germany	<ul style="list-style-type: none"> ○ <i>„SINUS -Steigerung der Effizienz des mathematisch-naturwissenschaftlichen Unterrichts”</i>, IPN Kiel (1998 bis 2003) ○ <i>„SINUS Transfer“</i>, IPN Kiel (ab 2003) http://www.sinus-transfer.de/ ○ <i>„SINUS Transfer Grundschule“</i>, IPN Kiel http://www.sinus-grundschule.de/ ○ <i>„PING- Praxisintegrierte naturwissenschaftliche Grundbildung“</i>, (1993-1997) http://www.ping.lernnetz.de/pages/index_DE.html ○ <i>„CHiK - Chemie im Kontext“</i>, http://www.chik.de/Englisch/index2.htm ○ <i>„IMST- Innovations in Mathematics, Science and Technology Teaching“</i> http://imst.uni-klu.ac.at/english.php 	<ul style="list-style-type: none"> ○ German/ some doc. in English ○ German/ English ○ German ○ German ○ German/ English ○ German/ English

Hungary	<p>In Hungary there are no programs or projects as such, but two successful courses for teachers and PhD students:</p> <ul style="list-style-type: none"> ○ "Course for teachers teaching integrated science subjects" - organized by alternative economy secondary school , Budapest ○ "Doctor-ship school for physics teachers" 	
Norway	<ul style="list-style-type: none"> ○ "VITEN" http://www.viten.no/ http://www.viten.no/eng/ ○ "large database for science teachers- NATURFAG" http://www.naturfag.no/ ○ "Georg- Geology in senior high school", national centre for science education, Norway) 	<ul style="list-style-type: none"> ○ Norwegian /English ○ Norwegian
Spain	<ul style="list-style-type: none"> ○ "Climantic, Environmental education project", of the Autonomous community of Galicia http://www.climantica.org/climanticaFront/en/page/Weblog ○ "ALDEA- Environmental Education project", from the Autonomous Community of Andalucia" http://www.juntadeandalucia.es/averroes/programasyactuaciones/aldea.php3 ○ Roda USC, Universidade de Santiago de Compostela (webpage although still in construction) http://rodausc.eu 	<ul style="list-style-type: none"> ○ Galego/ Castellano/ English ○ Spanish ○ Spanish
UK	<ul style="list-style-type: none"> ○ "CASE - cognitive acceleration in science education", based at King's college , London http://www.kcl.ac.uk/schools/sspp/education/research/projects/case.html ○ "IDEAS -Ideas, Evidence and Argument in Science" (Osborne, Erduran and Simon,2004), King's college, London http://kcl.ac.uk/schools/sspp/education/research/projects/ideas.html /resources' available in different languages – international impact) ○ "CSciTeach -Chartered Science Teacher", ASE in collaboration with the Science Council http://www.ase.org.uk/htm/thease/siteguide.php 	<ul style="list-style-type: none"> ○ English ○ English ○ English

The French project “**PEGASE**” is created for science teachers and teacher educators at the secondary level. The site is designed to provide resources for teaching sequences with comments and videos. The site is directed towards ideas for both teachers in classrooms as well as for teacher professional development.

“**Climántica**” is an environmental education project in Spain designed for secondary students. Students are asked to deal with environmental problems related to global climate change through eight teaching units. These units may be used across the curriculum with teams of teachers. In addition, its structure makes possible for teachers to use isolated chapters, or extract those parts considered more useful for students.

“**CASE**” is an intervention program of 30 activities (thinking lessons) to be used within the science curriculum at grade seven and eight (UK). Each lesson is designed for one class lesson. There is a particular teaching model involving careful and strategic use of group work.

“**IDEAS**” is developed to assist teachers of science at elementary and secondary schools (UK). The materials are designed to help teachers improve their skills in teaching about ideas, evidence and argument in science education. The materials consist of an in-service workshop pack, which is supported by a DVD. “Ideas” has been widely used outside of the UK.

“**CSciTeach**” is an award (UK) that recognizes the professional standing of an individual working in that science. The award accredits and values the recipient’s expertise in science education and commitment to updating their knowledge, skills and understanding.

The aim of the “**SINUS-Transfer**” program (Germany) is to improve the competence in mathematics and science by disseminating the results of the SINUS program on a much larger scale. The SINUS program basically focused on a frame of modules. The modules represent “problem areas” in mathematics and science education as pointed out by expert groups. Next to these contents of TPD, SINUS built on the cooperation between teachers, subject staff at a school, and school networks. Furthermore, the program was characterized by systematic formative and summative evaluation components. The SINUS program is the basis for new ideas in TPD in Norway and the Czech Republic.

“**ChiK**” is a German project designed to further develop chemistry education. Accompanied by colleagues from school authorities and science educators, participants developed new teaching units for chemistry education for all grades and types of schools. The lessons provide as much methodological variety as possible.

The Norwegian “Viten” project is a web based science curriculum designed to supplement other types of teaching materials. Three viten units have been translated into English (Northern Lights, Photosynthesis and Global Warming) and are available for teachers throughout the world. Viten units are used in TPD courses for teachers to introduce the use

of ICT into science teaching. Viten units are also translated into Danish and Swedish, demonstrating the possibility of transfer between country and context.

VI) Criteria for success of good practice programs

One of the aims of work package 6 in the Mind the Gap network it is to compare and analyse existing models and programs of teacher professional development in the network, looking at criteria for successful programs in the participating countries. All referred programs or projects in the previous section are characterized by being particularly successful in the respective European country. Which criteria determine the success of these projects in the eyes of the leading experts in the professional development in science education? Which requirements for success do the questioned experts see? The following chapter shows (based on the interview statements) which indicators were pointed out by the interview partners. Countries are sorted in alphabetical order.

Denmark

The most mentioned criteria for successful programs is relevance for teachers which means *“that they can use it in their practice”*(3). Another important criteria is that: *“the motivated participants from courses may be used as developing agents at the schools”*(3). The last point is particularly important for impact of TPD courses.

Summary – Criteria for success/Denmark

- Relevance for teachers practice
- Satisfied participants as developing agents at schools

France

The evaluation of student achievement and comparison with other students is an important criteria along with: *“The use of the teacher resources which are produced. Are they used by other researchers and teachers”* (14). Likewise to the interview partner from UK the French expert sees teacher involvement as a strong indicator for success: *“One important criteria is own perception of the teachers who participatehave they improved or modified, have they changed their way of teaching”* (14).

Summary – Criteria for success/France

- Evaluation of student achievement
- Teacher resources
- Teacher involvement (perception, change in practice)

Germany

The German interview partners classified the following as important criteria: *“a high acceptance with teachers and students, positive effects on achievement of the students, high innovation potential, a coherent concept and evaluation able to prove the impact”* (12). Consistently with research findings in view of the effectiveness of teacher professional development the experts also describe the importance of long term structured programs, based on active learning and collaboration, as well as general a good cooperation between all involved partners in teacher education. In addition, the German experts emphasize the importance of scientifically based expertise for providers of TPD. The SINUS program from Germany was developed through such expertise. In the SINUS program there are eleven modules which address the major deficiencies of science and mathematics instruction in Germany. These modules concern the methods of teaching and learning and selected certain topics and contexts in which teaching is embedded (e.g. learning from mistakes).

“The benefit is that one sees a starting point. If we tell a teacher generally that she should improve a lesson, this has no effect. If, however, we look at particular tasks the teacher is using in her lessons, this has an effect! By focusing on specific tasks the teacher is able to improve her lessons”(8). Summarizing, one German expert said: *“The main success factors are: Working together with external support, one is able to solve problems together and the profession progresses”* (11).

Summary – Criteria for success/Germany

- High acceptance with teachers and students
- Positive effects on achievement of the students
- Active learning in programs
- Collaboration and cooperation
- Scientifically based programs
- Module structure

Hungary

The Hungarian experts mentioned that *“the courses should feel successful and consistent with what teachers are able to do in practice so that they are more motivated and satisfied with their own work”* (1). Furthermore it is important that the teachers are more willing and more open to cooperating with colleagues. Another interesting perspective was highlighted:

“In my opinion an important criteria is to produce new teaching materials that teachers could use while they are teaching. Currently this is a general problem in Hungary, that we need new type of teaching materials as well”(2).

Summary – Criteria for success/Hungary

- Support teachers for success in improving own practice
- Cooperation between teachers
- Production and dissemination of new teaching materials

Norway

From the Norwegian point of view a program is successful if *“the numbers of teachers using it is large”* (13). In relation with this it is necessary to have research which looks at classroom use. A good project must establish a culture which fosters an environment allowing teachers to come together and discuss projects. Finally it is essential that good programs be disseminated to teachers through magazines or websites.

Summary – Criteria for success/Norway

- Numbers of teachers using it
- Research looking for classroom use
- Spread throughout country
- Discuss projects from practical perspective

Spain

Important criteria for success are *“that they produce change in practice and that teachers are able to show ownership in the program”* (5).

Summary – Criteria for success/Spain

- Change in practice
- Ownership of the teachers

UK

One of the most important criteria is that the programs are evidence-based. This means that *“they have been tested and shown to improve teacher’s practices and students learning, using skill development of particular skills as a measure of success”* (15). Another point is the involvement of the teachers which guaranties a better linking with daily life in the school. For example the teachers were asked: What is good science in your school? *“Is it when you're asking questions or when you're outside or when you do something practical?”* (7). These may then be used as the criteria against which you measure your success rate.

“So we are trying to be sort of top down and bottom up at the same time, if you see what I mean in terms of using the research but applying it on a local practical level which is relevant to that school and their circumstance”(15).

A further criterion is the evaluation of each course for example with teacher feedback. In addition there is follow up research with the teachers to find out about their impressions of the course.

Summary – Criteria for success /UK

- Evidence based (measure of success)
- Linking with daily life in school – involvement of teachers
- Mix of top down and bottom up
- Research based and applying on local level
- Evaluation of courses with teacher feedback

Summary

There seems to be consensus that TPD courses are successful when they are relevant to the context teachers find within their schools and classrooms and when they are relevant to the content teachers need to teach. Teachers want help in designing their lessons in such a way that their students will learn more science and they want to feel a sense of ownership in that process.

VII) SINUS-one effective model of teacher professional development in Germany

One aim of the Mind the Gap project is to explore the possibilities of transferring successful models of professional development from one European country in other countries. A series of workshops was held to introduce the successful SINUS project to researchers, educators and policy makers from the participating Mind the Gap countries. At the workshop in Lyon (2009), participants discussed the possibilities of transfer of this program in the own educational system. After the workshop a questionnaire was developed to find out is implementation of SINUS was at all possible in different countries.

The SINUS program was developed and implemented in Germany (Prenzel et al., 2009). The program named “SINUS – Increasing the efficiency of mathematics and science instruction” started in 1998 and ended in 2003. The idea of SINUS was to change and improve the instruction in mathematics and science education. 180 schools from 15 federal states in Germany participated in the first phase of SINUS. These schools were organized into 30 sets of 6 schools each. A total of 1000 teachers participated in SINUS. The module system (11 modules) is at the core of the SINUS conception. The starting point for their development was provided by problem areas in mathematics and science instruction which were identified in the middle of the 1990s by international school comparison studies (e.g. TIMSS). The modules are connected by having the common aims of improving learning and promoting students’ motivation. They can be combined flexibly. So it is possible for schools

to start their common work at various points (vgl. Prenzel et al. 2009). An important principle of the work with SINUS is the cooperation between the teachers of a school and with teacher of neighborhood schools (school sets). In these networks teachers learn from each other, discuss together and reflect their own instruction as well as share experiences (For more detailed information see Prenzel et al. 2009).

In the following we give an overview of the results of the analyses of interview data in view of the question of dissemination in other countries. This is reported in alphabetical order and illustrated with statements of the interview partner.

Interview question: Is the SINUS- model one that could be used in other European countries?

The Danish experts describe the SINUS model as very inspiring. They reported on a quite similar model at the upper secondary school which they have had 10 years ago. This model was a kind of *“cascade model where we have those developmental notes, where teachers met around problems and they received resources for instance they could use to have a lecture and they could buy books together and so on”* (3). The difference between these two models is that in the Danish model *“the teachers themselves formulated the problem responded to deal with. While SINUS kind of has developed some packages for use, our teachers developed their own packages”* (3). The reason is that there is a lack of money in area of teacher in-service training in Denmark *“we will not implement exactly the same project, perhaps something like SINUS”* (6).

From the French perspective there is more reservation about the implementation of SINUS. *“But the structure of SINUS as a whole seems for me as not easy to develop like that or to take some main ideas certainly... but not the structure like that it seems rather difficult.”* (14) However some ideas from the program could be very useful (e.g. cooperation between teachers).

We consider the German expert group even though SINUS program was already implemented in all federal states. Therefore, we have modified the question in direction: Do you think the other partner countries could use and implement the SINUS program? *“Yes, I think in view of the basic principles”* (12). Because the general conditions in some European countries are better developed than in Germany. For example *“I think that the Scandinavian or in the Swiss schools could implement this since teachers have longer working days at the school.”* (11). Allowing teachers time to work on the SINUS modules and discuss their practice is an important part of the implementation of the program.

For Hungary it is a very interesting model, *“because now the situation in Hungary is quite similar to that in Germany in the 90s when the SINUS started”* (1). In this view there are

many parallels. *"It would be a good idea to introduce it here. We would like to use some elements and also the whole idea of SINUS"* (1).

Also the Norwegian expert group sees the SINUS program as a very interesting concept and approach and see possibilities of adapting SINUS to their own system. *"I don't think we could start from page one and then implement the program, sort of mechanically. But I think we can use these ideas and they fit in with so many things that we already do"* (9). However they critically noted that the model is very expensive, *"in terms of money and in terms of people time"* (13).

"I think that SINUS is a big program but if we do it here in Spain it would be a different thing, then it is not SINUS" (5). The expert describes SINUS as useful for his country but there is a lack of money in Spain as also in Denmark. The seventeen autonomous regions make implementation also a challenge in Spain.

For the UK, SINUS is also seen to be an interesting and inspiring model for TPD. And like Norway, they see that parts of the SINUS model could be adapted in the US rather than the whole program. In UK *"it would be difficult to implement in the same way sort of financially and practically because we have local and regional administrative boundaries and areas"* (10).

In summary, it becomes clear that all experts see SINUS as a useful model for TPD. Most statements also show some reservation in view of the implementation in their own country. Dissemination of the model could be possible, but in ways other than the model from Germany which was also described as being very expensive. The ideas of SINUS are regarded as useful by almost all participants. The implementation however, would have to be adapted to the specific conditions of TPD in the respective countries.

Summary

In the report we focused on activities of work package 6: dissemination and professional development. In chapters I and II we systematically summarized knowledge about teacher professional development in the Mind the Gap network countries. In chapter V we illustrated successful programs of teacher professional development from Mind the Gap countries. Based on discussions about the SINUS program in Lyon together with in-depth interviews we explored the question of possibilities to use the SINUS program in partner countries (chapter VII). It was noticeable that the majority of the questioned experts see SINUS as an inspiring model. However, to implement it in its entirety in other countries, adaptations are necessary because structures of the educational systems as well as structures for TPD are different. Nonetheless the ideas of SINUS (e.g. module system, school networking, long-term) were regarded as useful. In view of existing models of TPD in European countries, similar projects were described yet none were long-term like the SINUS project.

With regard to success criteria for effective models of TPD there was broad consensus among countries. Experts referred to evaluation and measuring, linking with everyday practice of teachers, research based concepts, teacher's involvement, long-term activities, cooperation between teachers and institutions which are involved in teacher education as necessary factors for successful TPD. These factors seem to match those described in the literature for successful TPD (Desimone, 2009).

Whereas systems of education and TPD do differ in participating countries, there seems to be consensus about the aims and ideas of what constitutes good teacher professional development for science. These ideas were reflected in the Mind the Gap workshop in Lyon, where science educators and educational administrators had the opportunity to exchange ideas through discussions and presentations. There is the necessity for more and regular meetings across Europe to bring together existing research and development projects and so to create synergy effects on a European level (Jorde & Klette, 2009). In this way the project can contribute to systematic and specific knowledge on teacher professional development which can help teachers to increase their knowledge and change in instructional practices. Substantiated knowledge about teacher professional development in science education contains the chance to transfer into other learning domains.

The Mind the Gap project is now participating with the EU funded STEAM project where TPD in science is also the main theme. The SINUS model for TPD is currently being adapted for use in Norway and the Czech Republic. Exchange of ideas of successful TPD structures between countries continues in this new network, which has expanded to 15 countries in Europe (<https://www.ntnu.no/wiki/display/steam/>).

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Appendix I

Anonymisation scheme for qualitative interviews Mind the Gap

Short cut	Number	Expert from:
MR	1	Hungary
LS	2	Hungary
JD	3	Denmark
AI	4	Norway
JA	5	Spain
OG	6	Denmark
BB	7	UK
CH	8	Germany
MD	9	Norway
KT	10	UK
MP	11	Germany
GB	12	Germany
DJ	13	Norway
AT	14	France
SE	15	UK
BE	16	Denmark