

Dear readers of the STEM PD Net newsletter,

*Dealing with an **increasingly complex reality in class** is a development which has accelerated in the last years and puts high demands on teachers. Thus, teachers need support through professional development (PD) activities to adopt new integrative methods. This need is particularly pronounced in STEM teaching (Science, Technology, Engineering and Mathematics), since STEM is a field in which all pupils, including migrants or those from disadvantaged backgrounds, should acquire appropriate skills in order to ensure their participation in work and life.*

*Nowadays, the need for high-quality STEM teacher PD and the promotion of approaches that allow teachers to deal with complex classroom realities has been recognized. This can also be seen in policy documents and reports such as the **science education report** (Science Education for Responsible Citizenship, European Commission 2015). It is also evidenced by the recent trend in Europe to **establish PD centres to promote STEM teacher PD**. However, these PD centres were not connected to each other and did not exchange experiences. Hence, the aim of the **European Network of STEM Professional Development Centres (STEM PD Net)** is to strengthening the position, work and knowledge base of STEM PD centres across Europe: through transnational exchange and mutual learning in a stable European PD centre network, through linking research with practice, through developing ready-to-use guidelines and reference materials for STEM PD providers. This will also contribute to improving the quality and relevance of STEM teacher PD on a large scale.*

That is the essence of our new project STEM PD Net, funded by Erasmus+ KA2 (Key action for ‘Cooperation for Innovation and the Exchange of Good Practices’). We would like you to join in!

Your STEM PD Net team

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Read about

European STEM Teacher Professional Development: the Network and the Project

What is the 'European STEM Professional Development Centre Network'?

The network is the origin of the STEM PD Net project. The network grew out of the idea that national PD centres should be connected and work together at the international level since they have similar aims and agendas, namely: investing in teacher professional development to **substantially improve STEM education**. Despite different national circumstances, foci and structures the national PD centres across Europe encounter similar concerns and challenges. Therefore, bringing together and connecting these centres is essential. This will ensure knowledge exchange to improve local practices in STEM professional development as well as strengthen the voice of practice when it comes to shaping innovation in STEM education in Europe.

To date, five meetings of the European STEM Professional Development Centre Network took place since 2014 in Germany (twice), Lithuania, Bulgaria and Czech Republic. The European STEM Professional Development Centre Network has also grown substantially since its initiation in 2014 and currently comprises around **30 STEM PD centres from 12 European countries**. They are either independent organisations or affiliated to educational authorities like Ministries of Education or to Universities. The University of Education Freiburg who has acquired a renowned standing in Europe in the field of promoting innovative practices in STEM education serves as the Network Coordinator.

More information about the network can be found under: www.ph-freiburg.de/international/STEM-PD-Centre-Network

What is the project 'European Network of STEM Professional Development Centres' (STEM PD Net)?

The network members are proud that only after two years of the first meeting they bid successfully for competitive EU funding. The project STEM PD Net is an essential step to further strengthen collaboration within the network.

STEM PD Net is supporting STEM teaching through strengthening partnerships with and among PD practice by setting up a European project and network as a stable partnership among PD providers. Thus, the STEM PD Net project also strengthens the national position of STEM PD centres and their potential for forming effective local partnerships through the involvement in the European network.

The development and promotion of a **compendium of PD provider models** will encourage ways forward to establish new specialized centres in STEM PD across Europe, where they do not yet exist. A **set of policy briefings** aims on strengthening the partnerships to communicate with policy makers.

STEM PD Net aims to improve the quality of STEM teacher PD delivered in Europe on a large scale by:

- setting up research-based **criteria for high-quality PD** and enriching these with good-practice examples
- developing **ready-to-use guidelines** on how to feasibly measure the success of teacher PD in day-to-day settings as a mean of quality assurance in relation to the criteria for high-quality PD,
- developing a **catalogue for PD providers** showcasing good-practice examples on how to prepare teachers to deal with diversity.
- collating a **commented collection of STEM PD material** allowing PD providers to easily find and select materials with a focus on their purpose, content, quality and potential.

With our various activities, for example transnational learning activities and multiplier events, we aim to reach **target groups** like PD centres within the partnership and beyond; individual facilitators of PD and policy makers. Additionally, teachers will be reached through activities of the PD centres.

STEM PD net is represented by the following partner universities, centres, schools and PD providing institutions:

University of Education Freiburg, Germany (Coordinating institution)
University Klagenfurt, Austria
University of Innsbruck, Austria
Institute of Mathematics & Informatics at the Bulgarian Academy of Sciences, Bulgaria
Ljuban Karavelov School, Bulgaria
Texas Instruments Education Technology GmbH, Germany
University of Duisburg-Essen, Germany
Spanish Ministry of Education, Culture & Sport, Spain
Education Development Centre, Lithuania
Gymnasium of the President Valdas Adamkus, Lithuania
Linköping University, Sweden
University of Gothenburg, Sweden
Turkish Ministry of National Education, Turkey
Hacettepe University, Turkey

Work in the partner countries

Communication towards policy – strengthen cooperation and giving PD centres a voice

PD centres and policy makers are important key-actors in STEM education. They therefore need to communicate and cooperate in order to overcome the challenges in providing high quality STEM PD. This is important as high-quality PD will support teachers in delivering high-quality STEM education for pupils. An important question is how the **cooperation between PD centres and policy makers** can be strengthened?

During the STEM PD Net Kick-Off meeting in Freiburg, Germany, in December 2016 we ran a workshop aiming at identifying different aspects of the communication between STEM PD Net members and actors at the policy level.

Main questions concerned were: What institutions or organisations are considered as “policy makers”? What can STEM PD Net offer? What are the most urgent topics to discuss? How can we initiate fruitful communication?

The outcomes of the workshop show that it is necessary to address both **formal and informal stakeholders at the policy level** and form different forums where issues can be discussed. Among the most important topics for communication between PD centres and policy makers were: long term planning for STEM education, better relationship between research-policy-practice, quality criteria for good STEM education (a guide will be developed within the project), spreading of experiences and good practice at the organisational arena on running cooperated projects between STEM PD centres and policy makers.

Apart from setting the topics, it is also important to support a fruitful communication by **agreeing on common frameworks and standards as well as establishing platforms for cooperation** and channels for communication in different countries. For example the SINUS project in Germany, the IMST network in Austria, the Lärarlyftet from Sweden and last but not least the Educating the Educators conference with many countries involved exemplify how successful cooperation between STEM PD and policy can look like.



Results from the policy workshop

(Claes Klasander, Swedish National Centre for School Technology Education, Sweden)

STEM PD Net presented at the Ministry of Education and Science in Lithuania

In January 2017 the Lithuanian partner from the Education Development Centre attended a meeting at the Ministry of Education and Science Lithuania organized by Lifelong Learning Departments' Teacher Activity Division. The aim of this meeting was to present international projects currently being implemented by institutions under the Ministry of Education and Science Lithuania and to search for **synergies and ways of cooperation across the projects and institutions**.

The Education Development Centre team took the opportunity to present STEM PD Net amongst other projects implemented at the centre (e.g. MENTEP, STEM capacity building, Teachers Professional Competences Common framework). Participants of the meeting were informed about the project's aims, target groups and outputs. The chairs of the meeting welcomed the focus on STEM and in-service teacher training and emphasised its relevance. The Ministry of Education and Science Lithuania also stressed that the project STEM PD Net meets nationally and internationally **highly important goals** and **a great potential**. Amongst others, STEM PD Net is going to set up a platform which provides ready-to-use professional development materials (for mathematics and science) collected and used by European PD centres. The Ministry of Education and Science Lithuania announced to support the dissemination of project's results like this material collection to different stakeholders more actively in future and plans to create a unified platform to share project's outcomes.

(Rūta Mazgelytė, Education Development Centre, Lithuania)

An example of modern STEM teaching: Engaging students as partners in a research team

An interview with Eleonora Pavlova, an IT teacher in the High School of Mathematics in Varna

In my long professional life I have been working with a great number of very motivated teachers and students, ready to tackle open problems of various kind (not only mathematical ones). A relatively newer extension of a joke by George Bernard Shaw reads: *Those who can, do; those who can't, teach; those who can't teach, interview those who do and teach*. And here I am, ready to interview Eleonora Pavlova, a teacher in IT from the High School of Mathematics „Dr. Petar Beron” in Varna. Eleonora is known not only as a teacher who inspires her students to do original research but as a specialist who is actively involved in the professional development of other teachers in helping them implement the ideas of inquiry based learning (IBL).



Eleonora Pavlova holding a PD course

It is sometimes believed that in order to be engaged in inquiry oriented activities students need to design scientific investigations from scratch and carrying them out on their own. In fact, there are different levels of inquiry that students can progress through as they move toward deeper scientific thinking.

Eleonora Pavlova shares good practices in the highest levels of IBL – the **guided inquiry** (where the teacher provides students with an open research question, and students design the method to solve the problem with mentoring support), and the **open inquiry** (where students can act like scientists, formulating their own hypotheses, carrying out investigations and communicating their results). This level requires experienced scientific reasoning and domain competences from students.

The most recent event at which I enjoyed Eleonora's presentation was a PD Seminar for teachers on how to be a mentor of high school students working on research projects in mathematics, informatics and IT. The seminar was held from 13th to 15th of January in the town of Vratsa, within the traditional Winter conference of the High School Students Institute of Mathematics and Informatics, affiliated with [IMI-BAS](#).

Here are my questions to Eleonora I took the chance to pose during the coffee-break:

Q. Isn't it kind of risky to work with high-school students on open problems?

A. This is absolutely necessary. I think that we have to give our students open problems in order to get the chance of looking for the answers together. Such problems are not only for students who are high achieving in

mathematics and informatics Olympiads. Everybody has its own original way of thinking and could contribute to solving the problem. Furthermore, even the smallest progress in the work makes the students feel like researchers, like discoverers. Thus, the students are motivated to work harder – they enjoy their efforts being noticed and appreciated. Many colleagues do not feel comfortable when they don't know the solution of a problem or when they cannot answer a question. But the very notion of an “open problem” means that there is no known solution and we have to seek it together with our students.

Some time ago, when I was coaching a group of students for contests and Olympiads, one of them gave a very precise description of our activities: „All of us here are willing to do something we don't know how to. But we got here together to learn how to do it together...”

As teachers we do not just convey knowledge. We are role models. Our students follow what we are doing and copy to a great extent our behaviour. We can't teach them how to stay calm and confident, and how to reason in an unknown situation if we ourselves do not act like that in such a situation.

Q. Which is the most crucial feature of working on projects in inquiry based style?

A. The project-based work is extremely interesting and very different from the work in the regular classes. When my students work on a project they tackle an open problem, sometimes formulated by them. We try to solve the problem together, as a research team. The role of the teacher is to direct the process, to channel the efforts, to prevent a waste of time and energy. When working on projects the students enrich their knowledge but not only that. They develop soft skills and competences of a great importance for their successful professional development in the future. The reason for this is that the students pass through all the stages of planning, development and presentation of a product.

Q. mascil (mathematics and science for life! <http://www.mascil-project.eu>), a partner project of STEM PD Net, aimed at promoting a widespread use of inquiry-based science teaching and to connect mathematics and science education to the world of work (WoW). You are one of the Bulgarian mascil multipliers, carrying out professional development courses on connection IBL and the WoW in class. Could you give a couple of examples demonstrating how you have used the project resources in support of IBL and WoW?

A. I have used the mascil Problems of the Month as ideas for projects my students could work on in the IT classes. Usually I modify the scenario so that it requires more working hours - the focus is on the gathering of information, analysing and visualizing it, on the development of the presentation skills, on the team work (i.e. – on the IT- enhanced soft skills).The problems are very interesting and allow for large enough and free interpretation. When working on such problems my students can show their creativity and get convinced in the applicability of the knowledge acquired at school. Let me be more specific:



mascil classroom material 'Bicycle Insurance'

After you introduced us to the Bicycle insurance problem at the seminar "Dissemination of Inquiry Based style of Education" in October 2014, I tried it out with my 7-graders in our classes in IT. In view of the specifics of the IT syllabus I had to modify the scenario by envisaging more hours in a class setting including data analysis (based on Excel). We invited a parent who works in an insurance company to talk about the specifics of his profession. The students learned how to create and use mind maps, to determine the direction of the project development.

The teams that were formed presented their own formulae for insurance. Then, after discussing the different versions, they came up with a general formula.

The 7-graders worked with enthusiasm and although the time was limited they acquired valuable competences in team-work and in information search. They were satisfied with their achievements and now they are actively participating into interdisciplinary science projects.

During the next school year I was working with 10-graders using the same scenario but requiring them to create more products. In addition to creating a formula and presenting it, they were expected to prepare

advertisements and a contract for insurance. The students started to work on the problem in October and were working on it during the whole school year. Thus they were able to implement their math and IT knowledge from previous years and to carry out step-wise refinements and enrichments of their products.

At the end of school year 2015 (as a homework for the holidays) I gave to the 12 graders-to-be the Problem of May - Design of a parking entrance I did not give them directions since I wanted to see how they would tackle such a real-life problem. I wanted them to feel the necessity of constructing a dynamic model as a basis for experiments. They spent sufficient amount of time to discuss and then present their ideas. I split the class in groups and every team had to suggest its own method, to defend it and to construct a relevant model. At the end of the session the students were convinced that the project topic and what we study in the IT classes are related and that they were able to assist the work of designers and architects by means of computer model.



masci classroom material 'Parking Entrance'

Q. You already have remarkable success in mentoring students to do research at the highest levels of IBL. What type of help was crucial for such a success?

A. The motivation of the students, the collaboration with their peers and teachers, the mutual trust and support are crucial for the success of the work in IBL style. The support of my colleagues and the school board are also very important for a creative atmosphere. Our role is to teach students to ask for help when necessary and to identify the right people for such help. It is often the case that university professors, scientists from IMI-BAS as well as business experts mentor students during their research. Alumnae of our school are also very helpful with professional advice and ideas. To work on innovative tasks, at the highest levels of IBL, is time-consuming and requires a lot of efforts. That is why we should not underestimate the support and understanding the students get from their families.

Thank you, Eleonora. And good luck to all your students! Three of them got a diploma for excellence at this conference and we are following with interest their further steps.

(Evgenia Sendova, Institute of Mathematics and Informatics at the Bulgarian Academy of Science, Bulgaria)

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