mascil

Dear readers of the mascil newsletter,

Interest in innovation in maths and science education is the factor that unites our readership. Whether you are working at the policy-making level, a teacher educator or an individual teacher exploring the frontiers of maths and science education in 21st century classrooms, we are pleased to present you with the second mascil newsletter. Supporting high-quality, engaging and relevant maths and science education is a central aim of the mascil project. Our multi-level work addresses both stakeholders and actors as we seek to foster meaningful maths and science education. Here in particular, our approach connects inquiry-based maths and science learning (IBL) to the world of work (WoW). But, how can world of work aspects benefit and promote inquiry-based learning? And how do researchers who are trained and based at universities actually get access to the world-of-work?

We´ll share some answers to such questions in this edition of the mascil newsletter which will also present interesting results of a study conducted to assess the contextual challenges of our approach, and point to policy implications of it.

We are also proud to announce our 2014 conference in this newsletter. We hope to welcome many of you in Essen, Germany this year for an exchange centred on the topic: 'Educating the educators – international approaches to scaling-up professional development in maths and science education'.

Your mascil team

THE MASCIL PROJECT: ADDING WORLD OF WORK ASPECTS TO INQUIRY-BASED LEARNING APPROACHES

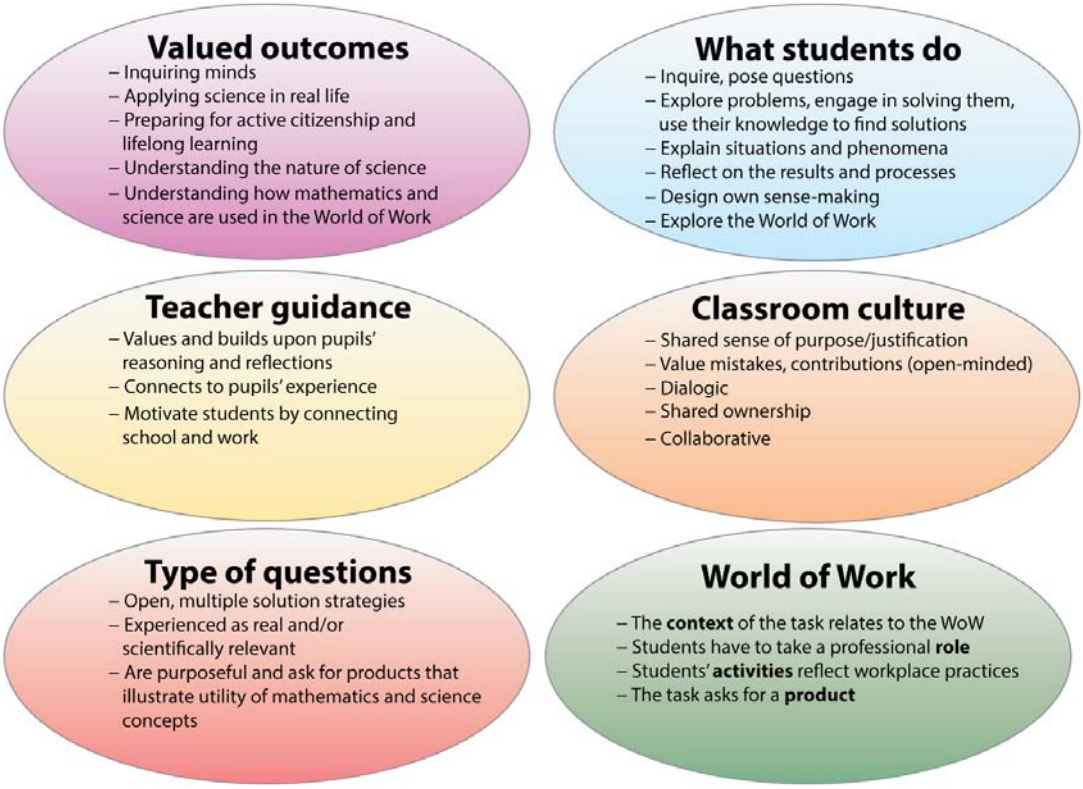
The heart of the mascil project is to promote more meaningful and motivating science and mathematics teaching and learning. Our approach more closely connects school to the world of work in IBL lessons.

Inquiry-based learning aims to develop and foster inquiring minds and attitudes that are vital for students to be able to successfully take on their future roles as productive and capable citizens in our modern, global society. Fundamentally, IBL is based on students adopting an active, questioning approach. The tasks they address are supposed to be experienced as real and meaningful as they explore problem situations and evaluate results. Learning is driven by open questions and multiple-solution strategies. IBL is a perspective on learning that creates a new learning culture in the classroom.[1]

[1] See the PRIMAS Youtube-Channel that features short videos about IBL and gives you first-hand experience of what an 'IBL-classroom' can look like (http://www.youtube.com/user/PRIMASProject/videos)

The European Commission has supported a number of projects with aims similar those of mascil[2]. The major innovation of mascil is to connect IBL to the world of work so as to make students' learning experiences more meaningful and further, to eventually motivate their interest in careers in science and technology.

The figure below provides a quick overview of the initial mascil framework that summarises some fundamental aspects of inquiry-based learning supported by world of work aspects. All our work eventually aims to support *'inquiring minds'* and we *value educational outcomes* such as active, critical and science-literate young citizens. We use an inquiry-approach to learning to achieve this. The *IBL approach* is characterised by appropriate teacher guidance for the students, asking specific (open) types of questions and by the specific ways in which the students work: experimenting, choosing strategies and finding – and explaining – solutions. These components foster a certain type of *collaborative classroom culture* that further contributes to students' learning.



The *connection to the world of work* (see the figure) is an aspect added to the inquiry-based learning environment as a specific focus of the mascil project. Our inquiry-based learning materials and courses are developed to include vocational and WoW aspects. Working on tasks with such concrete aspects related to real life and the world of work helps students experience mathematics and science as being real and meaningful for their lives. The WoW aspect in inquiry-based learning tasks and materials thus fosters the desired learning outcomes of IBL approaches.

If you are a teacher, teacher educator or researcher you may be interested to know more details about the WoW-aspect in our materials and courses. More information – including a first collection of IBL-WoW classroom materials – is on our website; or you can simply get in touch with our international team.

[2] Projects with similar aims – like Primas, inGenious, Parrise and others – have been supported within the 7th Framework Programme (Science in Society strand), as well as the former LLP Programme (now in ERASMUS+). The Scientix project provides a platform (www.scientix.eu) on which many projects supporting maths, science and technology education are accessible.

RESEARCH-BASED TEACHER EDUCATION GETTING IN TOUCH WITH THE WORLD OF WORK

Most mascil project partners are based at universities or research institutes. Our team comprises a group of experts in the fields of mathematics and science education and inquiry-based learning. At the same time, universities and the world of work are two fields that are traditionally not interconnected. It is therefore necessary for university-based teacher educators to seek contact with the world of work and to learn and draw insights from such contact in order to develop top-quality professional development and classroom materials.

mascil partners have found and experienced different ways of making contact with the world of work. We will present two examples of such cooperation and the resulting outcomes it led to: how research-based teacher education and the world of work inspire and challenge each other, how IBL-WoW classroom materials for general education gradually develop in such settings and how one such cooperation successfully introduced IBL in vocational schools.

Rotational symmetry meets creativity: the Bulgarian cooperation with a woodworking professional school

Toni Chehlarova and Evgenia (Jenny) Sendova from the Bulgarian mascil team at the Institute of Mathematics and Informatics at the Bulgarian Academy of Science (IMI-BAS) accepted an invitation to an international open house day from the Sava Mladenov Forestry and Woodworking Professional Secondary School in Teteven (about 100 km east of Sofia). The school offers education for a variety of careers in the woodworking industry, including furniture-making techniques and wood carving. The day provided the opportunity for an exchange with students and teachers at the school and with representatives from similar schools in near-by countries (e.g. Macedonia, Serbia, Czech Republic, Slovakia and Hungary).

The researchers from IMI-BAS offered a workshop in a mathematics class and introduced the 8th and 9th year students, their teacher and the school's master craftsman to a GeoGebra dynamic constructions tool based on the mathematical concept of rotational symmetry. The workshop focused on the use of the tool to produce artistic designs for wood-carved artefacts. The students explored the tool and quickly learned how to use and modify the dynamic models and create design templates they could later craft into the wood.

Exactly this act of craftsmanship and the implementation of the designs in practice were then explored in the school's crafting studio. This visit revealed the specifics of different approaches to design and their possible implications in manufacturing: rotational-symmetric 'versus' creative-artistic: The master craftsman, Mr. Raykov, explained that he based his artistic work on the natural beauty and patterning of the wood itself. He pointed to a specific point of a natural, triangular-shaped pattern in the wood. He described this point as the 'the most aesthetic one and as one where the wood would not let the chisel go further'. And he challenged the mathematicians to mathematically identify and describe this point that had immediately caught his artistic eye and around which he would centre his crafting work. After a lively discussion, the mathematicians agreed that this was not one of the well-known centres in a triangle in the plane, but obviously a 'dynamic' point in the sense that it is a matter of a creative decision in each singular case that a craftsman takes, depending on the specifics of the wood in question.

'Our approach could be seen as a powerful generator of ideas for the young designers', is how Toni Chehlarova summarises her impression on the day. All participants profited from this meeting of mathematical knowledge and artistic expression involved in wood-working. Jenny Sendova explains the next steps the mascil team is planning to take. 'We will develop a mascil scenario in which the students will learn how to use ready-made dynamic models for generating rotational designs suitable for woodcarving, and how to make their own dynamic models. As mathematicians, we would try to define mathematically the 'point of Raykov'.'

Win-win effects of cooperation: Bringing IBL into vocational schools and the world of work into IBL materials

Following an announcement of the German mascil team based at the University of Education Freiburg about the project and its offerings (such as IBL courses for teachers), a group of vocational teachers contacted the team. The group comprises teachers who educate young people involved in the food industry, such as future bakers, pastry-cooks, butchers, salespersons and professions in the hotel and restaurant trades. This group has been working together for years in a professional learning community. During their maths lessons, they were experiencing significant problems which include: deficient prior knowledge; missing understanding of mathematical concepts; weak self-confidence; and students' lack of learning motivation. Thus, the vocational teachers asked the Freiburg team led by Katja Maaß for support in teaching mathematics applied to their professions.

Vocational training and education has a strong tradition in Germany and vocational teachers often have a strong professional background. But when it comes to the universities that educate teachers for general education (like the University of Education Freiburg), there are traditionally rare linkages to the practice of trade or industry. For the German team, this was thus a great opportunity to support high-quality mathematics education in vocational schools and bring inquiry-based learning into the vocational sector. Additionally, it was an inspiring challenge for the team's work as teacher educators and a fantastic opportunity to develop IBL materials with a WoW context. The desire and need for mutual cooperation led to establishing several course programmes for this professional learning group that emphasise inquiry-based learning and advanced maths teaching approaches.

During the past months, the German mascil team and the vocational school teachers have worked together and generated motivating learning scenarios leaving behind the common presentation of predetermined calculating procedures as a starting point to learning relevant mathematical concepts. After introducing the vocational school teachers to the principles of inquiry-based learning, they collected and discussed real work problems connected to the vocations they teach to then work out IBL tasks based on these problems. 'Since vocational school teachers don't only impart theoretical but also practical knowledge, they came up with many great ideas for vocationally-oriented tasks which they further developed in accordance to the principles of inquiry-based learning', says Katja Maaß.

The tasks were then reviewed by the Freiburg team of teacher educators with respect to enabling processes of inquiry and also adapted for students in general schools. In turn, teachers tried out the new tasks in their classrooms and were pleasantly surprised by the growing understanding and motivation of their students. Katja Maaß and her team are proud of the success of this collaboration. 'With our training we show mathematics teachers at vocational schools how they can initiate motivating learning processes based on real work experiences, and through our cooperation we developed a series of IBL classroom materials with rich world of work aspects that have a really great potential to motivate students' interest in mathematics', Maaß adds.

The collaboration also led to the organisation of a professional development (PD) course where vocational school and general secondary school teachers team up. This is a very innovative concept, as Katja Maaß explains: 'In the course of the training, the vocational and general teachers work in tandems and adapt the tasks we developed in the run-up to the training to their students' needs, so that they can eventually try them out in their own classrooms.'

'When one teacher is trying out the tasks in the classroom, they are accompanied by their tandem partner. In this way, both teachers profit from each other's experiences. This concept also makes it possible to evaluate and compare the reactions of the students at the various schools,' she concludes. Eventually, this benefits students and helps us to realise our project's overall goals of students profiting from a coherent mathematical learning biography and more meaningful and motivating maths learning.

POTENTIAL CONTRIBUTIONS OF AND CHALLENGES FOR A EUROPEAN PROJECT FOCUSING ON INQUIRY-BASED LEARNING WITH A WORLD OF WORK CONTEXT

The mascil project has set out to accomplish the innovative aim of making a sustainable contribution to mainstream inquiry-based learning connected to the world of work. The implementation of an innovation depends on its context and how it is perceived. To maximise the contributions of the mascil project, a comprehensive international analysis of the educational contexts of the different countries involved in the project has therefore been carried out.

The main analysis aim was to elaborate on the opportunities and challenges in the various local settings in relation to implementing IBL and connecting maths and science education to the world of work, and further, to inform the development of future policy design in national and European settings.

Key outcomes emerged from the analysis regarding the levels of policy, school and classroom.

The policy making level: National policies that support IBL provide for the 'friendly' environment that is conducive to implementing the mascil project at the international level. However, the results also show that it will be necessary for the project and the policy-making level to direct attention to the great variations that (still) exist between individual countries. We should also be aware of, and work to avoid the danger of a backlash towards merely subject-oriented policy objectives in some countries that have a long tradition of IBL. Furthermore, the policy making level should also attend to significant incompatibilities that remain between orientations as evident in policy documents and the factual priorities in teacher education programmes. For a project like mascil, this gap is also an opportunity for building bridges between what is envisioned in general – and how it can be implemented in practice.

The school level: Despite the fact that educational policies are in favour of IBL, as well as connections between schools and the world of work, school cultures in many countries do not seem to support such changes. The analysis reveals a need to leverage change at this level. The mascil project provides for the opportunity to accelerate a change in school cultures through offering courses that are conceptually based on the latest research on professional development effectiveness, such as long-term PD, integration with the school environment and into professional learning communities. Giving sufficient regard to the different parameters pertaining to school culture will benefit the successful accomplishment of the project objectives in each country.

The classroom level: Policy orientations should eventually be manifest in day-to-day teaching and learning practice. However, the international analysis revealed that neither IBL nor connections between schooling and the world of work are of dominant classroom practice in many countries. Despite it being a challenge for a single project, mascil set out to also have an impact on this level. Suitable training activities, teaching materials, resources and teacher guidelines that will be implemented within the project, will provide a basis for change of classroom practices.

The analysis thus revealed that as we move 'down' from the policy-making level to classroom practice we can observe a gradual ebbing out of supportive environments and practices of inquiry-based learning in schools that is connected to the world of work. Implications for the policy-making level include the necessity to provide long-term and effective support for change that reaches 'down' to the classroom level. Implications for projects like mascil include a large responsibility when it comes to supporting change at the classroom and school level and an opportunity for translating policy into sustainable practice.

In a next phase of the project, all mascil consortium partners will hold national workshops to facilitate dialogue with policy makers in their countries. Policy context will be examined in more detail and partners will consider how the strategic aims of policy priorities can be negotiated for further educational improvement in the local settings.

MASCIL CONFERENCE: EDUCATING THE EDUCATORS – INTERNATIONAL APPROACHES TO SCALING-UP PROFESSIONAL DEVELOPMENT IN MATHS AND SCIENCE EDUCATION

Teachers are the key factor in ensuring the achievement of learning outcomes in mathematics and science education that foster competences and literacy in maths and science. Teachers also foster young people being interested in – and capable of – pursuing careers in these fields and help their students become responsible professionals and active citizens. The professional development of those teaching maths and science is key to ensuring such achievements. Research on the professional development of teachers (in maths and science education) is a dynamic and growing field. Scaling-up the professional development of teachers (and teacher educators) in maths and science is also receiving increased public attention, policy support and institutionalisation. In recent years for example, an increasing number of specialised centres that support the professional development of educators and teacher educators in maths and science has been set up across Europe.

The mascil project therefore has organised its first conference around the topic of 'Educating the educators' and aims to provide a platform for exchange of experiences and concepts between researchers and practitioners alike on approaches to scaling-up professional development in maths and science education.

The conference (15-16 December 2014 in Essen, Germany) has been organised in cooperation with the DZLM (German Centre for Mathematics Teacher Education). A pre-conference will be held for heads and representatives of centres supporting the professional development of teachers. Renowned researchers and influential practitioners will be present at the conference and deliver keynotes and plenary speeches.

The mascil Consortium invites you to submit research- and practice-oriented proposals (papers, reflected practice, interactive sessions, etc.). Complete information and our call for proposals can be found on our website: http://educating-the-educators.ph-freiburg.de/.

The deadline for submissions ends on 30 May 2014.

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