

## **Strategy Paper for Long-Term Valorisation Deliverable 8.1**

At the central project meeting in month 6 the partners developed strategies for valorisation on the large scale and in the long term. These ideas have been refined in the months after the first project meeting. This paper contains the results, it is the basis of the deliverables 8.2, 8.3 and 8.4.

Several offers for the development of pupils' key competences mathematics education are provided within the project KeyCoMath. Teacher students and teachers develop field-tested learning/assessment scenarios for the application in mathematics classes. In addition, mathematical competitions, workshops or mathematical camps, where pupils can spend their holidays with activities like geocaching, mathematical puzzles, paper folding or origami are organized.

A publication on the results of the project, including best practice examples, is published at the end of the project. The booklet is to be implemented as a standard reference. In order to succeed, local education authorities have to be informed about the project on the one hand, and on the other hand, the cooperation with publishing houses has to be improved. Conference contributions and scientific articles should cause discussions of ideas and research in mathematics education. There are also various nation-wide and international conferences where a topic like key competences can be broached. The findings of the project should also be made accessible to a more general public, supported with practical examples and with an interview of teachers, students and pupils about possible shifts in their attitude.

Another way to disseminate ideas in the long term is the development and maintenance of a virtual mathematics laboratory, which is available online for pupils, students and teachers.

The project partners are involved in the development of new learning materials, schoolbooks, applets, standards and curricula in their respective country and beyond. The ideas of the project for supporting key competences are included in these development processes. For that, scientific research results would be helpful. That is why research on the influence of mathematics teaching on the development of key competences will be done and presented at conferences (such as CERME, PME, ICME, etc.).

Another political point is the institutionalization of long termed in-service education including various parts of reflection, of experience in the own class, of workout and refinement of assignments and assessments. There should be also a single point of contact where teachers obtain help in planning and applying their lessons for example from the perspective of problem solving.

After the formal end of the project, the participants' general work including seminars for teacher students, advanced training courses for teachers or in-house courses at schools will progress. In this context, the presentations, lectures or workshops of project-participating people are reorganized and enriched with ideas referring to key competences and with project results.

Even other cooperation partners benefit sustainably from the developed concepts and can use the ideas of developing key competences in mathematics education. Moreover, the network of schools and universities and its sharing of project-related knowledge through joint research and development events will have ongoing multiplier effects.

Concrete strategies of the eight partners for long-term valorization of projects results are:

#### University of Bayreuth (DE)

- Implementation of didactic concepts for supporting key competences in activities for teachers' professional development in the region of Swabia and the region of Upper Franconia (for teachers who work with "inclusion" and also for teachers of regular classes)
- Development of school book "Zahlenzauber" for primary school
- Information of the Government of Swabia and the school board Augsburg on the project
- Implementation of didactic concepts for supporting key competences in initial teacher education courses at the University of Bayreuth (seminars "Mathematik Lehren und Lernen", "Fachdidaktisches Seminar", "Begleitseminar zum Schulpraktikum", ...)
- Bachelor/master theses in the field of developing key competences
- Conference contributions in the future
- Work on curricula for mathematics education (in cooperation with the Bavarian "Staatsinstitut für Schulqualität und Bildungsforschung"),
- Exploitation of project results in projects in the future, e.g. in the field of supporting highly gifted and talented pupils

#### Bulgarian Academy of Sciences (BG)

- Teacher training courses enhancing the use of ICT and IBL (Inquiry-based learning)
- Direct work with students, especially gifted ones, who are working on their own projects
- Development and maintenance of a Virtual Mathematics Laboratory available online for all schools in Bulgaria (the first steps turned to be very popular among teachers and pupils)
- Development of a competition "Mathematics with computer", where the students solve problems with the use of computer and more experiments
- Binary lessons (led by two teachers, one of them mathematician, the other from another field like physics, chemistry, biology, etc.)
- To end up every session with teachers with asking them to reflect which competences they think have been enhanced. Then they could use the same approach with their students. The feedback could be used for refinement of the resources
- To make inquiry (among university students) which competence acquired during high school math education turned out to be the most crucial and which one lacking
- To organize a pre- and post-test among participating teachers which competences are best cultivated / developed during the math education based on their personal practice
- To publish for a more general public the findings of the project, to organize interviews with teachers and students about possible changes in their attitude
- Organizing competition / contests on thematic greeting cards (commixes, tabs, etc.) using mathematics ideas for illustration

### University of South Bohemia (CZ)

- Contributions to the conference "The use of computers in teaching mathematics", supported by the Czech Mathematicians Union
- Organizing seminars by Department of Math Faculty of Education directly at schools (on the wish – our teachers at school – not teachers of schools)
- Establishing the network of schools from various regions
- Improving cooperation with another school of education and with publishing houses (e.g. Fraus Publishing House)
- Mathematical pilgrimage (camps)  
The courses organized by Faculty of Education for pupils in holidays (geocaching + mathematical puzzles, paper folding, origami etc.)
- the use of attractive examples from daily life in mathematics lessons (useful mathematics - problem solving, social, communicative, digital, professional, learning competencies)

### University of Bergen (NO)

- Initial teacher training / teacher education, bachelor and master thesis and in-service teacher training:
  - We can establish a local tradition at our University (Bergen, Norway) for inclusion of these ideas in all our teacher-related activities
  - We can publish articles in the newsletter / journal "Tangenten" which is an national, Norwegian place for dissemination and discussion of ideas and research in mathematics education. Articles from "Tangenten" (in Norwegian / Danish language) are often used in teacher education, also at other universities and university colleges in Norway.
  - We could write and publish similar articles in the Danish journal "MONA" which might be seen as a parallel to "Tangenten".

### University of Cyprus (CY)

#### Long-term activities for initial teacher education and post-graduate courses

- Ideas will be used for the university courses for pre-service teachers' education (BA)
  - Course for "Didactic of Mathematics" will be reorganized with the use of ideas from the project
  - The same will be done for the courses for the specialization topic of mathematics for BA in education
    - Didactics of Mathematics (II)
    - Use of technology in mathematics education
    - Special topics in mathematics education
- Ideas will be used for the development of post graduate courses
  - Mathematics curricular + evaluation

#### Long-term activities for in-service education

- The University of Cyprus organizes most of the courses for in-service education in Cyprus. In these courses, which pre-primary, primary and secondary school teachers participate, we will present ideas referring to key competences and how the teacher will offer opportunities to develop these competences.

Future work in the field of standards and curricular in mathematics education in Cyprus, development of new book and other learning media

- Cyprus is in the process of developing new material for the new curricular K-12 such as schoolbooks and applets. Ideas of the project will be used for these developments.

Further scientific research and paper

- Professors of the University of Cyprus and their students will conduct research dealing on the influence of mathematics teaching in developing key competences. The research will be presented in conferences (such as PME, CERME, ICME, etc.) and be submitted for publications in scientific journals

#### University of Klagenfurt (AT)

- Initial teacher education: Implementing the concept of key competences within mathematics teacher education seminars in Klagenfurt.
- In-service teacher education: Implementing the concept of key competences in various nation-wide in-service teacher education programmes (e.g. IMST, PFL mathematics, PROFIL, etc.)
- Conference contributions (e.g. CERME) and scientific papers
- Integration of key competences in the formulation of standards and curricula in Austria
- Integration of key competences into a book publication (on cooperative learning)

#### German Department of Education in South Tyrol (IT)

- Apply the strategies and concepts for in-service teacher education in KeyCoMath in the long term (working at least for one year with the same group of teachers)
- Support teachers of Sek I to develop assignments, formative and summative tasks. At the end of the process the final examination of Sek I will be changed, not only mathematical competences but also
- Intensive working at dialogic learning: “Hospitation” (observation of schools) in Switzerland. In-service education to form 10 “experts”. Support two schools (a primary, a secondary school) in establishing dialogic learning. Make these schools to “models” for others.
- Long termed in-service education will be institutionalized. These courses include various parts of reflection, of experiences in the own class, working out end refining assignments and assessments.
- A cooperation of all MINT-teachers in high school: “modellings days” in each school as an out-put.
- Regular meetings with math teachers of a centre in school to develop tasks, criteria for evaluating assessments
- Follow up meetings in in-service teacher education with the goal of distribute and discuss the application of the contents
- Assisting single teachers in planning and applying their lessons in projects as days of problem solving or modelling → Starting up a special kind of initial teacher education focused on key competences and institutionalized for every beginner involving decision makers.

### School Rottenschwil (CH)

- In-service teacher education offers on „dialogic learning“ including results and experiences from KeyCoMath
- Publication of results and experiences of the project activities in Switzerland, made concrete with best-practice examples from KeyCoMath
- Conference on project results with special focus on “dialogic learning”
- Coaching of schools and teachers’ professional development offers with focus on competence-oriented education (in cooperation with Universities and Universities of Education)
- Seminars in initial teacher education at Universities of Education including general didactic results from the project
- Emphasising didactical concepts for supporting key competences in practical courses for teacher students for primary school
- Establishing a network of schools and multipliers by common days on research and development in the field of education

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