SEFI UMBRELLA FOR TEACHING MATHEMATICS IN ENGINEERING

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Outline of the presentation

- **SEFI Mathematics Special Interest Group – 40 years**
- **Selected projects**
- **Comparation of project´methods, aims and results**
- **Final remarks and general recommendations**

SEFI Mathematics Special Interest Group – 40 years

Cooperation of mathematics teachers under the umbrella of SEFI Mathematics Special Interest Group MSIG
(former - SEFI Mathematics Working Group)

Common activities date back to the year 1982

Bi-annual seminars organised by MSIG
https://sefi.htw-aalen.de/

SEFI annual conferences

SEFI Mathematics Special Interest Group – 40 years

Successful international research teams were formed

8 European projects accepted and supported last 20 years

in different European programme schemes

Socrates, Leonardo da Vinci, Erasmus

Erasmus+ programme - centralised action managed at the European level by the European Education and Culture Executive Agency (EACEA)

Strategic partnerships or Partnerships for cooperation

Selected projects

1. **EU Socrates programme project No. 90196-CP-1-2001-1-NO-Minerva-M**

   ***X*math**, years 2002 -2004

   Coordinator: Hogskolen i Buskerud, Kongsberg, Norway

   6 cooperating partners:

   – Universita Potificia Madrid and Salamanca University from Spain

   – University in Kuopio, Finland

   – Munich software company from Germany

   – International Centre for Theoretical Physics in Trieste, Italy

   – Slovak University of Technology in Bratislava, Slovakia.

Project was aimed to explore the possibility of creating a database of mathematical modules available free on the Internet. Team of researchers was formed during SEFI annual conference in 2001 and their cooperation was successfully fulfilled with development of one basic module on **Differential Calculus**.

XMath project modules, available at:
http://www.evlm.stuba.sk/~velichova/xmathkluc/index.html

Selected projects

2. **Leonardo da Vinci programme project No. N/03/B/FF/165.011**

   dMath, years 2003 – 2006

   Coordinator: Hogskolen i Buskerud, Norway

   6 cooperating partners as in project Xmath

Continuation of the previous project aimed to finalisation of the second module of **Integral Calculus**.

First attemps to develop an on-line calculator (supported by Mathematica commercial software product) providing step-by-step calculations in a remote mode. This idea proved to be not very successful due to utilisation of an expensive software solution.

Both modules that were developed by means of innovative presentation of mathematical formulas using MathML coding in xml pages are still used as additional materials for students at the participating universities.

dMath project modules, available at:
http://www.evlm.stuba.sk/~velichova/xmathkluc/index.html

Selected projects

3. **Leonardo da Vinci programme project No. SK/06/B/F/PP-177436**

   EVLM – European Virtual Laboratory of Mathematics, years 2006 – 2008
   Coordinator: Slovak University of Technology in Bratislava, Slovakia

   7 partners recruited among participants at the SEFI MWG seminars:
   – Paisii Hilendarski University of Plovdiv, Bulgaria,
   – West Bohemian University in Plzeň, Czech Republic
   – Tulossilta Company from Tampere, Finland
   – Technical University in Miskolc, Hungary
   – University of Limerick, Ireland
   – Salamanca University, Spain
   – Coventry University, United Kingdom

Successful project aimed to develop database of on-line electronic materials available on a freely accessible platform in all language mutations.

Portal is partially functioning at some of the partner institutions.

EVLM portal, available at:

http://www.evlm.stuba.sk/

Selected projects

4. **Erasmus - Strategic Partnership project No. 2015-1-FI01-KA203-009044**

   Future Mathematics, years 2015 – 2018

   Coordinator: Tampere University of Applied Sciences, Finland

   3 partners:

   – Polytechnic University in Madrid, Spain

   – Slovak University of Technology in Bratislava, Slovakia

   – Technical University of Civil Engineering in Bucharest, Romania

Project was initiated to support teachers and students by providing a platform as well as resources for teaching and learning in digital form.

Moodle environment was used at the platform, and the idea of step-by-step calculations available for students to self-testing was realised by generated stack-exercises.

Project responded to the requirements of making mathematics' learning and teaching more digitalized, effective and accessible.

Future mathematics platform available at:

http://www.futuremath.eu/index.php/en/

Selected projects

5. **Erasmus - Strategic Partnership project No. 2017-1-PT01-KA203-035866**

   DrIVE-MATH, years 2017 – 2020

   Coordinator: PTEI Porto, Portugal

   3 partners:

   – Claude Bernard University, Lyon, France

   – Technical University in Chemnitz, Germany

   – Slovak University of Technology in Bratislava, Slovakia.

Project aimed to introduction of innovative active learning methods into the basic mathematics courses in engineering study programmes. Various learning scenarios as eduScrum, Problem Based Learning, Individual Projects, Gamification, Jigsaw Puzzles, Interactive lectures, hands-on-techniques were tested in the educational practise. Results were analysed and compared, while all gained good and bad experience was published in Project book with didactic instructions and recommendations.

Project webpage available at:

https://www.isep.ipp.pt/page/viewpage/drive_math

Selected projects

6. **Erasmus - Strategic Partnership project No. 2017-1-PT01-KA203-035866**

   RULES_MATH, years 2017 – 2020

   Coordinator: Salamanca University, Spain

   8 partners:

   – Paisii Hilendarski University of Plovdiv, Bulgaria
   – Slovak University of Technology in Bratislava, Slovakia
   – Ankara Haci Bayram Veli University, Turkey
   – Czech Technical University in Prague, Czech Republic
   – Polytechnic Institute of Coimbra, Portugal
   – Technical University Dublin, Ireland
   – Technical University of Civil Engineering in Bucharest, Romania
   – Spanish National Research Council, Madrid, Spain.

Project main objective was to develop assessment standards for a **competencies-based teaching-learning** system for mathematics in engineering education, **concept developed and elaborated at the SEFI MSIG seminars**.

Project webpage available at:

https://rules-math.com/

Selected projects

7. **Erasmus+ Partnership for Cooperation**
   Project No. 2021-1-RO01-KA220-HED-000032258
   DIGI STEM, years 2021 –2024
   Coordinator: Tampere University of Applied Sciences, Finland
   3 partners:
   – Polytechnic University in Madrid, Spain
   – Slovak University of Technology in Bratislava, Slovakia
   – Technical University of Civil Engineering in Bucharest, Romania.

This new project is going to lay the foundations of digital pedagogy by summing up experience of the two-year long distance education with heavy utilisation of digital technologies in on-line or hybrid teaching and learning during the Covid-19 pandemic throughout the whole world.

Project is aimed more theoretically, its primary goal is to provide fundamental guide to maths teachers on how to adapt teaching/learning strategies to the paradigm of the 21st century – digitalisation of all aspects of social life, not excluding education and knowledge acquisition in general.

Project webpage available at: www.digistem.eu

Selected projects

8. **Erasmus+ Partnership for Cooperation**
   Project No. 2021-1-RO01-KA220-HED-000032258
   PYTHAGORAS, years 2022 –2025
   Coordinator: Lucian Blaga University of Sibiu, Romania
   7 partners:
   – Aalborg University, Denmark
   – Karlstad University, Sweden
   – Porto Polytechnic, Portugal
   – Slovak University of Technology in Bratislava, Slovakia
   – University dela Laguna, and EVM Spanish Consultancy Company, Tenerife, Spain
   – Hellenic Mediterranean University, Heraklion, Crete, Greece.

Ambitious project striving to make learning Mathematics more inclusive, efficient, enjoyable and real, connecting Mathematics teaching with real life cases linked to the students' fields of study.

Expected intellectual outputs and results: Toolbox for teachers on Education for Sustainable Development, Learning scenarios and guide for gamifying online and hybrid mathematics education at university level, and online and open access Precalculus Course (MOOC) in English.

Project webpage available at: https://www.pythagoras-grant.eu/

Comparation of projects´methods, aims and results

YEARS 2002 - 2008

- first attempts to utilise ICT and available software products appearing at the scene in education - teaching mathematics

YEARS 2010 – 2020

- design of platforms and resources for teaching and learning in digital form
- introduction of innovative active learning methods into the basic mathematics courses in engineering study programmes
- development of assessment standards for a competencies-based teaching/learning system in engineering mathematics education

YEARS 2022 ...

- serious research efforts to define, develop and implement into pedagogical practise novelty digital methodology and didactics

Comparation of projects´methods, aims and results

The worldwide Covid-19 pandemic lasting more than 2 years caused the rapid and almost complete switch from the “steady on-site” to “experimental on-line” teaching at all levels of education systems.

This unexpected situation fostered the urgent need of digitalisation of all aspects of educational processes, from delivery of information, communication between teachers and students, through practising theoretical knowledge and formative assessments up to the summative assessment and on-line examination solutions.

Consequences of these fast changes reflected in the knowledge acquisition will be analysed in the currently solved projects 7 and 8.

Comparation of projects´methods, aims and results

All referenced projects were aimed to introduce innovations into traditional university learning scenarios used for ages in mathematics courses

– lectures for delivery of theoretical backgrounds
– practicals for training solutions of related problems
– oral or written examinations.

Overall digitalisation of all social processes evoked legitimate attempts and efforts to rethink how mathematics is taught to engineering students.

Comparation of projects´methods, aims and results

On one hand, ICT revolution enabled

- experimentation with different distance learning scenarios
- enabled development of more versatile modes of instructional materials
- on-line modules for self-study
- stack exercises for step-by-step calculation training
- electronic lecture notes available free on-line
- didactic videos, animations, solved examples and applications

On the other hand, these strategies were sometimes leading to

- even more passive behaviour of students than it was the case of traditional didactic situations
- learning was more personalised and dependent mostly on the involvement of students themselves and their inner motivation to study and acquire new knowledge
- sophisticated equipment became a standard must to follow digital courses
- individualisation of didactic process
- loss of personal relations between teachers and students

Comparation of projects´methods, aims and results

In all mentioned projects, research teams strived to receive feedback from both actors in the education process.

Structured didactical questionnaires were used to perform opinion poll and to receive and analyse answers of respondents in realised didactic experiments at the partner universities.

Cohorts of students were chosen on voluntary basis, sometimes there was an entire traditional Mathematics course transferred into a personalised distance learning module, or into a team work solving relevant applied problems by mathematical methods.

Attempts to introduce active learning methods as eduScrum, Jigsaw puzzles and PBL methods were one of the most interesting, while the overall detailed analysis of the case studies was presented in articles published in educational journals and at the didactic conferences.

Final remarks and general recommendations

In general, none of the surveys carried in the terminated 6 presented projects proved that the greater efforts by teachers to support students lead to their exceptionally better results and better motivation to learn.

Most attention is usually paid to support weaker students , while this great deal of efforts rarely meets our high expectations.

More attention should be paid to better and average students, where knowledge progress is much greater and more certain.

It is necessary

- to monitor and carefully record results of all students and give them due feedback
- to appreciate achieved results of all students, regardless the are weaker or smarter, to support and encourage all students respectively.

Final remark

We believe that, given

the current state of knowledge of incoming students,
their basic working and methodical skills necessary for the succesfull study at universities,
and the new roles of teachers in the educational process,
the goal of university education (and teachers) will continue

to be focused on the quality

not on the quantity of students

who complete all subjects and graduate as engineers.