

University education in Environmental Chemistry in Serbia - lessons learned from Tempus MACHEM and Erasmus+ NETCHEM project

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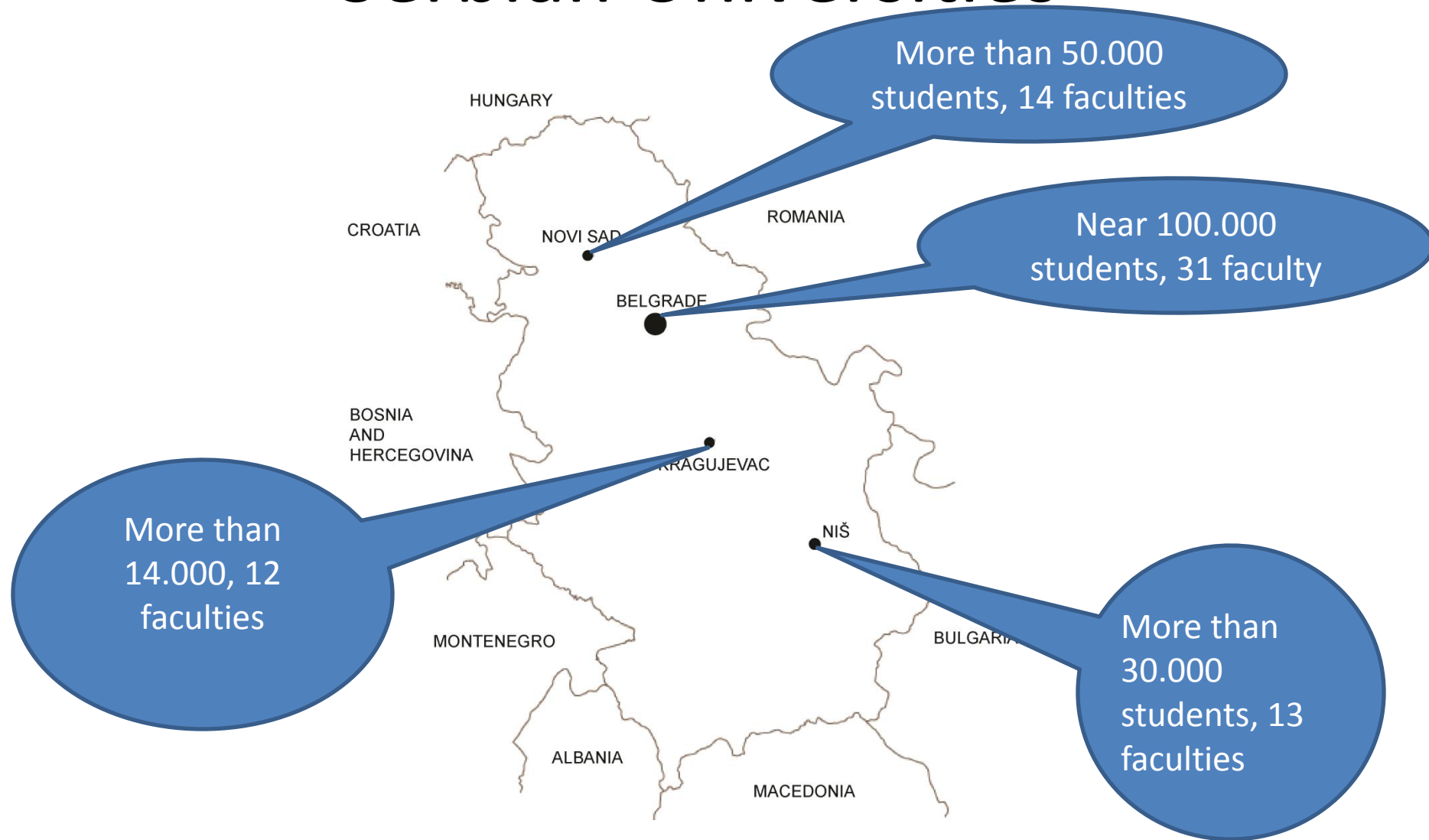
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Presentation overview

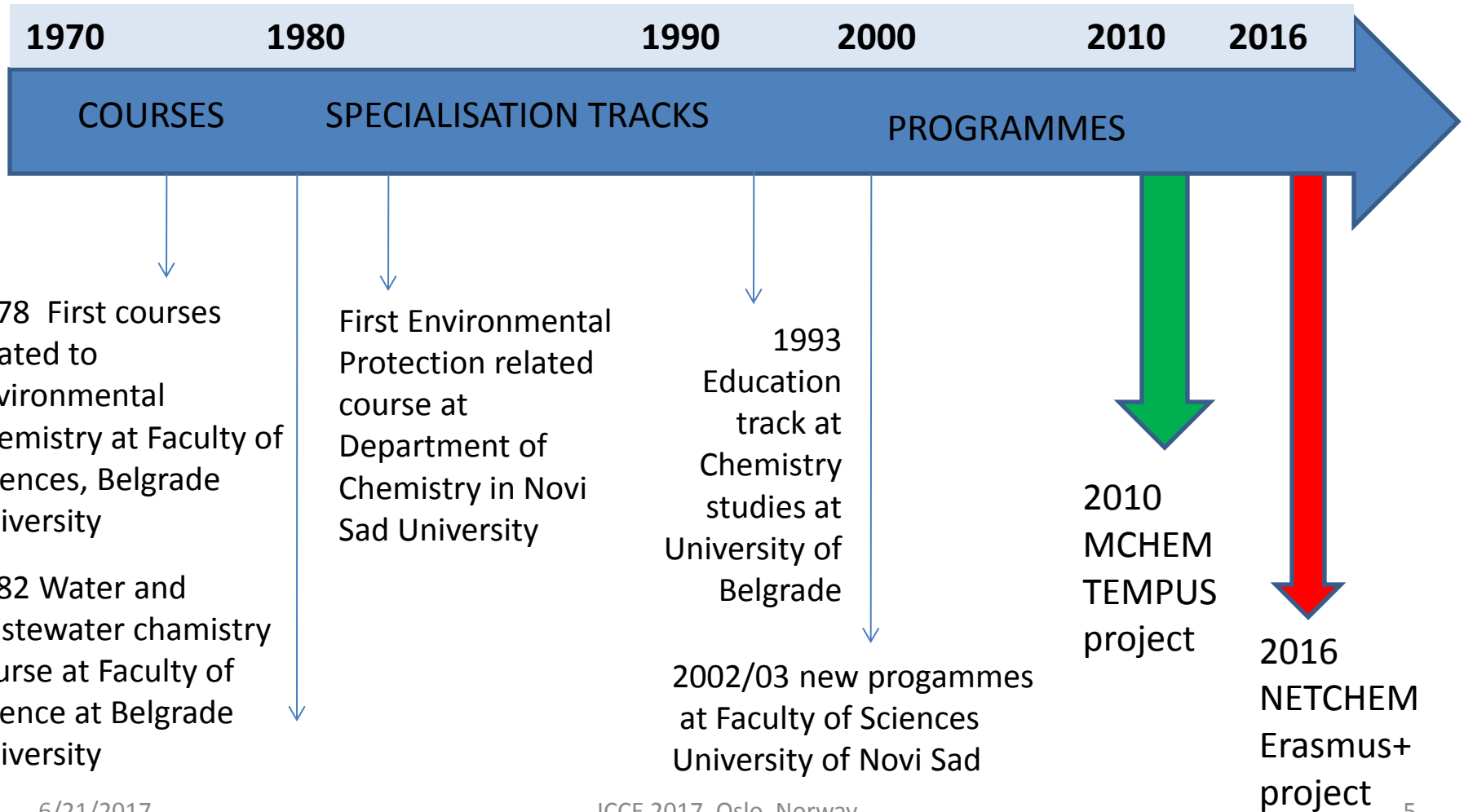
Content

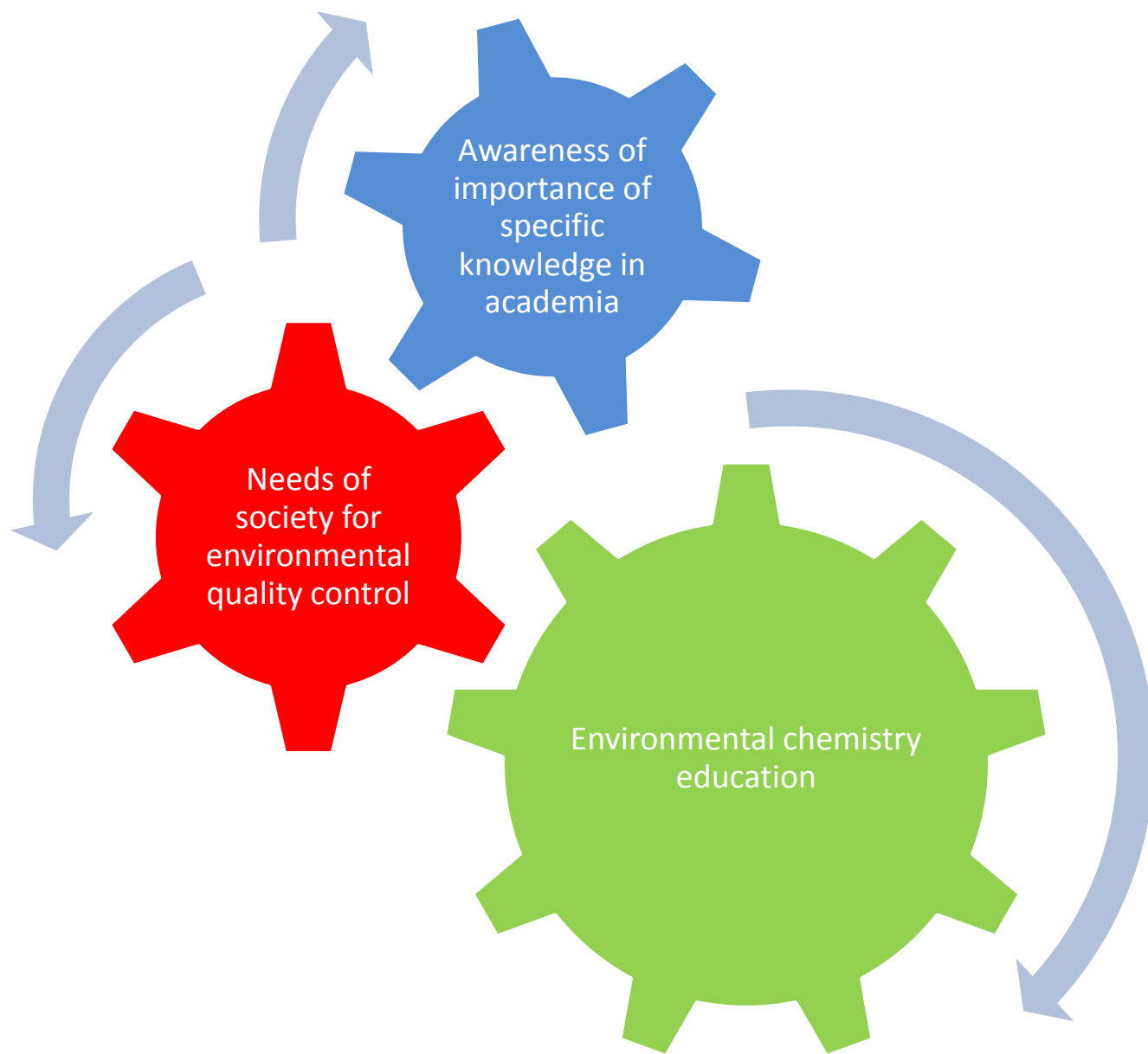
1. Environmental Chemistry Education in Serbia
2. Tempus MCHM and Erasmus+ NETCHEM projects consortia
3. Goals of the Projects
4. Lessons learned
5. Results

Serbian Universities



Environmental Chemistry Education in Serbia

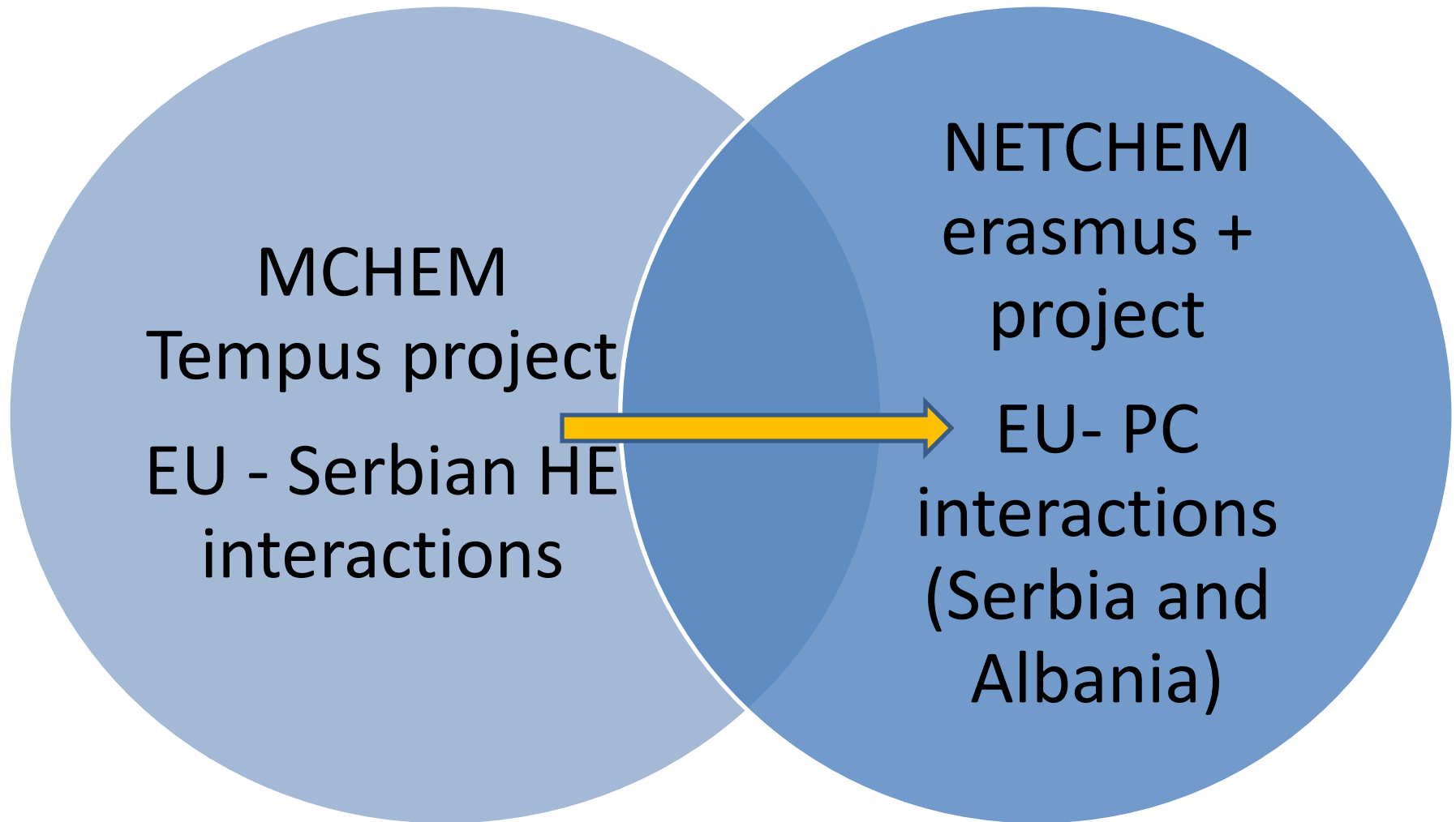




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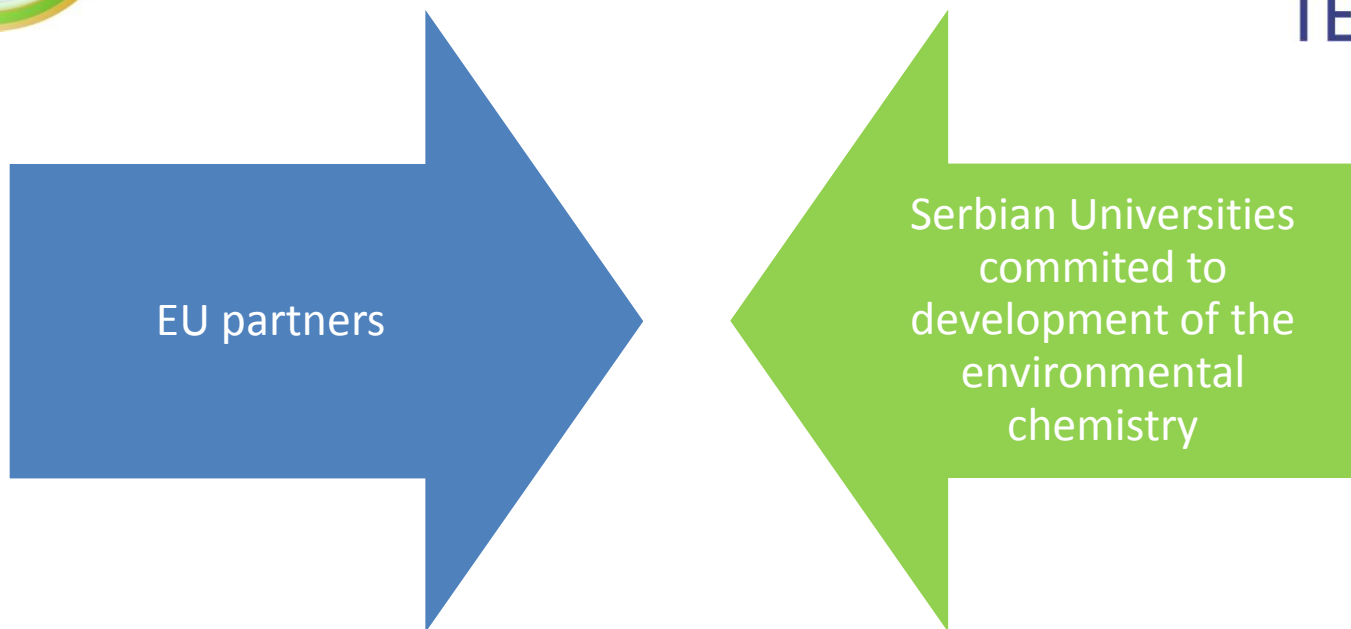
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2010-2014



1. University of Greenwich, UK
2. University of Aachen, DE
3. Brno University of Technology, CZ
4. University of Nova Gorica, SLO

1. University of Belgrade
2. University of Novi Sad
3. University of Kragujevac
4. University of Niš
5. High School in Užice





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of the European Union

2016-2019



International cooperation between Programme Countries & Partner Countries

Programme Countries Institutions	Partner Countries Institutions
<ol style="list-style-type: none"> University Pierre and Marie Curie University of Greenwich Brno University of Technology Alternative Energies and Atomic Energy Commission 	<ol style="list-style-type: none"> University of Nis University of Belgrade University of Novi Sad University of Kragujevac Agricultural University of Tirana University of Tirana Analysis Enological station Zlatiborac Thermo Fisher Scientific Bremen 

NETCHEM
Kick off meeting
Nis, January 9-10th 2017

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2010-2014



European Commission

TEMPUS

Modernisation of Master courses in Chemistry and Chemistry related programmes in Universities in Serbia through programme design and taking into account society needs

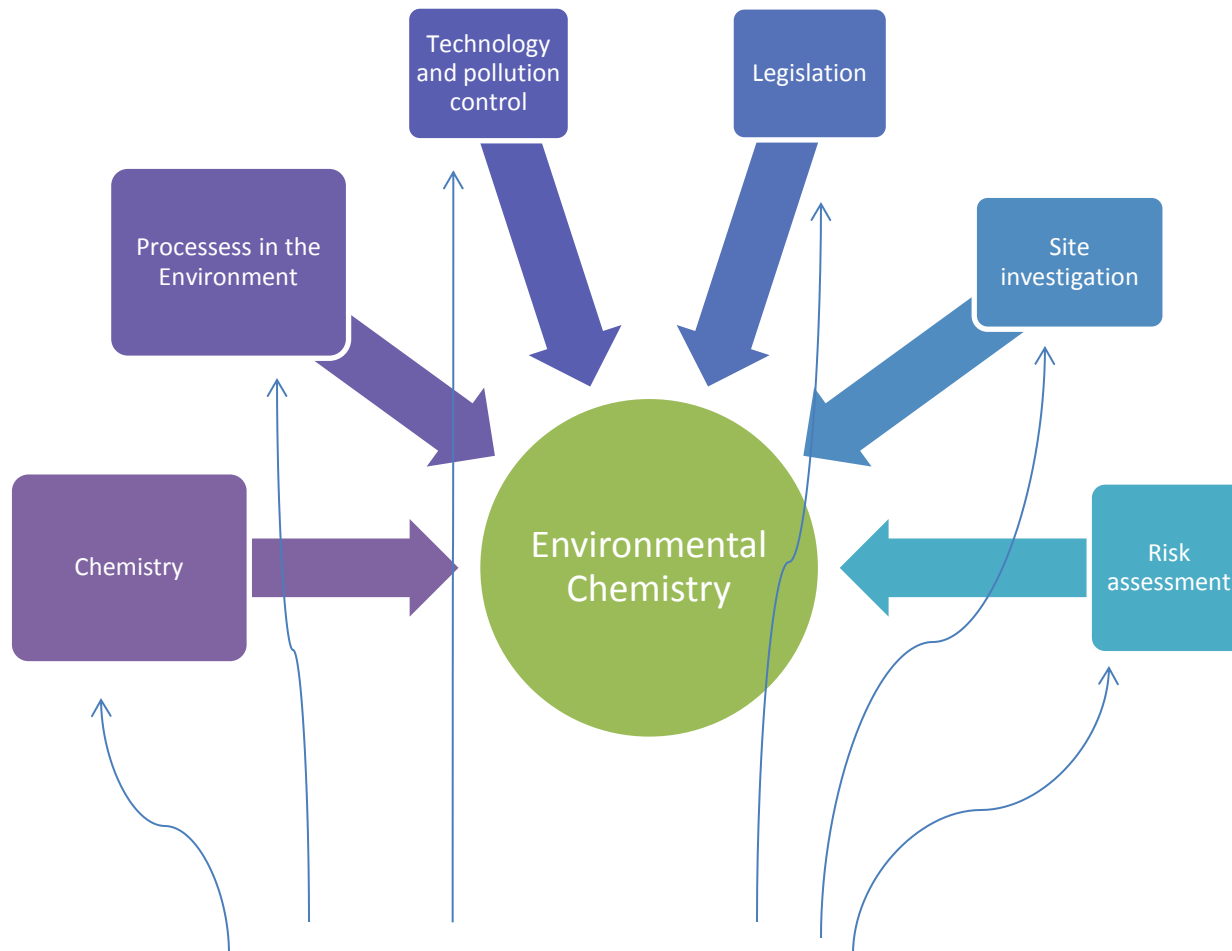
1. Programme of **staff training and resource development** to aid the creation of effective teaching, learning and assessment systems

2. To build **academic, employer and professional networks** that will guide programme development

3. To **improve existing and to develop a new MSc programme** in Environmental Chemistry

Objectives

- Modification and regulation of **learning outcomes and competences** of existing master programmes in line with best EU practices
- To **modernise curriculum delivery** and quality standards of the Master programmes in chemistry in line with the recommendations for the Euromaster label;
- **Development of new interdisciplinary master programmes** at universities in Serbia.



Where is modern environmental analysis ?

Whatever we do, we need to have good knowledge of analytical techniques or to fully understand the obtained analytical results



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2016-2019



Needs/Problems which NETCHEM intends to solve:

- Small number of analytical instruments
- No sufficient up-to-date equipment available
- Low level of education/skills in instrumental techniques
- Mostly theoretical instrumental analytical courses without enough active student participation
- Low level of Instrumental techniques application in courses for EFSC
- Gap between EU and BC in knowledge/experience/skills in Natural Sciences/Chemistry/Chem's application in EFSC



2016-2019



Develop and improve **knowledge, skills** and **technical resources** in the region

1. Training and widespread use of **OER**

2. Training and widespread use of **WARIAL**

3. Develop SQL based system at **NETCHEM** platform to **share** knowledge

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Lesson 1



- **Students** were **in the centre** of the programme development process
- **Partners have been trained** in contemporary pedagogical methods of student centred learning
- A series of **benchmarking statements** which succinctly summarise the skills acquisition expectations of the affected bachelor and master programmes are **developed and adopted**



Lesson 2



- We should create product that is **fit for purpose!**
- Who are the stakeholders in this process:
 - Authorities (Local, Regional, National)
 - Companies (SMEs, NGOs etc.)
 - Industry



Lesson 3



- **Virtual learning environment (VLE)** is helpful to increase the interest and success of students in the design of teaching and learning activities
- Academics should follow the new trends, needs and ways of communication of current students

Lesson 4



- Need to increase national and regional cooperation
- Introduce new teaching and learning skills by application of Open education resources and remote control of laboratory instruments

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2010-2014



- New MSc programmes were launched
 - At University of Belgrade at Faculty of Chemistry
 - At University of Niš at Faculty of Sciences
- Modernised existing MSc programmes
 - at Faculty of Sciences Novi Sad
 - at Faculty of Sciences in Kragujevac

Base for modernisation and development

New courses developed during the project which are incorporated at each university to different extent

- Advanced Analytical Techniques in Environmental Science,
- Environmental Processes,
- Chemical Pollution and Environmental Impact,
- Environmental Remediation,
- Environmental and Human Risk Assessment and
- Site Investigation

The structure and content of these courses has been circulated amongst the partners



2010-2014 activities



- Training for teachers- how to design the program (**content and teaching strategies**), how to use new teaching tools (Moodle, Elluminate collaborative software was used, public response system application, interactive table application, QA/QC practice in EU was shared)-**152 academic staff, 48 non-academic**
- Training for students- experience of working abroad in international teams, **18 student mobilities**.
- Series of workshops in Serbia with focus on **Moodle** and **Site investigation module combined with Risk Assessment**
- Equipment purchase- IT and lab equipment
- Dialog with society-more responsive to wider societal, commercial and industrial needs- **presentations, questionnaires, workshops**



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Jasna Adamov

КАКО SE KORISTI INTERAKTIVNA TABLA

- osnovne funkcije -

Neka tabla je model Hitachi StarBoard FX Trio 77 (lika 1), uz koj smo dobili i odgovarajući softver.



ХЕМИЈСКИ ПРЕГЛЕД

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бр. 5 (новембар)

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TEMPUS ПРОГРАМИ У РАЗВОЈУ УНИВЕРЗИТЕТСКЕ НАСТАВЕ У СРБИЈИ

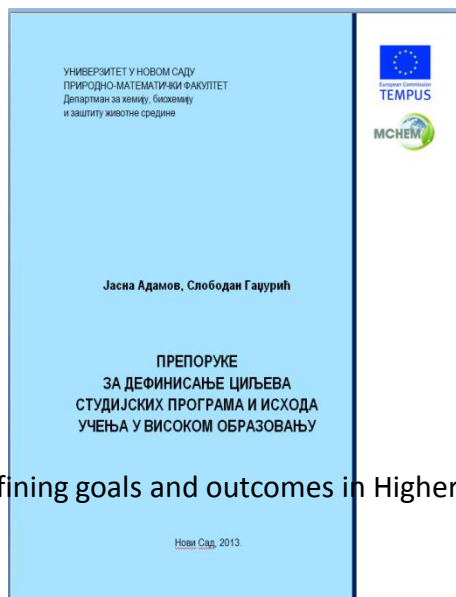
ХЕМИЈСКИ ПРЕГЛЕД

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Љубица ДИКОВИЋ, Висока пословна техничка школа струковних студија Узапце
Милан АНТОНИЈЕВИЋ, University of Greenwich - School of Science

РЕФЕРЕНТНИ ОБРАЗОВНИ СТАНДАРДИ ЗА ХЕМИЈУ И СРОДНЕ ДИСЦИПЛИНЕ



Guideline for defining goals and outcomes in Higher Education



New MSc Environmental Chemistry Belgrade



Course	Code	ECTS	Semester	
			1	2
Year I				
Human Health and Environment Risk Assessment	553S1	9	4+2+3	
Elective Course 1	E51S1	9	—	
Elective Course 2	E52S1	9	—	
Study and Research	R51S1	3	(0+3)	
Study and Research	R52S1	10		(0+10)
Master Thesis	Z50S1	20		(0+20)
		60		

Elective Course 1

- **Organic Geochemistry and Petroleum Pollutants** (551H1)
- **Environmental Monitoring** (552S1)
- **Remediation** (554S1)

Elective Course 2

- **Modern Structural Methods** (256H1)
- **Selected Methods of Instrumental Analysis** (351H1)
- **Chromatographic Methods** (352H1)
- **Statistics for Analytical Chemistry** (353H1)
- **Toxicological Chemistry** (460H1)
- **Green Chemistry** (751H1)

Elective courses can also be those courses that are compulsory on other study programmes of the same study level.



University of Kragujevac



- Modernisation of study program: Ecology (Industrial pollutants), graduate academic studies
- Modernisation of study program: Chemistry (Methods of rehabilitation of chemical accidents), master academic studies



New MSc at University of Niš



Master of Science in Chemistry - Applied Chemistry Module Environmental Chemistry (three elective courses in the field plus obligatory Scientific Trends in the field) (120ECTS)

1. Modern optical instrumental methods of analysis	8ESPB Appl. Chem.
2. Electrochemistry	8ESPB Appl. Chem.
3. Environmental Chemistry 2	6ESPB Appl. Chem.
4. Chemistry of the Atmosphere and Soil	6ESPB Gen. Chem.
5. Selected topics from Inorganic Chemistry	4ESPB Gen. Chem.
6. Selected Topics from Bioinorganic Chemistry	4ESPB Gen. Chem.
7. Chemistry and Technology of Water	5ESPB Appl. Chem.
8. Industrial Processes	5ESPB Appl. Chem.
9. Chemistry and Technology of Materials	4ESPB Gen. Chem.
10. Synthesis of bioac. and pharmac. active comp.	6ESPB Appl. Chem.
11. Forensic chemistry	6ESPB Appl. Chem.
12. Standards of lab. work and validation	(Faculty of Tech. Leskovac)



University of Novi Sad

- At Faculty of Sciences, Department of Chemistry in Novi Sad there are two environmental related MSc programmes (60 ECTS)
 1. Master of Science in Chemistry-Quality control and Environmental Management (three elective courses in the field plus obligatory Scientific Trends in the field)
 2. Master of Science in Environmental Protection-Environmental Protection Analyst (obligatory risk assessment and three elective courses in various fields).

Students are mainly those from corresponding Bachelor studies. In 2016/17 it is enrolled 29 and 22 students respectively.

Dialog with society

Through involvement of Serbian Chemical Society

- Continual professional development courses were delivered
- Wide dissemination was made

List of courses

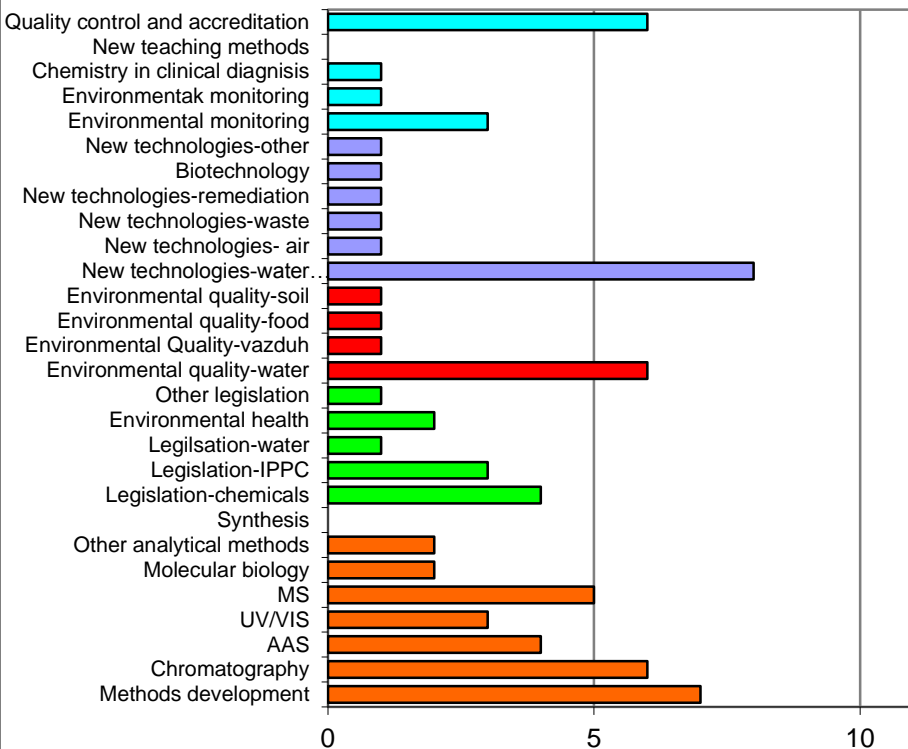
University	Course	Number of participants
Niš	MASS SPECTROMETRY IN ENVIRONMENTAL AND LIFE SCIENCE	61
Niš	ENVIRONMENTAL CHEMISTRY – ATMOSPHERIC GASES	10
Niš	ENVIRONMENTAL CHEMISTRY – MINERALS, ROCKS, ORES	14
Belgrade - Mining and Geology	APPLICATION OF SCANNING ELECTRON MICROSCOPY WITH ENERGY-DISPERSIVE SPECTROMETRY (SEM-EDS) IN ENVIRONMENTAL PROTECTION RESEARCH	10
Belgrade - Technical Faculty from Bor	WASTEWATER TREATMENT METHODS	6
Belgrade - Physical Chemistry	ILUSTRATIVE EXPERIMENTS AND LECTURES FOR GENERAL AND PHYSICAL CHEMISTRY IN SECONDARY SCHOOL TEACHING	10
Kragujevac	REMEDICATION	10
High Business Technical School Užice	MONITORING OF POLLUTERS AND SAMPLING	54
Novi Sad	SELFMONITORING DESIGN FOR INDUSTRIAL WASTEWATER	31



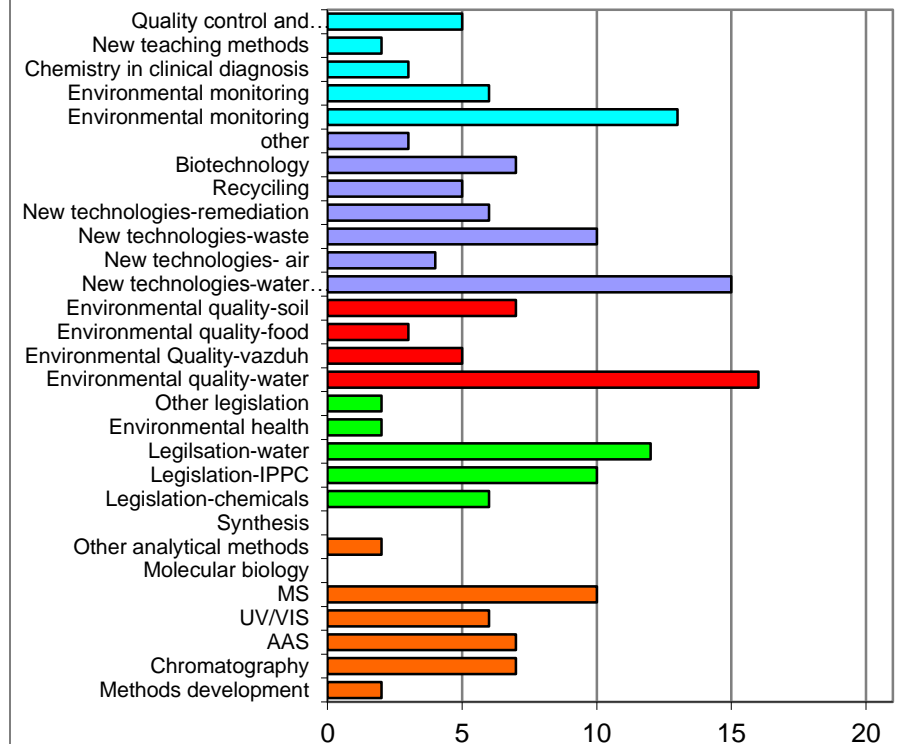
Knowledge gaps detected, 18 leaders, 50 employees

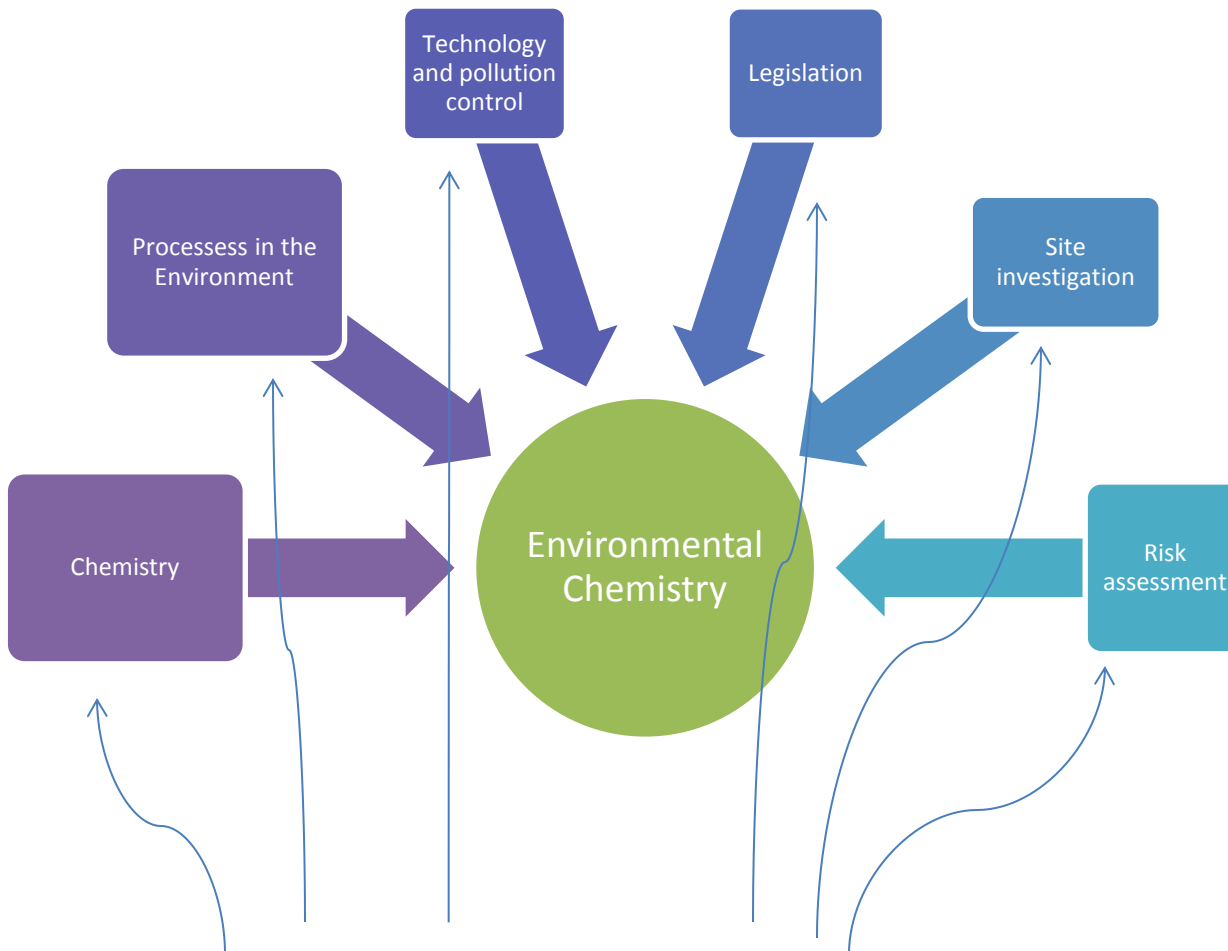
low response outside the academia!

Leaders -fieldswhere knowledge gap exists



Others- fields where knowledge gap exists





Modern environmental analysis ?
Whatever we do we need to know either
techniques or to understand the results



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New project results 2016-2019

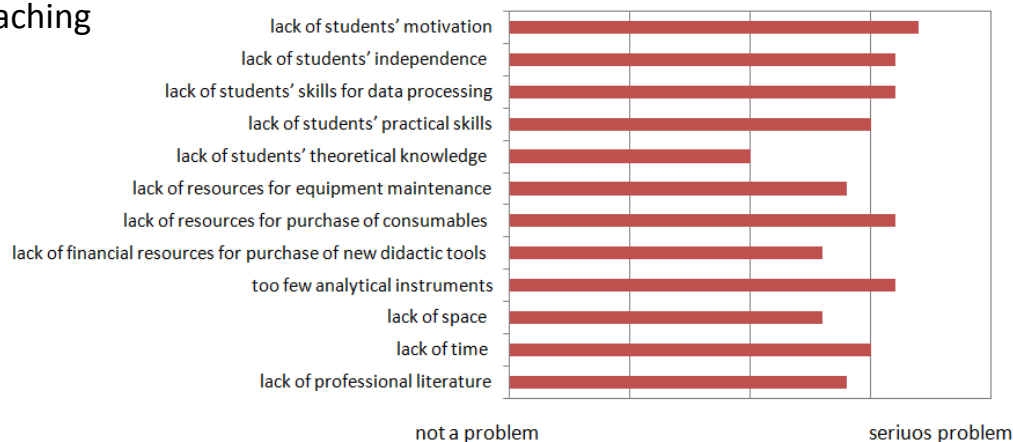


- Analysis of programme and partner countries in OER and WARIAL – done!
- To establish NETCHEM platform for exchange of courses and data in EFSC – on going, to cultivate the culture of the discussion and cohesion of the expertise
- To modernise MSc and PhD courses using OER and WARIAL – expected
- To develop CPD courses – expected

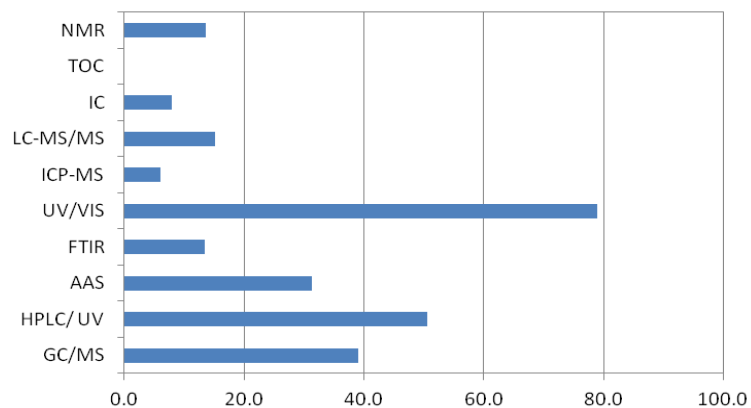
Dialog with society is continued



Problems teachers encounter in teaching



Overall percentage of teachers who use different analytical instruments in students' practical work in Serbian universities



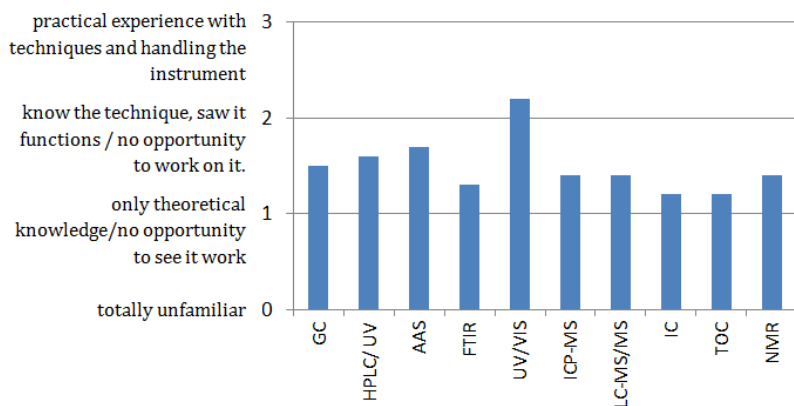


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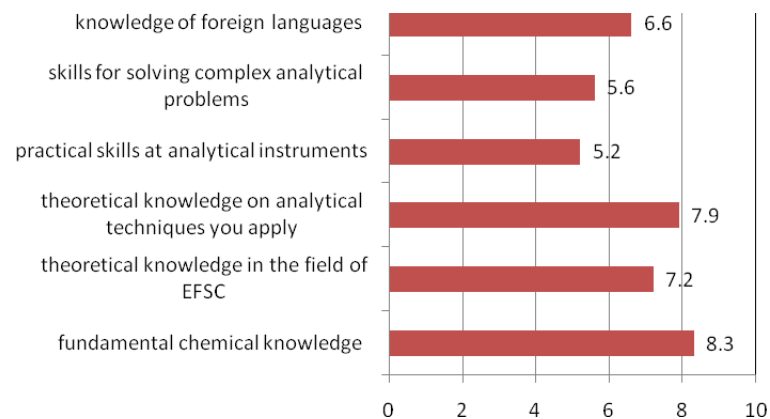
Students



Students' level of experience with analytical instruments



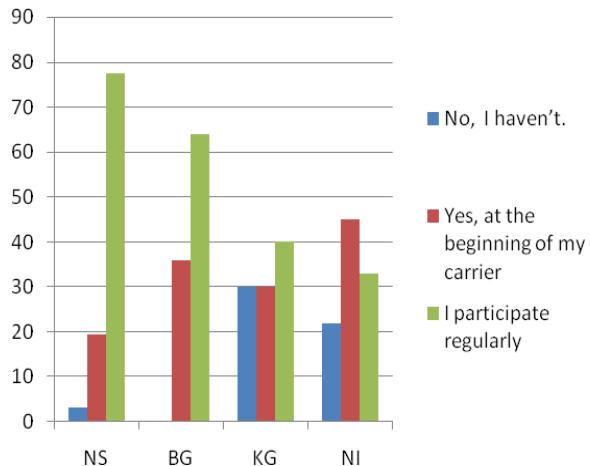
Students' knowledge in different categories (1 - insufficient knowledge, 10 – excellent knowledge)



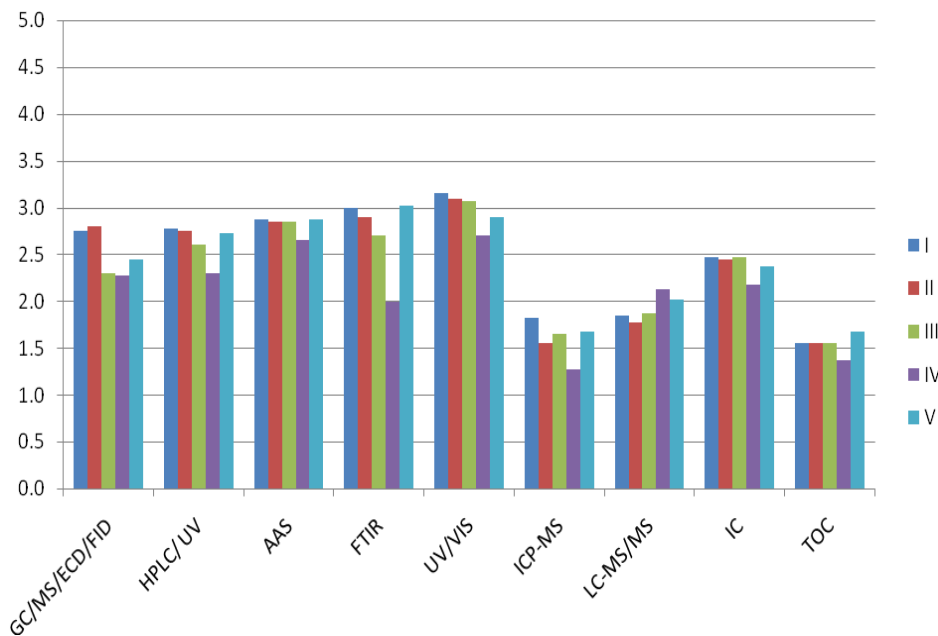


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Employed analysts



Participation in CPD courses

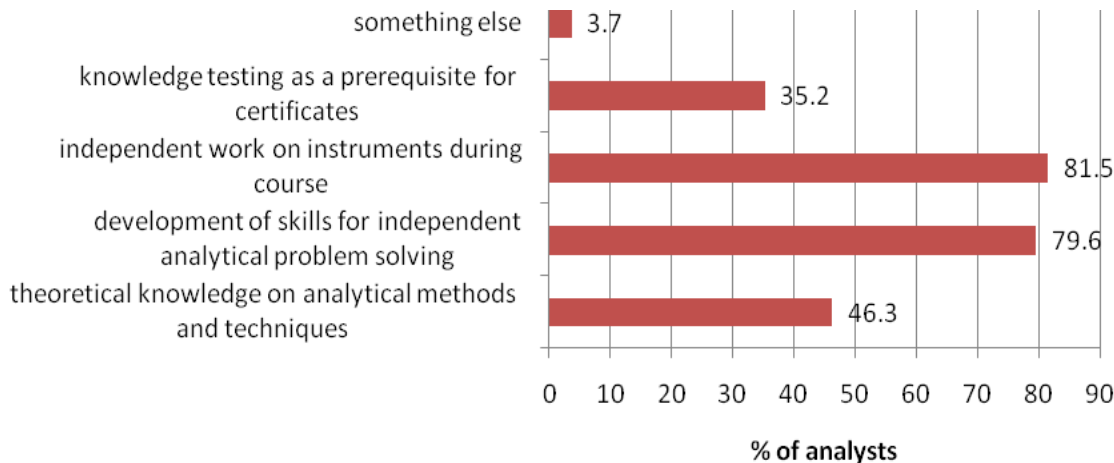


Average level of existing knowledge and skills in analysts (where 0 represents complete lack of knowledge and skills, while 5 denotes fully developed knowledge and skills) I - related to hardware, II - full usage of the possibilities offered by the software, III - knowledge of the software, IV - knowledge of the development and validation of the method, V - knowledge of the processes that happen in the instrument itself during the analysis

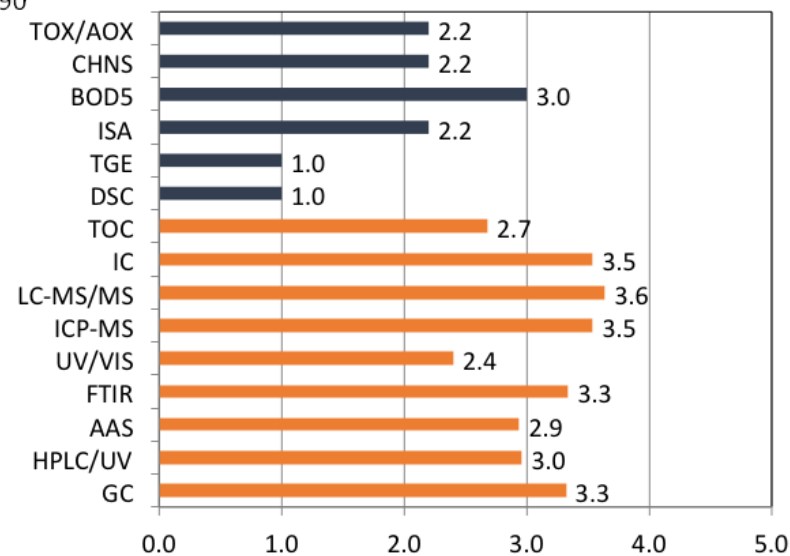


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Development of courses



Distributors thoughts - The gaps in customers' knowledge and skills related to usage of individual instrumental techniques (1 – just to the small extent, 5 - serious lack of knowledge and skills)



We are rising the knowledge in our region and are open to establish new collaborations

Thank you for your attention!

