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ICT Networking for Overcoming Technical and Social Barriers in Instrumental Analytical Chemistry Education

Final Report on Questionnaire from University of Tirana

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Purpose



- **COLLECTING DATA **ON THE DEGREE** OF KNOWLEDGE, SKILLS AND PRACTICE IN INSTRUMENTAL ANALYSIS APPLIED IN THE FIELD OF ENVIRONMENTAL AND FOOD SAFETY CONTROL.**



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Who participated the questionnaire?

- **Students**
- **Heads of HEIs**
- **University teachers**
- Heads of accredited laboratories**
- **Analysts**



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Students results

Bachelor and master students participated to the questionnaire.

According to students, OERs during teaching consists mainly of printed publications, scientific papers, e-books/text books and electronic materials.

No Moodle platform, interactive online or offline theoretical classes or web-conferences were used during lectures;

Online courses, webinars and movies were also never used by their teachers.



Students



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Use of OER



- **70%** of students use materials from reliable sources, **30 %** use only the recommended materials from their teachers.
- **100%** - agreed that **Learning** would be of higher quality using OER.
- **90%** - agree that Lectures would be with higher quality if OER will be used;

Students



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Use of WARIAL



- **80% of students admit to have never worked with any lab with Remote Web Access (WARIAL),**
- **only 20 % (mainly master students) have worked abroad with instruments like GC-MS, AAS, ICPMS.**
- **80% would like to use WARIAL in the first given chance.**

Students



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- ***Conclusions from Teachers Questionnaire***

- 54% of teachers that participated, belongs to the group having 10-20 years of job experience in higher education institution.
- 18% belongs respectively to each of groups:
- with 5-10 and 20-30 years experience.
- ***100% of teachers think that the quality of lectures would be better if OER is used .***



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90% of teachers resulted as **excellent** in knowledge and skills related **to office package** and from **undeveloped to average** related to other software (LMS, Web-conferences, Remote Desktop Control)

They **often** use scientific papers and printed publications while **occasionally** other electronic materials, simulations of instruments functioning, forums and other forms of online communications and data bases.

Never corresponds to using webinars, online courses in internet and web conferences.

Teachers



- Use of OER
- 90% of HEIs teachers use OER during **self-preparation of lectures**,
- 72% use OER as **additional recommended literature** for students,
- 45% use OER during preparation **of tests** for students and only
- 18 % use OER as **obligatory literature** for students.
- Online and offline resources for learning about **instruments functioning** are used by 90% and other e-learning tools by less than 30%
- 90% have not worked in a lab with remote web access to instruments but 45% would use it during teaching.
- 90% are ready to adopt the lectures if they would have the possibility relating the infrastructural capacities.



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- *CPD courses*



- All (100%) **of teachers** need training courses to work with analytical instruments of the new generations.
- 90% have never participated in any CPD course.
- About 10 % have participated in different training courses, in the framework of MEDPOL/IAEA project or COIMBRA Group Programme, in instrumental techniques such as Atomic Spectroscopy (absorption and emission) and Gas Chromatography.

Teachers



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• *Use of WARIAL*



- **36% of teachers assess practical skills of the students by testing their *theoretical knowledge*;**
- **55% of teachers do this by *assessing the analytical performance of a certain method*, applied by students.**
- **80% agree that application of WARIAL for students training and computer simulations is considered to be very important as an additional tool to the real experimental work with instruments.**

Teachers



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Training of teachers

- 50% to 75% need additional training to develop their skills in finding information for implementing contemporary education methods, for using new didactic tools and to assess students knowledge.
- 100% would like to participate in organization and implementation of CPD courses in the field of EFSC and only 70% feel competent to educate the professionals in the instrumental analysis because they regularly keep track on development of instruments and analytical methods.



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- **Heads of HEI Questionnaire**
- *2 deans, 1 vice dean and 2 department heads participated the questionnaire*



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- *They confirmed that:*
- The use of **sophisticated analytical instruments** in their HEIs:
- **mainly in education 20%;**
- **mainly for scientific work 40%**
- **for both education and scientific work 40%.**

Head of HEIs



The resources of financing the purchase and the maintenance of the equipments were assessed with:

- | | |
|---|---|
| <input type="checkbox"/> Ministry of education, science and technological development : | 4 |
| <input type="checkbox"/> Own institutional resources: | 1 |
| <input type="checkbox"/> Resources from international projects: | 1 |
| <input type="checkbox"/> Donations: | 4 |

Head of HEIs



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60% of HEIs heads will support

the engagement of humans and equipments to establish WARIAL courses with other higher education institutions (HEI) - e.g. online practical work using WARIAL:

- whilst 20%, will accept it only with **reciprocity**

by exchanging practical laboratory sessions by collaborating with other HEIs that use different instruments and techniques from the actual HEI.

Head of HEIs



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- **100% of the HEIs heads support the necessary changes of the schedule, to the smaller extent**
 - **(1-3 exercises per semester)**



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100 % of head of HEIs answered that:

- No CPD courses are organized at their respective institution/unit.
- Even when CPD courses are organized, they have different topics each time
- CPD courses are not accredited.
- No certificates are issued to participants of the courses upon successfully finished training.
- Evaluation of the knowledge of participants **is always controlled** after the training is finished.
- Would support the organization of CPD courses for professionals in the field of EFSC , implemented by their employees.
- These CPD courses will be organized as a service that respective institution provides in cooperation with professional societies.

Head of HEIs



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Conclusions from Heads of Labs

- The participants were 2 heads of University labs, one head of a private lab that works in the field of environmental protection and the head of the laboratory of National Environmental Agency in Albania.
- Two of them were head of the accredited laboratories and two others heads of the units that are in charge of instruments; 2 researchers and 2 environmental quality control **specialists**.

Head of Labs



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Analysts using the instruments in respective labs;

50% admit that up to 3 analysts work with instruments;
50% admit that 5 to 10 persons work with instruments.

Assessment of the skills and abilities that novices in their laboratories: (1 – lacking to small extent, 5 – lacking to very high extent)

| | | |
|---|-----------------|----------------------------------|
| verbal communication | 50% - 1; | 50% - 3 |
| written communication | | 1 - 3 |
| data analysis and reporting | 75% - 1; | 25% - 2 |
| practical work on instruments: | | 1 - 4 |
| project writing: | | 1 - 5 |
| knowledge on relevant regulations: | | 1 - 3 <i>Head of Labs</i> |



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They use the instrumental analysis in the fields shown in the table below.

| ANALYTICAL TECHNIQUE | IN ANALYSIS OF: | | | | | |
|--|-----------------|-------|-------|------|----------|-----------------------|
| | water | food | air | soil | sediment | objects and materials |
| GC/MS/ECD/FID | 1 | | | | | |
| number of analysts | 1 | | | | | |
| AAS | 3labs | 1 lab | 1 lab | 1lab | 2 lab | 1 lab |
| number of analysts | 3 | 1 | 1 | 1 | 2 | 1 |
| UV/VIS | 3 lab | | | | 1 lab | |
| number of analysts | 8 | | | | 1 | |
| If needed please list other techniques | | | | | | |
| ECHO PM | | | 1 lab | | | |
| number of analysts | 2 | | 2 | | | <i>Head of Labs</i> |

The employees of the labs need further professional training in



| ANALYTICAL TECHNIQUE | |
|---------------------------------------|----------------------|
| GC/MS | yes |
| GC/ECD | yes |
| GC/FID | yes |
| AAS | yes |
| UV/VIS | no |
| OTHER KNOWLEDGE AND SKILLS | |
| sample preparation | yes |
| development and validation of methods | yes |
| environmental regulations | yes |
| if YES | European national |
| regulations related to food | yes |
| if YES | European national |
| work with Web conferencing software | yes |



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Supporting the participation of their human and equipment resources in WARIAL courses:

- **50 %** would like to participate *in WARIAL courses with partners of NETCHEM project:* **and** higher education institutions ;
- **25%** would like to deliver such courses and to be trained this way;
- **25%** don't support the participation.

Head of Labs



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Conclusions from Analysts Questionnaire

- **Participants were PhD holders which haven't participated in any CPD course.**



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*The most serious barriers they have
meet during
their professional development;*



BARRIERS

| | | |
|--|--------|--------------|
| language barriers while looking for information: | 1-50% | 2-50% |
| i don't know where to find reliable info: | 2-50%; | 1-25%; 3-25% |
| lack of courses in my native language: | 5-50%; | 1-25%; 3-25% |
| courses that i can find are not at appropriate level: | | from 1 to 4 |
| lack of experience in handling instruments: | 2- 75% | 3- 25% |

(on scale 1-5, where: 1 – not the issue for me at all, 5 – very serious issue).

Analysts



*Missing knowledge and skills related to the
instrumental techniques they use in their work.*

| Knowledge And Skills | GC/MS/ ECD/FID | HPLC/ UV | AAS | FTIR | SF UV-VIS | ICP- MS | LC MS/MS | LC | TOC | Potentiometr y/ Voltametry |
|--|-------------------|-------------|-------|-------|-----------|------------|-------------|----|-----|----------------------------------|
| related to hardware | 3 - 4 | 3 - 4 | 1 - 2 | 2 - 5 | 1 - 3 | 4 | 5 | 4 | 4 | 1 |
| full usage of the possibilities offered by the software | 2 - 3 | 4 - 4 | 1 - 2 | 1 - 5 | 1 - 3 | 3 | 4 | 4 | 4 | 1 |
| knowledge of the software | 1 - 2 | 4 - 4 | 1 - 2 | 1 - 5 | 1 - 3 | 3 | 4 | 4 | 4 | 1 |
| knowledge of development and validation of the method | 1 - 2 | 3 - 3 | 1 - 1 | 1 - 4 | 1 - 4 | 2 | 3 | 3 | 3 | 2 |
| knowledge of the processes that happen in the instrument itself during the analysis | 1 - 3 | 3 - 3 | 1 - 1 | 1 - 5 | 1 - 3 | 2 | 3 | 4 | 4 | 2 |

Analysts

The most used techniques



| | Analysis of: | | | | | |
|---|--------------|------|-----|------|----------|-----------------------|
| | water | food | air | soil | sediment | objects and materials |
| GC/MS/ECD/FID | 50% | | | | | |
| HPLC/ UV | | | | 25% | 25% | 25% |
| AAS | 50% | 50% | 25% | 50% | 50% | 25% |
| FTIR | 25% | | | | 25% | |
| UV/VIS | 75% | 25% | 25% | 50% | 50% | 25% |
| ICP-MS | | 25% | | | | |
| LC-MS/MS | 25% | | | | | |
| IC | 25% | | | | | |
| TOC | 25% | | | | | |
| If needed, add additional techniques below | | | | | | |
| Electrochem. analyser | 25% | 25% | | | | |

Analysts

The use of different OERs during professional education:



| OER | never | occasionally | often |
|---|-------|--------------|-------|
| scientific papers (open access) | | | 75% |
| printed publications (books, journals) (open access) | | | 75% |
| e-books/e-textbooks | | | 75% |
| other electronic textual material (brochures, presentations, promotional materials) | | 25% | 50% |
| pictures/animations | | 25% | 50% |
| simulations of phenomena and processes | | 50% | 25% |
| simulations of instrument functioning | | 50% | 25% |
| movies | | 50% | 25% |
| forums and other forms of online communication | 25% | 25% | 25% |



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- **100% - would use OER if they will have a chance**
- **Using OER:**
- **25% prefer materials in native language and 75% in English.**
- **No one use WARIAL (100%) but all would try doing it (100%).**
- **For 75% would be easier if the education materials will be in the native language and 25 % do not think so.**
- **75% have had the chance to improve the knowledge by getting education abroad and 25 % had not the similar chance.**
- **100% of participants are not satisfied with the quality of CPD courses offered in the country**



- ***Results and Recommendations***

- **Using of all forms of OER will improve the quality of teaching, learning and laboratory work.**
- **The application of WARIAL will be appropriate for student's preparation and training for handling analytical instruments.**
- **Heads of laboratories are ready to be trained in WARIAL courses and to support the participation of their human and equipment resources in WARIAL courses with partners from NETCHEM project.**

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Results and Recommendations

In general analysts and equipment distributors have good and average knowledge in using sophisticated instruments.

They mostly have difficulties in method development and validation, software and full usage of the possibilities offered by the software.

It must be pointed out that they have a lack of knowledge in using all the other analytical instruments mentioned in the questionnaires, like FTIR, ICP-MS and IC, which are not present in our laboratories.

The most important source of financing the purchase of the equipment and for the maintenance of the equipments are the own HEIs followed by Resources from International projects.



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- *Results and Recommendations*

- **The most emergent issues to be emphasized are:**
- **Developing and use web accessed remote instrumental analytical laboratories (WARIAL) in environmental and food safety control (EFSC) domain;**
- **Training of the university teachers in the use of WARIAL and open education resources (OER) for the preparation of courses in EFSC;**
- **Developing MSc/PhD courses within the field of EFSC using WARIAL and OER;**



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- *Results and Recommendations*
- **Equipment of the labs with all the necessary instruments that would be use for educational purposes (OER &WARRIAL), like computers, analytical instruments and software related to them.**



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- **WOULD appreciate our involvement in NETCHEM Project that will help our HEI's in developing of professional knowledge and skills especially in fields of environmental and food safety control.**



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THANK YOU

