European Project - Transfer of Innovation

Leonardo Da Vinci : CHEMLAB II

Development and Establishment of ECVET Modules

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1 Development of ECVET Modules

To develop ECVET Modules in the field of analytical chemistry first a Module for Food Analysis was developed by the Technische Universität München. For doing so, the modules from the Credchem project served as a guideline. The modules are based on the concept of learning outcomes, which means that is not decisive how long a module lasts, but what a learner knows, understands and is able to do after attending the module. The learners aquire knowledge, skills, and competences during the module duration. The Learning outcomes are closely related to the different learning units of a module. In the module Food Analysis learning units regarding food components, sampling, extraction, analytical techniques as well as data evaluation and presentation of resultswere included. A special issue of the module is the application of different competence levels. In the first part of the module (the “exercise”) the participants work under instruction and by this aquire knowledge in the different areas of food analysis (Competence Level A). In the second part (the “project”) the participants get an own project they have to handle. For this they have to conduct literature search, work out and appropriate methods, apply this method and finale evaluate and present the obtained data and results (Competence Level A). Additionally to the Learning Units and Outcomes a timetable was created. In the following section the learning Units and Outcomes for the module Food Analysis are presented.

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1.1 The Module Food Analysis

1.1.1 Learning Units and Learning Outcomes

Title of the field of action	**Food Analysis**	
EQF Level		
Total ECVET points		
Units of Learning outcomes	**U1**	**Sampling and preparation of food samples**
	U2	**Extraction of different food contents, extraction methods**
	U3	**Chromatographic separation of food contents**
	U4	**Identification of compounds**
	U5	**Quantification of compounds**
	U6	**Calculation, evaluation and presentation of data**
Cross sectional Learning Outcomes	To acquire the learning outcomes following quailfications are essential He/she is able to apply and adopt different analysis methods use and control different analysis apparatus apply different kinds of software for data acquisition and evaluation	

LO1_Sampling and preparation of food samples	**LO2_Extraction of different food contents**	**LO3_Liquid-chromatographic separation of food contents**
Sampling Lyophilization Homogenization	Extraction by sonification Liquid-Liquid Extraction SPE Removal of solvent	RP-HPLC Stationary phases, normal phase, HILIC Gradient/Isocratic elution
LO4_Identification of food contents (Detection)	**LO5_Quantification of food contents**	**LO6_Data handling**
UV-Vis spectra Mass Spectrometric identification Basics of IR and NMR	Calibration Curves External/Internal Standard Calculation of recovery rates Quantification of compounds	Software handling Evaluation and interpretation of data Presentation of results

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Unit of Learning Outcome 1: Sampling and preparation of food samples			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Prepare food samples according to instructions	He/she is able to: • Sample diverse foods • Apply lyophilisation and homogenization methods	He/she knows about: • Significance of sample size • Sample preparation of different foods – advantages and disadvantages • Suitability of different sample methodologies for diverse food contents
Competence Level B	He/she is able to: • Choose the appropriate methods depending on the respective sample characteristics • Recognize and work out typical problems regarding sampling and sample preparation	He/she is able to: • Calculate necessary sample size • Apply the appropriate preparation procedure	

Work task	**Competence Level**
Sampling of tomatoes	A
Lyophilization of tomatoes	A
Homogenization of freeze dried tomatoes	A
Sampling of a (unknown) project sample	B
Lyophilization a (unknown) project sample	B
Homogenization a (unknown) project sample	B

Unit of Learning Outcome 2: Extraction of different food contents			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Extract food samples according to instructions	He/she is able to: • Extract target analytes from food samples • Apply extraction methods	He/she knows about: • Differences between extraction methods • Advantages/Disadvantages of extraction methods • Suitability of extraction methods for diverse target analytes
Competence Level B	He/she is able to: • Choose the appropriate extraction methods depending on the respective sample characteristics and target analytes • Recognize and work out typical problems regarding extraction methods	He/she is able to: • Extract diverse analytes from different food samples • Apply the appropriate extraction procedure	

Work task	**Competence Level**
Extraction of phenolics compounds from lyophilized tomatoes by sonification	A
Removal of solvent	A
Choose a method for extraction of another group of food contents	B
Extraction of another group of food contents, e.g. carotenoids	B
Removal of solvent	B

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Unit of Learning Outcome 3: Liquid-chromatographic separation of food contents			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Separate phenolic compounds by RP-HPLC	He/she is able to: • Apply RP-HPLC methods to separate food contents	He/she knows about: • Assembly and function of chromatographic devices • Chromatographic parameters • Different stationary phases and their fields of use • Characteristics of different eluting solvents • Gradient and isocratic elution • Retention/separation behaviour of different food contents
Competence Level B	He/she is able to: • Choose the appropriate separation method depending on the target analytes • Recognize and work out typical problems regarding chromatographic methods	He/she is able to: • Separate diverse food contents by different separation methods • Choose the appropriate separation methods depending on the target analytes	

Work task	**Competence Level**
Prepare extracted samples for HPLC analysis (dissolve, filtrate)	A
Separate phenolics compounds by RP-HPLC	A
Choose and develop a suitable method for separation of other food contents	B
Separate other food contents by the developed method	B

Unit of Learning Outcome 4: Identification of food contents (Detection)			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Detect and identify phenolic compounds by UV-Vis and mass spectrometry	He/she is able to: • Interprete UV-Vis and mass spectra	He/she knows about: • Characteristics of common HPLC detectors and their fields of use • Characteristics of food contents regarding detection • Use of UV-Vis and mass spectra to identify compounds • Basics of IR and NMR
Competence Level B	He/she is able to: • Choose the appropriate detector depending on the target analytes • Recognize and work out typical problems regarding detection issues	He/she is able to: • Apply different detection methods	

Work task	**Competence Level**
Identify phenolics compounds by UV-Vis and mass spectra	A
Choose the appropriate detector for other food contents	B
Identify other food contents	B

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Unit of Learning Outcome 5: Quantification of food contents			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Calculate calibration curves • Quantify food contents by use of external standards	He/she is able to: • Prepare calibration curves • Work with external standards	He/she knows about: • Relevance of concentration ranges for calibration curves • Regression lines • Prerequisites for internal standards
Competence Level B	He/she is able to: • Choose suitable internal standards • Calculate recovery rates • Quantify food contents by combination of external and internal standards	He/she is able to: • Work with external and internal standards •	

Work task	**Competence Level**
Quantification of phenolics compounds	A
Choose of a suitable internal standard	B
Calculate recovery rates	B
Quantification of food contents using external and internal standards	B

Unit of Learning Outcome 6: Data handling			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Evaluate data quality • Handle data according to Good Scientific Practice • Understand graphs	He/she is able to: • Work with different acquisition software • Transfer raw data to evaluation software • Work with standard software for data evaluation (e.g. Microsoft Excel) • Prepare standard graphs • Conduct appropriate data storage and backup	He/she knows about: • Principles for the Handling of Research Data • Use of different software solutions for data evaluation • Mean Values and deviations • Basic Statistic and data transformation
Competence Level B	He/she is able to: • Apply and interpret mean values, standard deviation • Apply and interpret appropriate regression functions • Choose appropriate statistic calculations • Choose appropriate data transformation if necessary	He/she is able to: • Prepare appropriate graphs depending on nature of data • Calculate means and deviations • Calculate regression functions • Conduct statistic and data transformation processes	

Work task	**Competence Level**
Transfer raw data to evaluation software	A
Preparation of standard graphs	A
Calculations on data (Mean values, standard deviation, regression functions)	B
Data transformation and statistics	B

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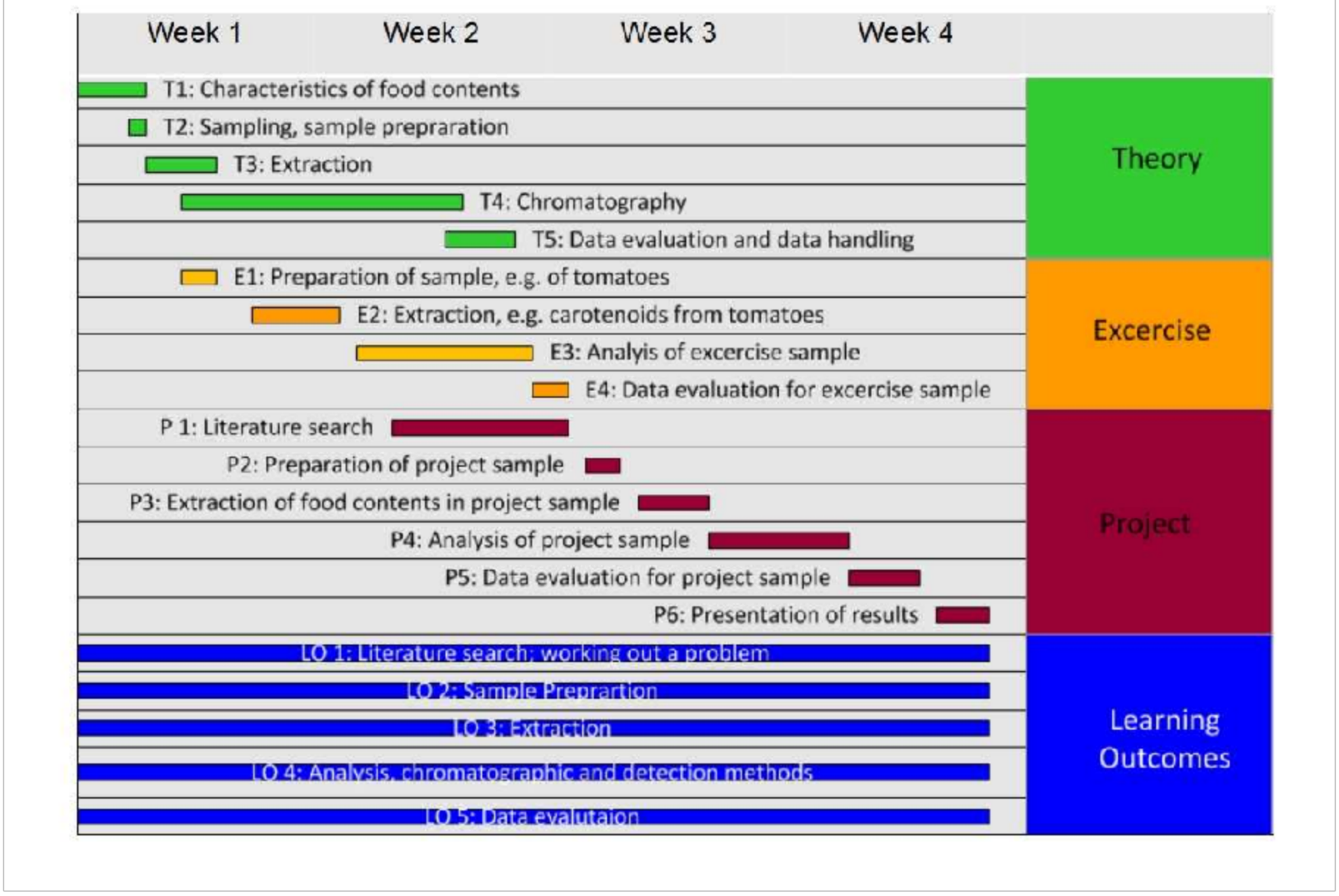
Preparation of advanced graphs and of presentations	B

1.1.2 Time Table



1.1.3 Realization and Experiences

The ECVET Module Food Analysis was conducted for the first time in January 2013. Five apprentices conducted vitamin analysis of spinach and wild berry samples (the “exercise”). They applied solid-liquid extraction and analyzed the samples by LC-UV. They worked with internal and external standards and identified and quantified several vitamins in the samples. The report can be found on the homepage www.eu-chemlab.eu (protected area). In the second part (the “project”) they conducted literature search regarding content and analysis of phenolics compounds in the same samples. They selected an appropriate method for the given samples. They conducted LC-MS analysis of phenolic compounds and evaluated the data by special software. By this, they not only identified known substances but also were able to find unknown compounds in the samples. The presentation of their results can be found on the homepage www.eu-chemlab.eu (protected area).

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The experience of this first conduction of an ECVET module was presented on the intermediate meeting. The most important findings are presented in the following.

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Food Analysis - the praxis

Exercise: Extraction and quantification (by **UV-Vis-detection**) of **fat soluble vitamins** in food samples

Project: Extraction and **mass spectrometric detection** of **phenolic compounds** in food samples

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Food Analysis - the praxis

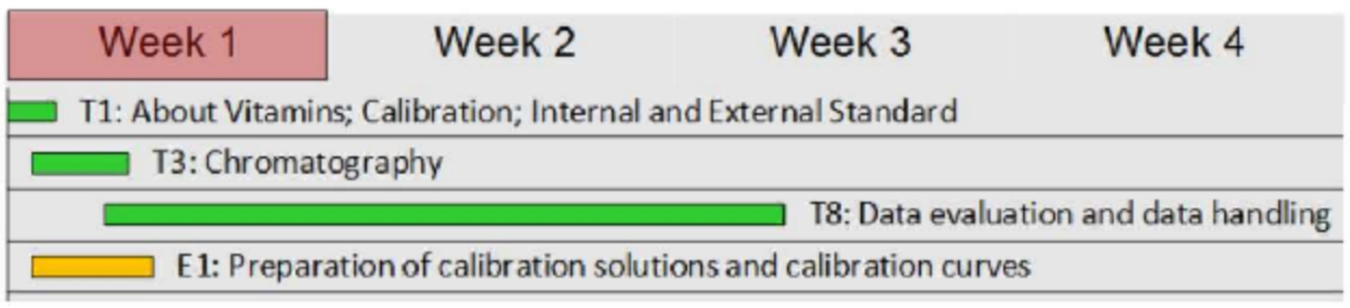
Exercise: Extraction and Quantification of fat soluble vitamins in food samples

Preparation of standard solutions

Injection of single vitamins to determine the retention time

Identification by comparison of UV-Vis-Spectra

Preparation of calibration curves



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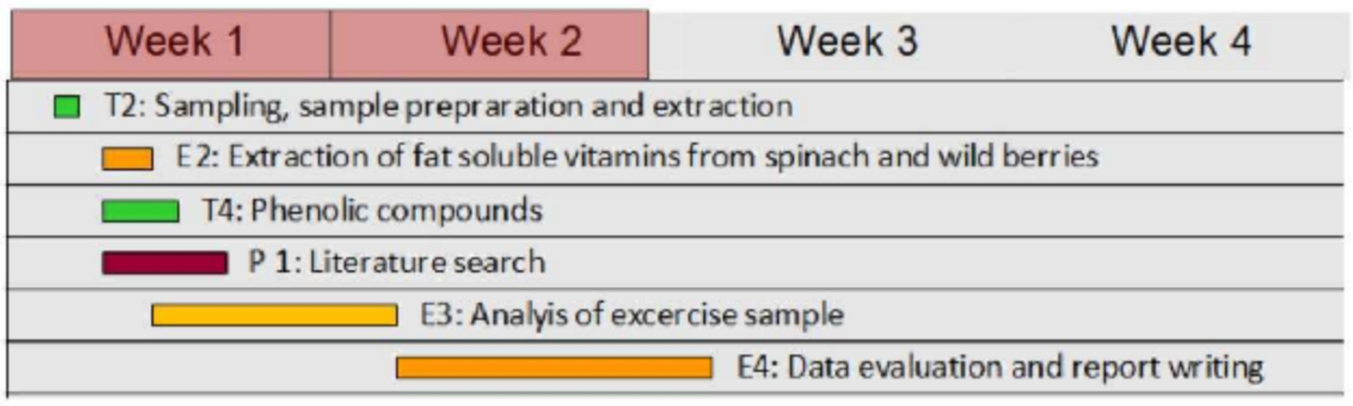
Food Analysis - the praxis

Exercise: Extraction and Quantification of fat soluble vitamins in food samples

Extraction of fat soluble vitamins from spinach and wild berries

Analysis of the samples: recovery rates, caculation of concentration

Data evaluation and preparation of the report



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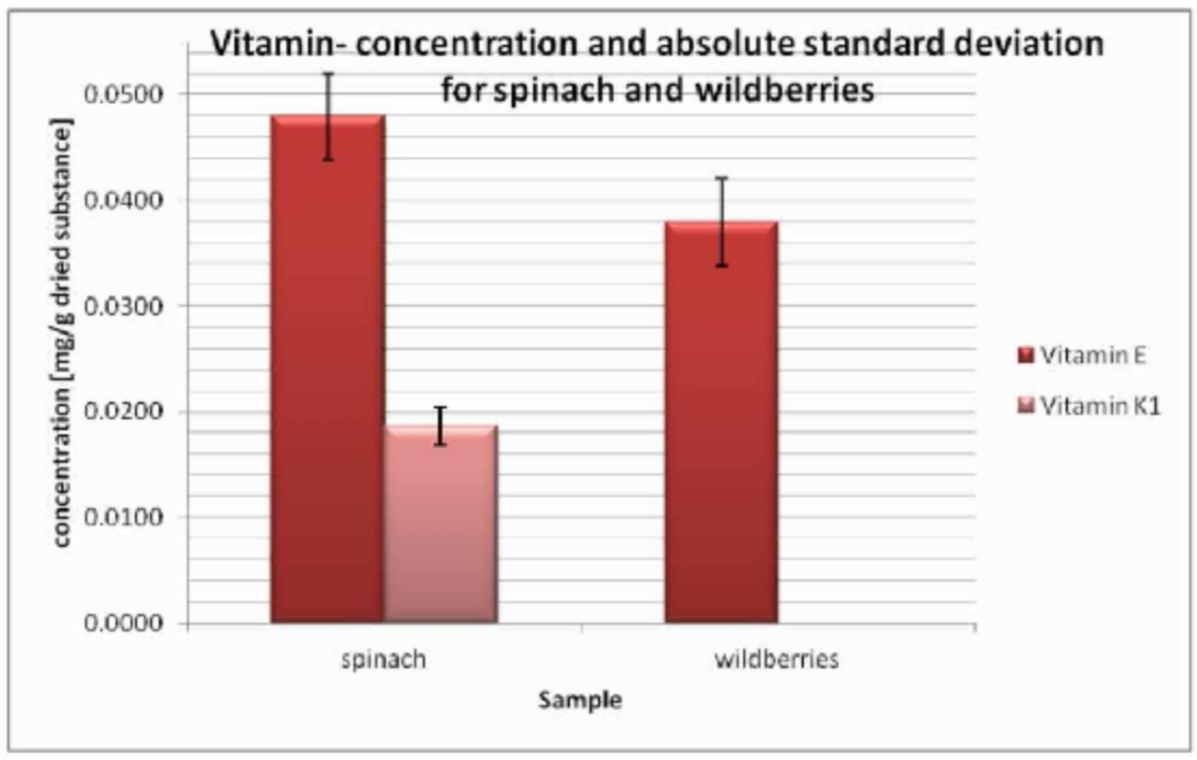
Food Analysis - the praxis



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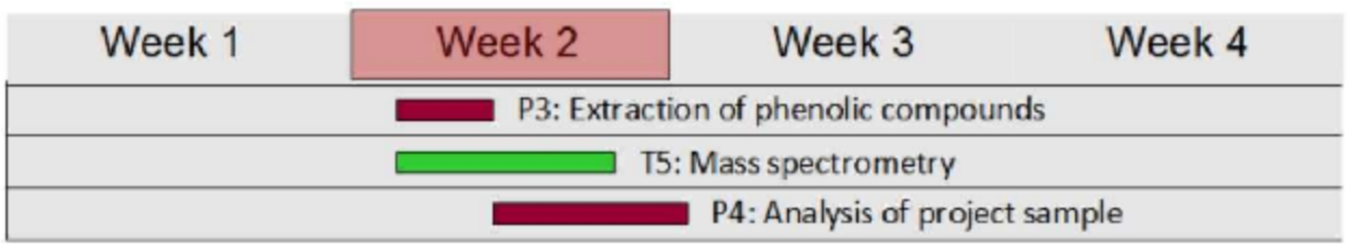
Food Analysis - the praxis

Project: Extraction and mass spectrometric detection of phenolic compounds in food samples

Extraction of phenolic compounds from spinach and wild berries

Analysis of the samples



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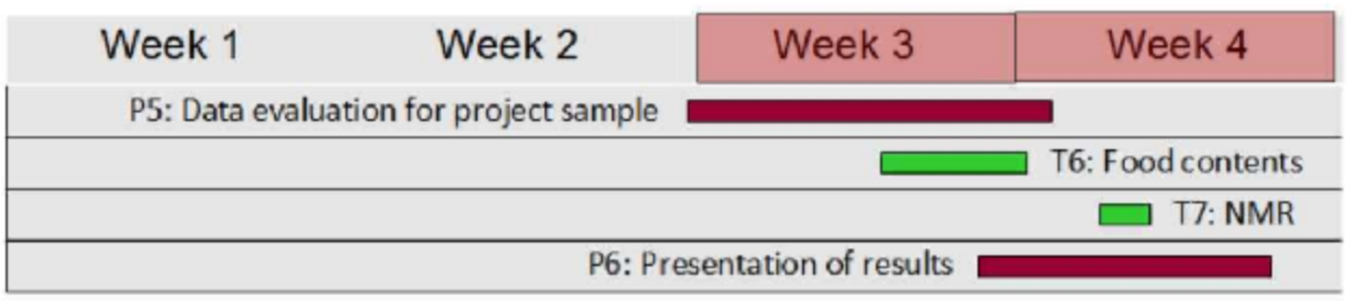
Food Analysis - the praxis

Project: Extraction and mass spectrometric detection of phenolic compounds in food samples

Analysis of the samples: Identification of known and unknown signals

Data evaluation and preparation of a powerpoint presentation



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Food Analysis - what we learned

Theory

The level of knowledge is very heterogenous

In our case the knowledge about chromatography was higher than expected

But the knowledge about food contents was lower…

→ It is important to meet the individual needs

In our experience new topics, e.g. phenolic compounds, have to be repeated several times

→ Allow extra time for recapitulation and questions

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Food Analysis - what we learned

Practical course and project

The lab experinces was quite good

Allow the apprentices to work indenpendently → that will increase their fun ☺

Literature search was a little unpopular

There was a need to explain evaluations like mean value and standard deviation

To learn and use the advantages functions of evaluation software – give the apprentices a hand and time to excercise by themselves

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Food Analysis - what we learned

General

The apprentices like to have a clear structure

They want to know, which tasks have to be performed on the day

Hold a feedback discussion every week and be open for suggestions

If possible build suitable groups, e.g. two persons each

Keep in mind that the apprentices (at least in our case) …..

….are very young….

….and are apprentices!

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The module was evaluated by use of questionnaires, which covered the following topics:

- General
- Theoretical lessons
- Practical Course
- Project
- Laboratory and Scientific work
- Instructors
- Acquired Competence
- Overall Opinion
- Free Comments

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1.2 The ECVET Modules in the partner countries

According to the experiences within the first module and the results of the evaluation the following modules were adapted and improved. In parallel in all partner countries similar modules were developed and conducted. The Learning Units and Learning outcomes of these modules can be found in the Appendix.

The Greek ECVET module “Environmental Analysis” focused on the development of an analytical method for determination of pesticides in water and sediment samples. It included the following learning units: Sampling in different environmental samples, sample pretreatment, chromatographic separation and detection, identification of pollutants, quantification and evaluation of results and presentation of the data.

The Turkish module “Water Analysis” included diverse methods like atomic absorption spectroscopy, GC-MS, UV-Vis spectroscopy. Also in situ and at site analyses like pH, dissolved oxygen, salinity, conductivity, temperature, turbidity, color measurements were included. Several volumetric and gravimetric methods for water analysis were also applied.

The Polish module “Cosmetic analysis” dealed with analyses of fragrances and essential oils by GC-MS. Diverse extraction methods , microwave or SPME were applied. Moreover experiments were conducted regarding the preparation of cosmetic formulation and the analysis of stability and active substance release of the prepared formulations.

Concluding the project was successful in developing five diverse ECVET modules. A major drawback was the lack of financing of mobilities in Greece, Turkey and Poland. Therefore only six German apprentices had the possibility to attend an ECVET module in the partner countries. The all were very happy about this experience abroad not only in a scientific but also in a social context.

Moreover an examination for the ECVET modules was developed within the project. The exams were hold by examiners from the IHK and all apprentices obtained a certificate about an “additional qualification”.

Presentations about the conducted moules and the achieved goals as well as encountered problems regarding the ECVET modules were given on the final meeting. They can be found in the appendix. An overview about the most important results is shown in the following.

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The ECVET Modules in Chemlab II

- Germany: Food Analysis
- Greece: Environmental Analysis
- Poland: Cosmetic Analysis
- Turkey: Water Analysis
- Georgia: Environmental and GMO Analysis

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Learning Outcomes in the different modules

Sampling and sample preparation

- Sample Size
- Sample Preservation
- Lyophilization
- Homogenization, Emulsification

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Learning Outcomes in the different modules

Extraction

- Sonication
- Microwave
- Headspace
- SPE/SPME

Separation

- GC-FID
- LC-UV
- LC-MS (/MS)
- GC-MS

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Learning Outcomes in the different modules

In situ and at site analysis

- pH, Dissolved oxygen
- Viscosity, Refractive index, Colour
- Salinity, Conductivity, Temperature, Turbidity
- Carbonate/Hydrogen carbonate measurement

Volumetry and Gravimetry

- Suspended matter, Total solid matter, Ignition residue
- Biological and Chemical Oxygen demand
- Kjelhdahl

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Learning Outcomes in the different modules

Spectroscopy

- Spectrophotometric nitrite and phosphate analysis
- Atomic absorption spectroscopy

Identification and Quantification

- Calibration curves, internal and external standard
- Mass spectrometric identification

Data handling

- Handling of diverse evalution software
- Evaluation and interpretation of data
- Presentaion of results

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Food Analysis - Germany (Jan/Mar/Oct 2013)

- Extraction and quantification (by UV-Vis-detection) of fat soluble vitamins in food samples

- Extraction and mass spectrometric detection of phenolic compounds in food samples

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Environmental Analysis - Greece (Sep/Oct 2013)

Extraction of pesticides from water and sediment samples
Analysis of pesticides by LC-MS/MS





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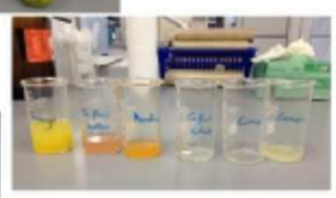
Cosmetic Analysis – Poland (Jun/Oct 2013)

- Quantitative comparison of the volatile flavour compounds in natural and commercial citrus products by GC/MS

- Comparison of Coco Chanel´s Mademoiselle and N°5 using GC/MS

- Preparation and analysis of cosmetics with the special emphasis on the stability of products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Water Analysis – Turkey (Sep/Oct 2013)

- pH, Dissolved oxygen
- Viscosity, Refractive index, Colour
- Salinity, Conductivity, Temperature, Turbidity
- Carbonate/Hydrogen carbonate measurement
- ……

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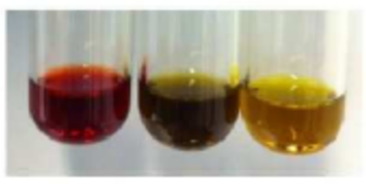
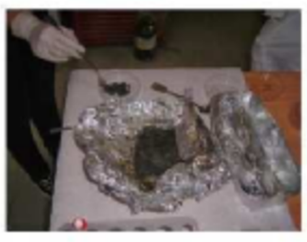
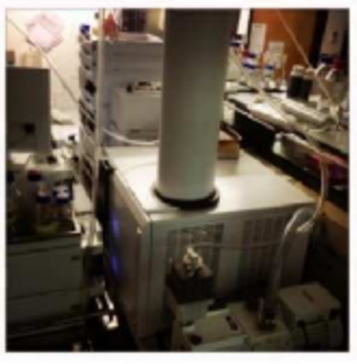
Summarizing….







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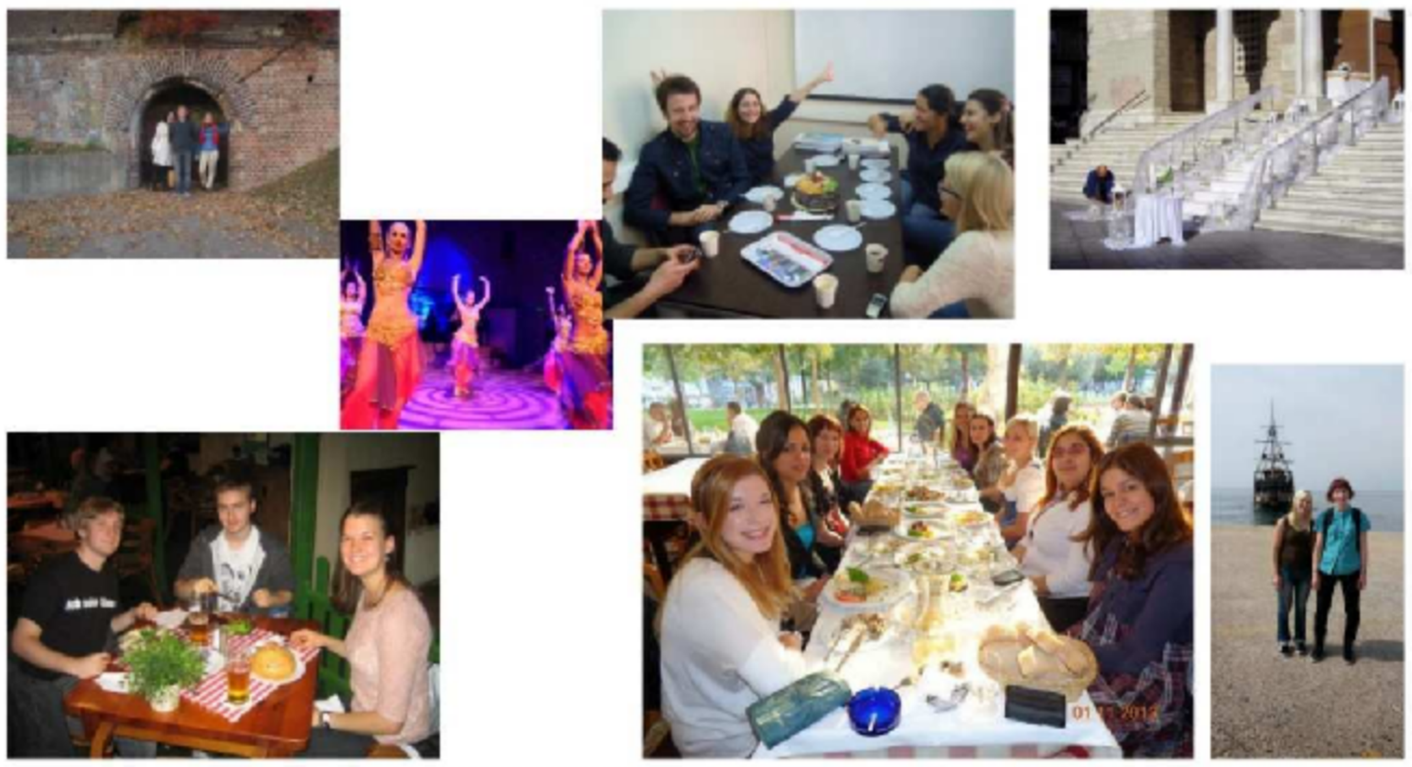
Besides work…..



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Conclusion

- ✓ ECVET modules with different topics and diverse methods have been developed and establisehd
- ✓ Apprentices rate the learning outcomes as high
- ✓ Apprentices rate the module as very good to good
- ✓ Apprentices rate the usefulness as high
- ✓ Apprentices made not only work experience abroad but also international experience

Let´s get on with it ☺

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After conduction of each module again an evaluation was conducted. The results are shown in the following section.

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1.3 The Evaluation of the ECVET Modules

The evaluation was carried out by use of a questionnaire, which can be found in the Appendix. In the following the results of the most important questions are shown. In total 38 questionnaires have been filled out by the apprentices. These 38 were used for data evaluation. From the 38 questionnaires 12 were from the German module, 8 from the Greek, 6 from the Polish, 4 from the Turkish and 8 from the Georgian module. All data shown are the percentage values.

1.3.1 Learning Outcomes

Figure 1 and Figure 2 show the assessment of theoretical and practical learning outcomes.

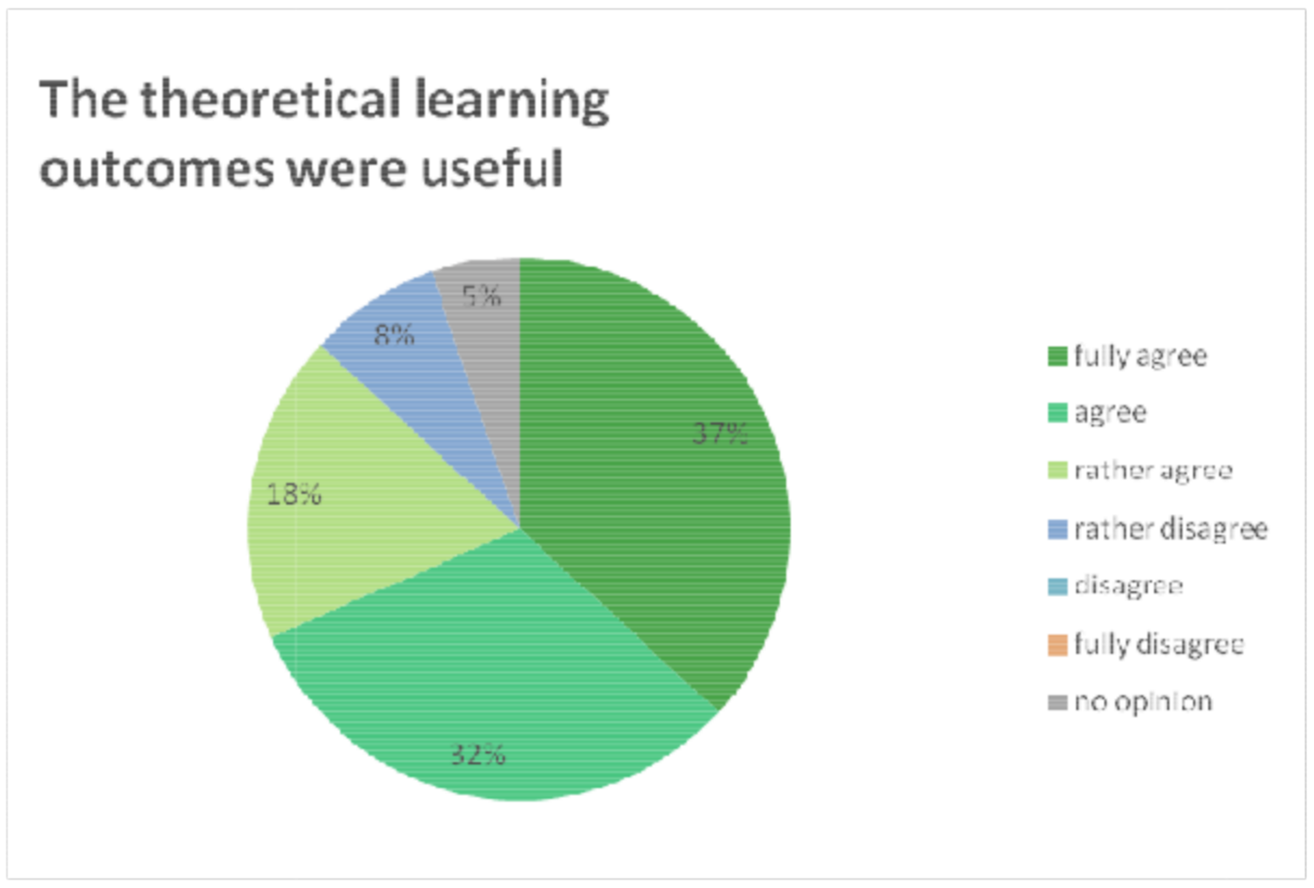

Figure 1: Assessment of theoretical learning outcomes

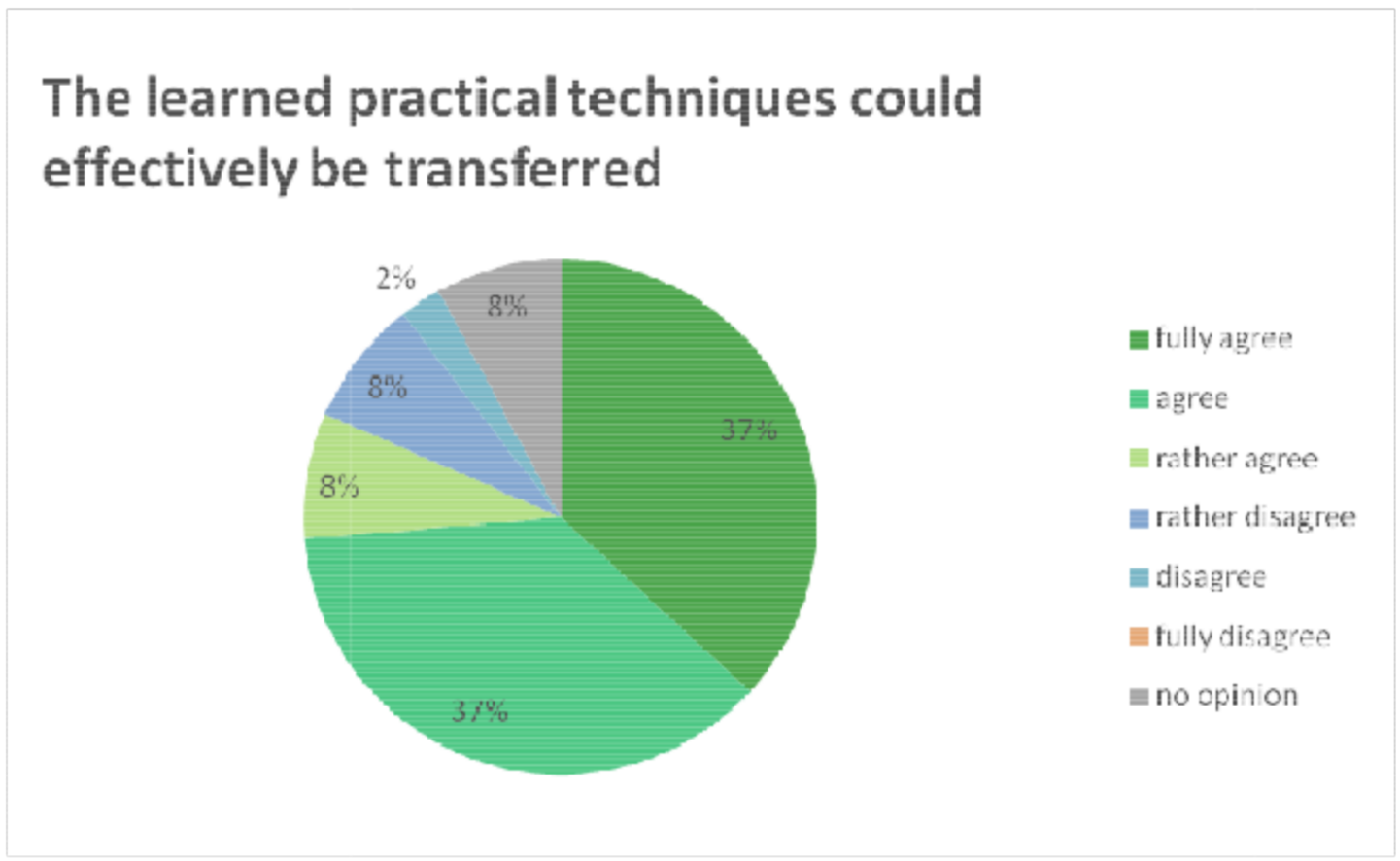

Figure 2: Assessment of practical learning outcomes

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As can be seen, 69% of apprentices rate the learning outcomes as useful, and 74% state effective practical learning outcomes.

1.3.2 Usefulness for professional praxis

Figure 3 and Figure 4 show whether the apprentices rate the modules as useful for their later professional praxis.

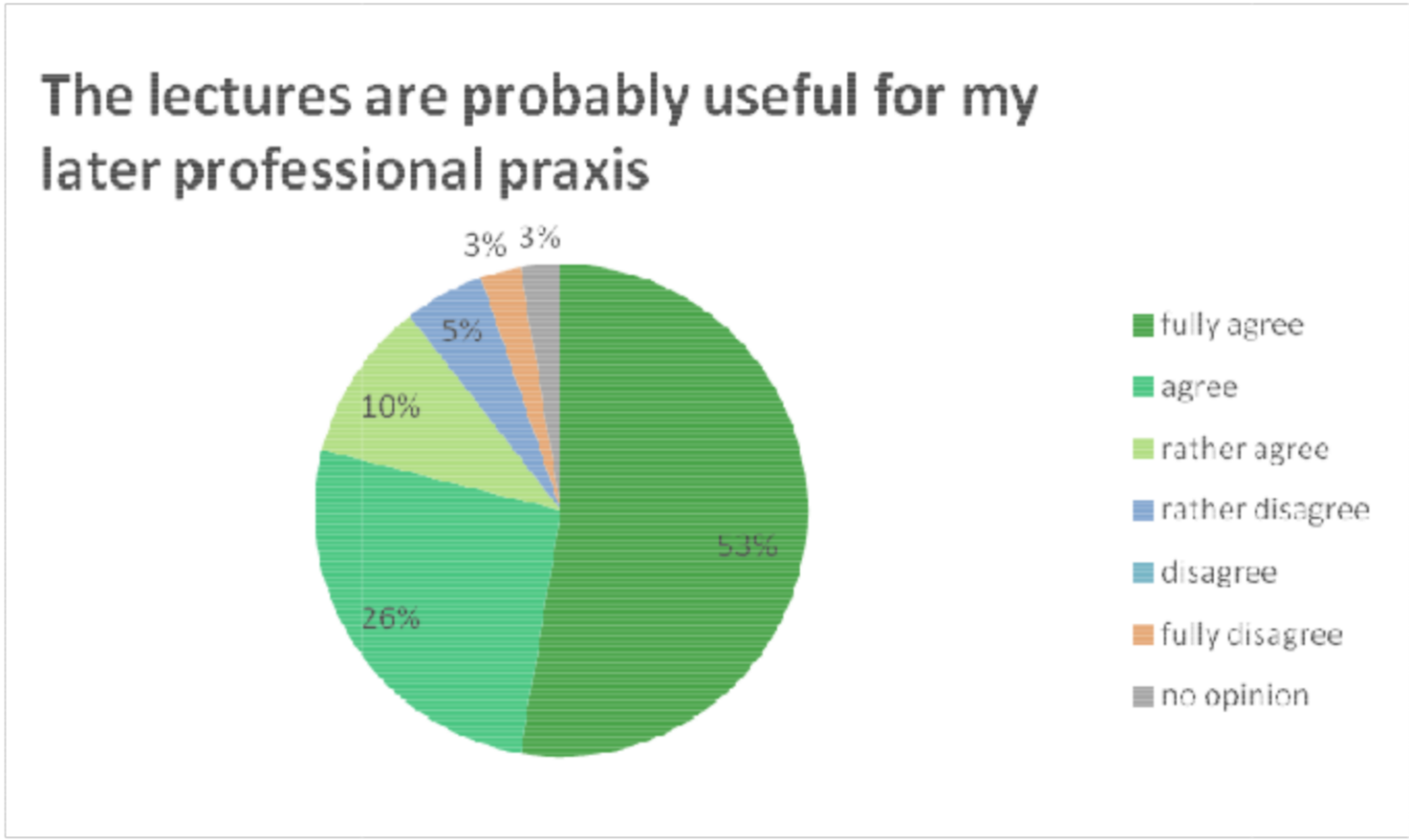

Figure 3: Usefulness of theoretical lessons for professional praxis

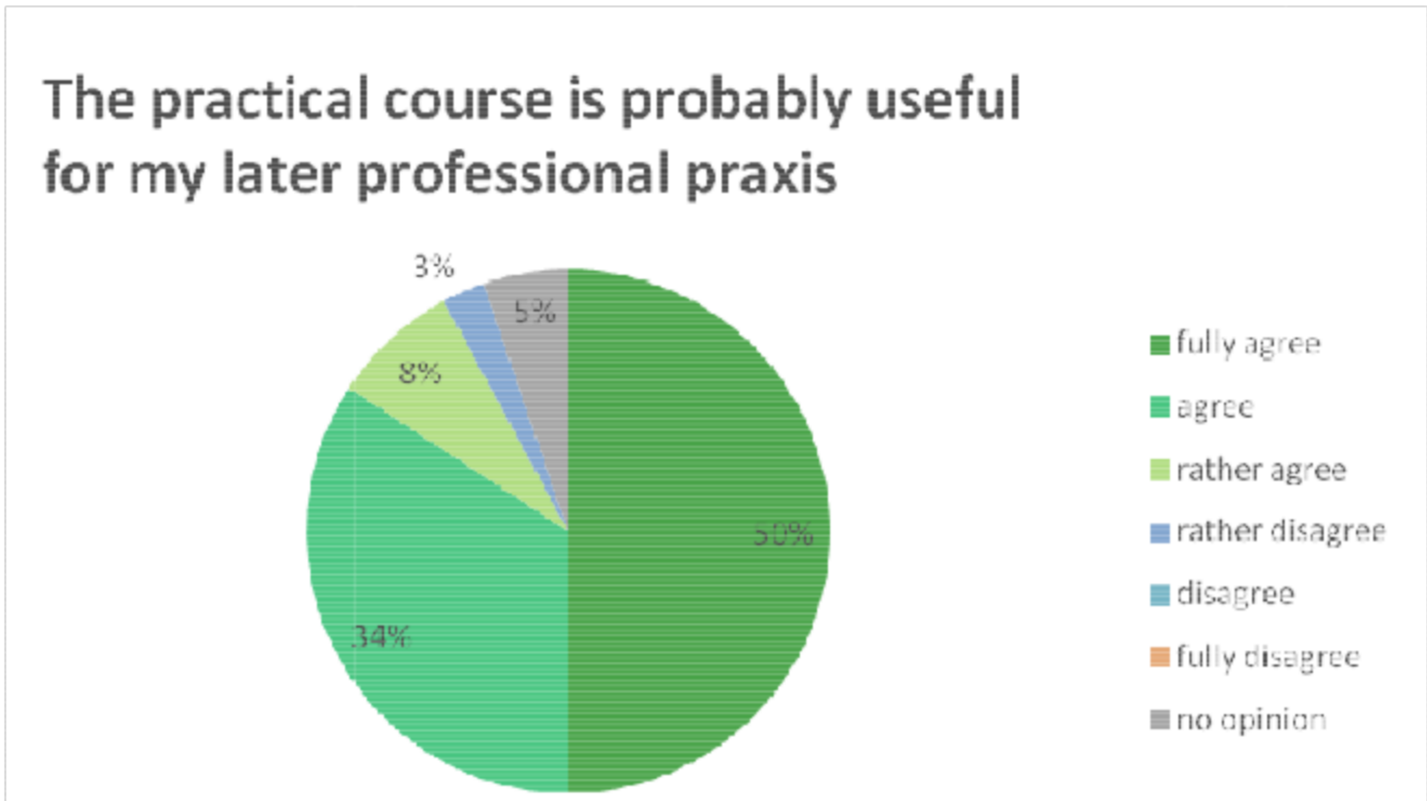

Figure 4: Usefulness of practical course for professional praxis

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79% state that the theoretical lessons may be useful for the later professional praxis. Regarding the practical course even 84% see it as useful for professional praxis.

1.3.3 Aquired Competence

Figures Figure 5 to Figure 11 show the evaluation of aquired competences by the apprentices. Only answers of apprentices who conducted the respective methods are considered in this evaluation (e.g. if an apprentice did not conduct extractions the answer is excluded). The data shown here are based on at least 32 evaluated questionnaires. The aquired competence in asmpling is rated as very hight to high by 52% of apprentices.

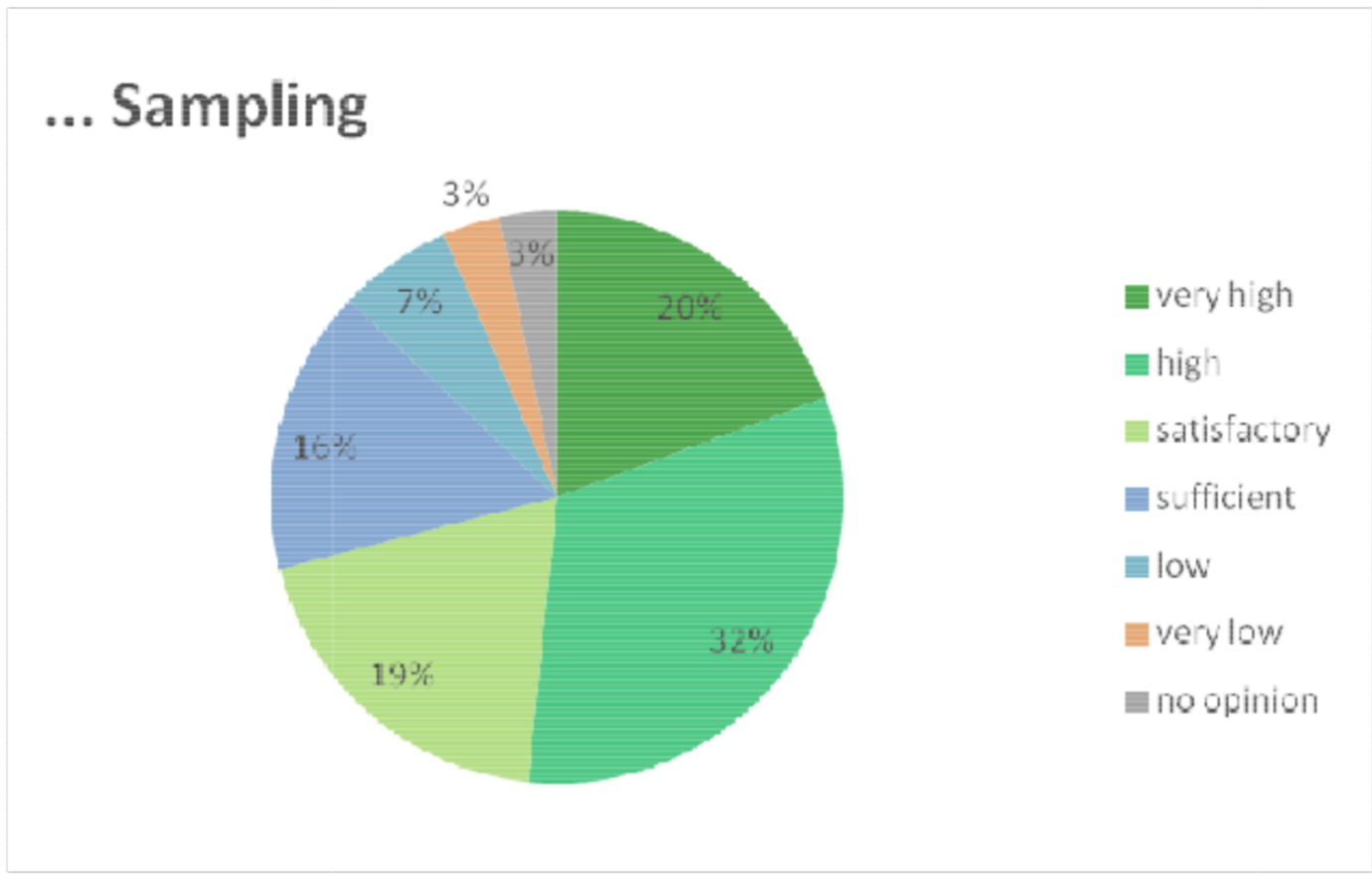

Figure 5: Acquired Competence in Sampling

In case of extraction methods the acqired competence is rated as very high to high by 72% of the apprentices and by 25% as satisfactory to sufficient.

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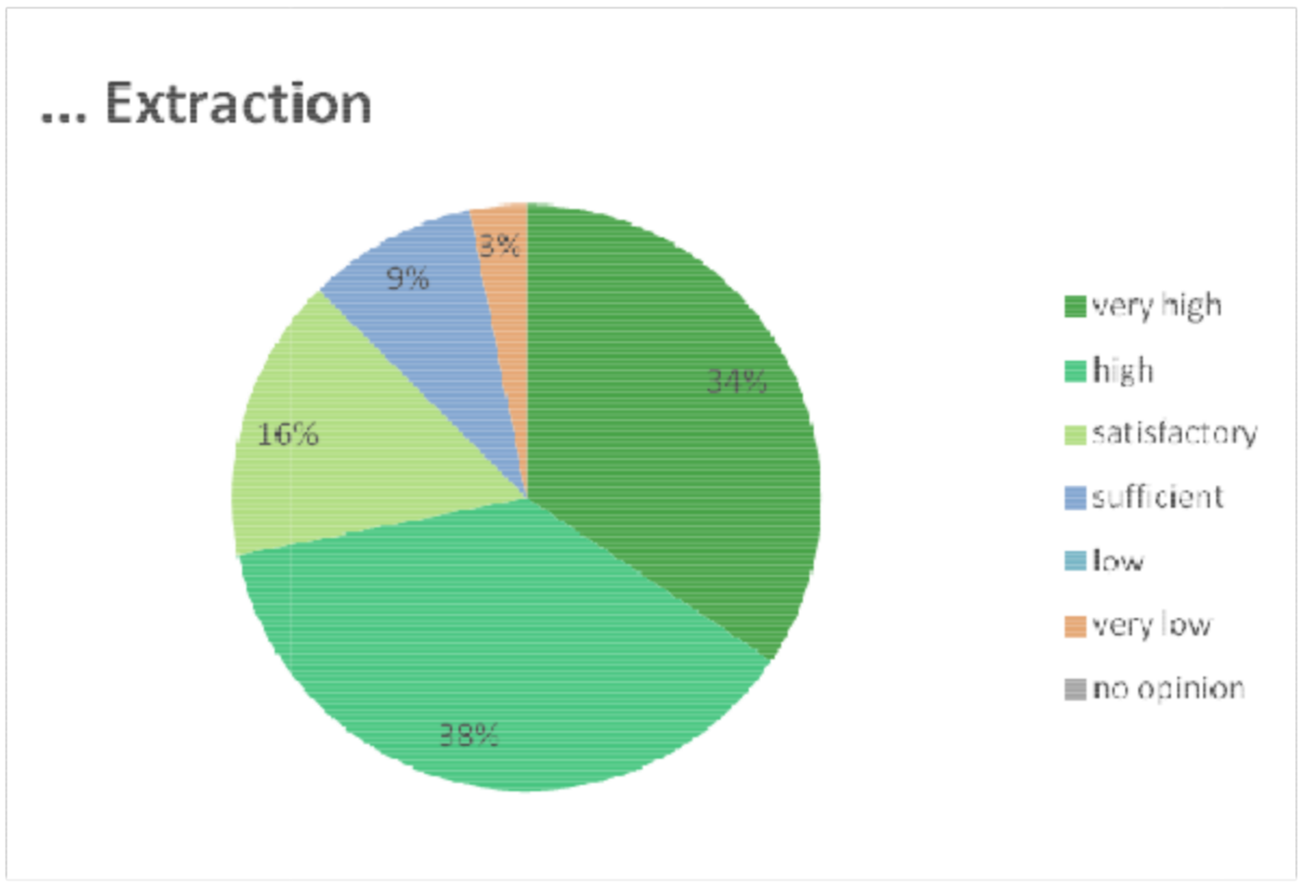

Figure 6: Acquired Competence in Extraction

Figure 7schows that 75% of the apprentices rate the acquired competence in chromatographic sepration as very high to high and 19% as satisfactory to sufficient.

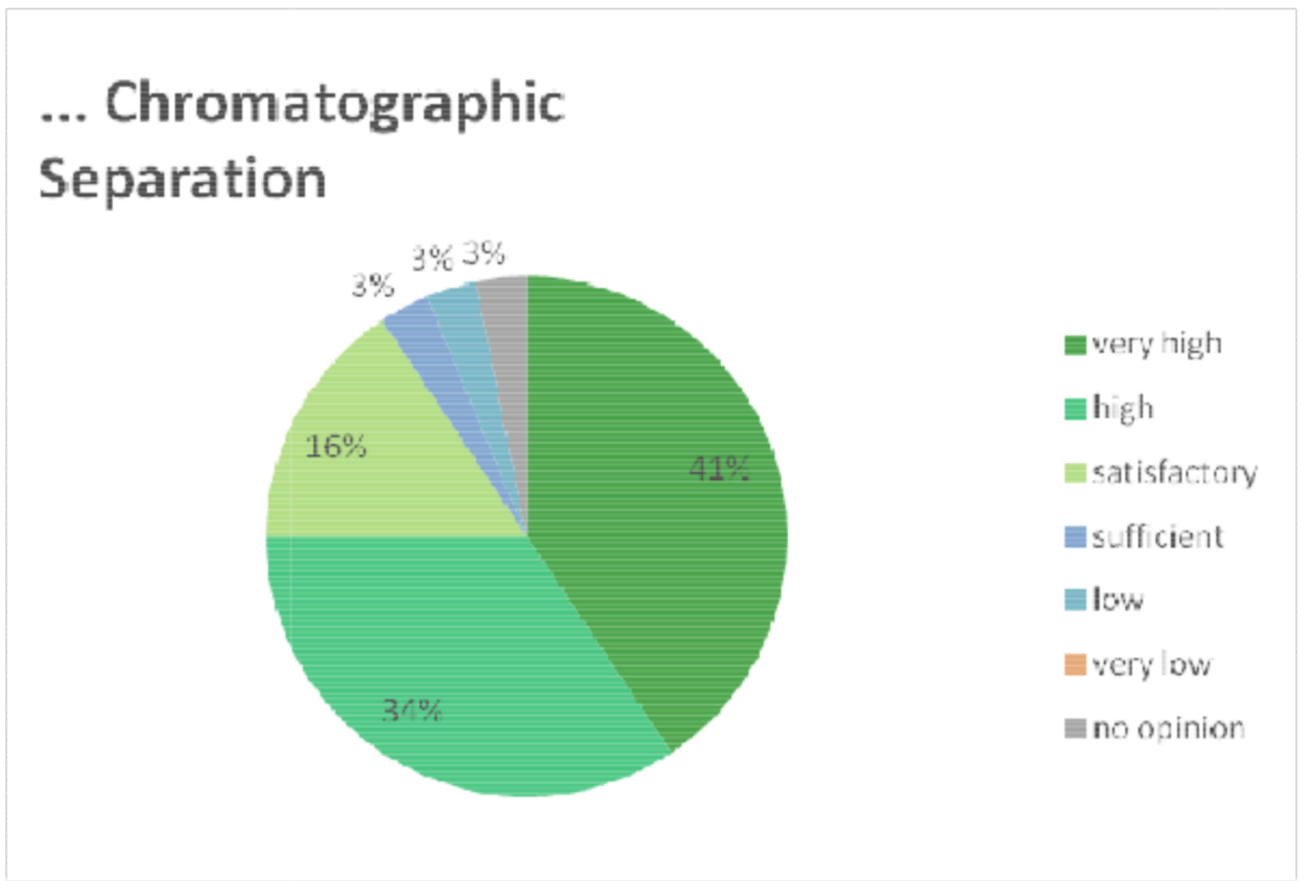

Figure 7: Acquired Competence in Chromatographic Separation

As can be seen from Figure 8, also the majority of apprentices rate the acquired competence in mass spectrometry as very high to high and only 28% as satisfactory to sufficient.

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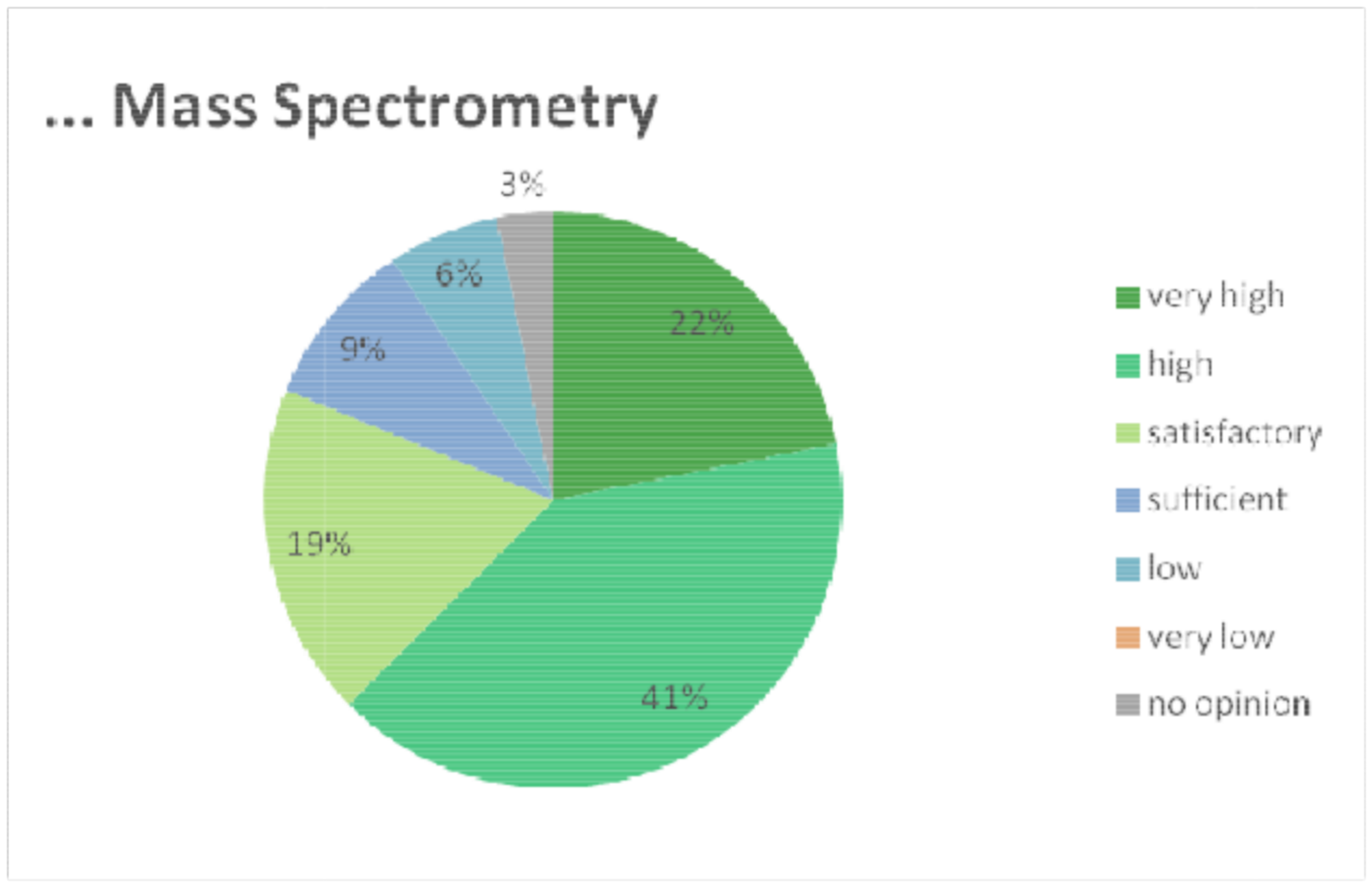

Figure 8: Acquired Competence in Mass Spectrometry

In case of Identification and detection techniques again the majority rate the acqiured competence as high. Another 30% state that it was satisfactory to sufficient.

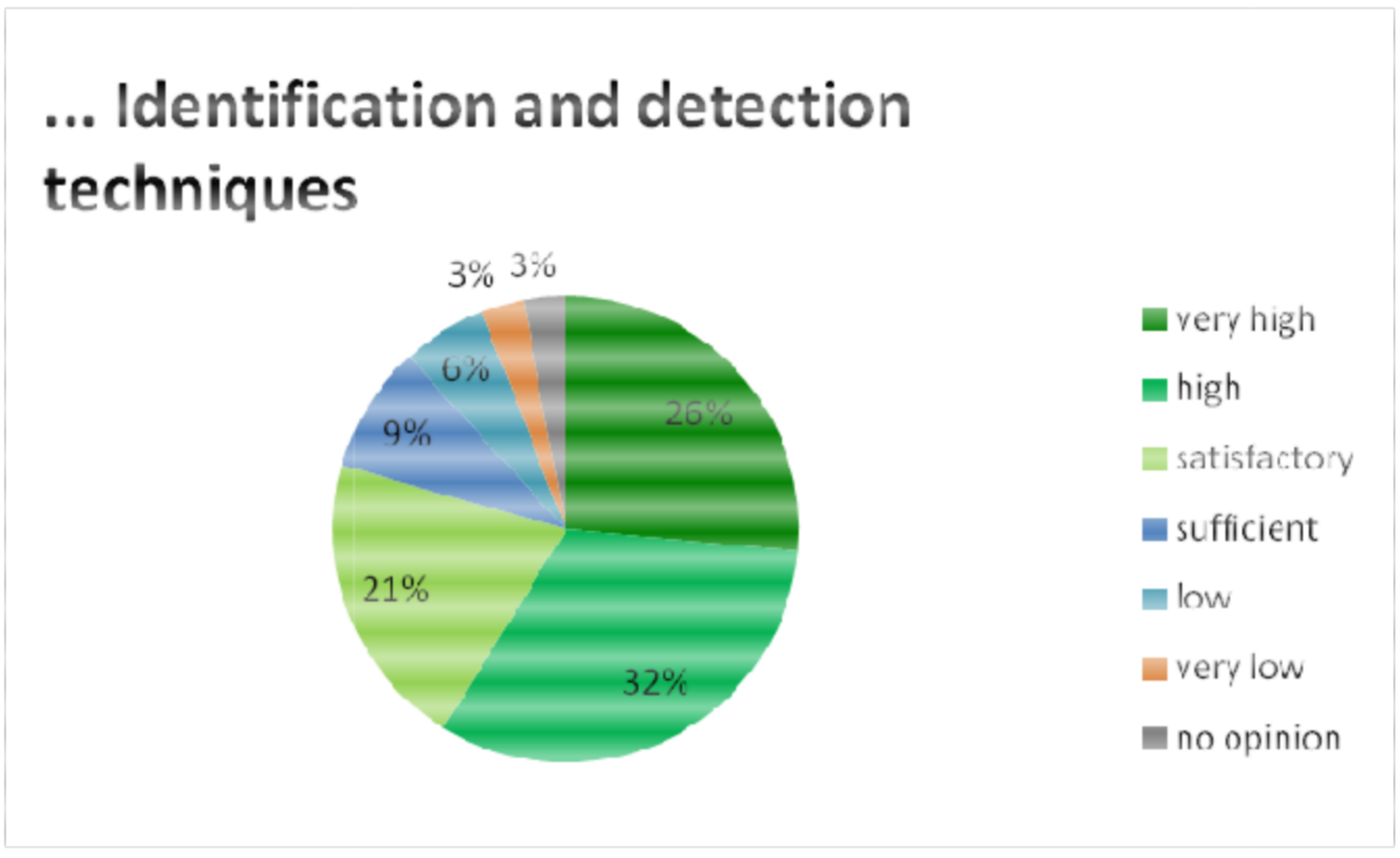

Figure 9: Acquired Competence in Identification and detection techniques

70 % of the apprentices acquired very high to high competence in qunatification techniques and 27% rated the acquired competence as satisfoactory to sufficient.

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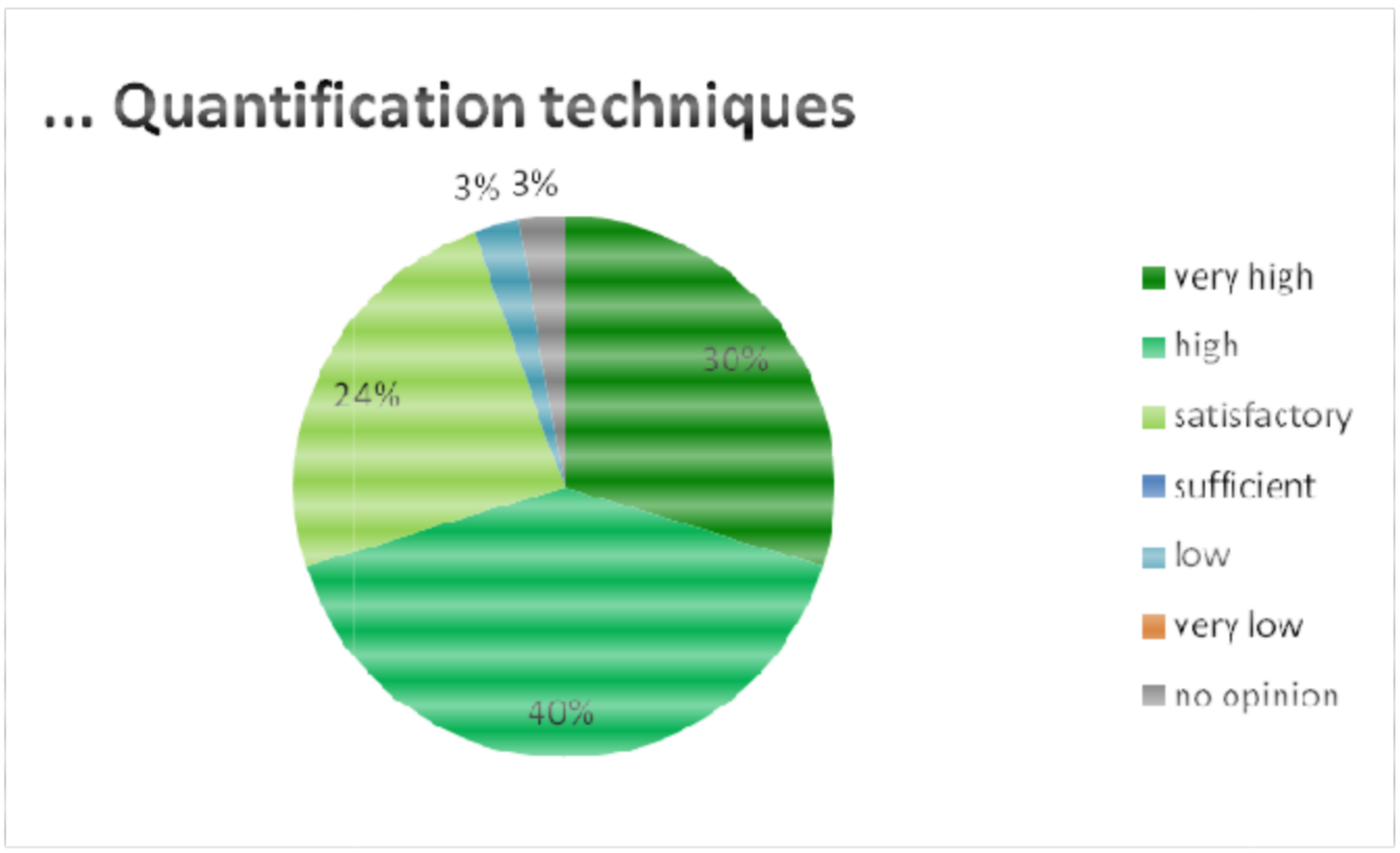

Figure 10: Acquired Competence in Quantificationtechniques

70 % of the apprentices acquired very high to high competence in quantification techniques and 21% rated the acquired competence as satisfoactory to sufficient.

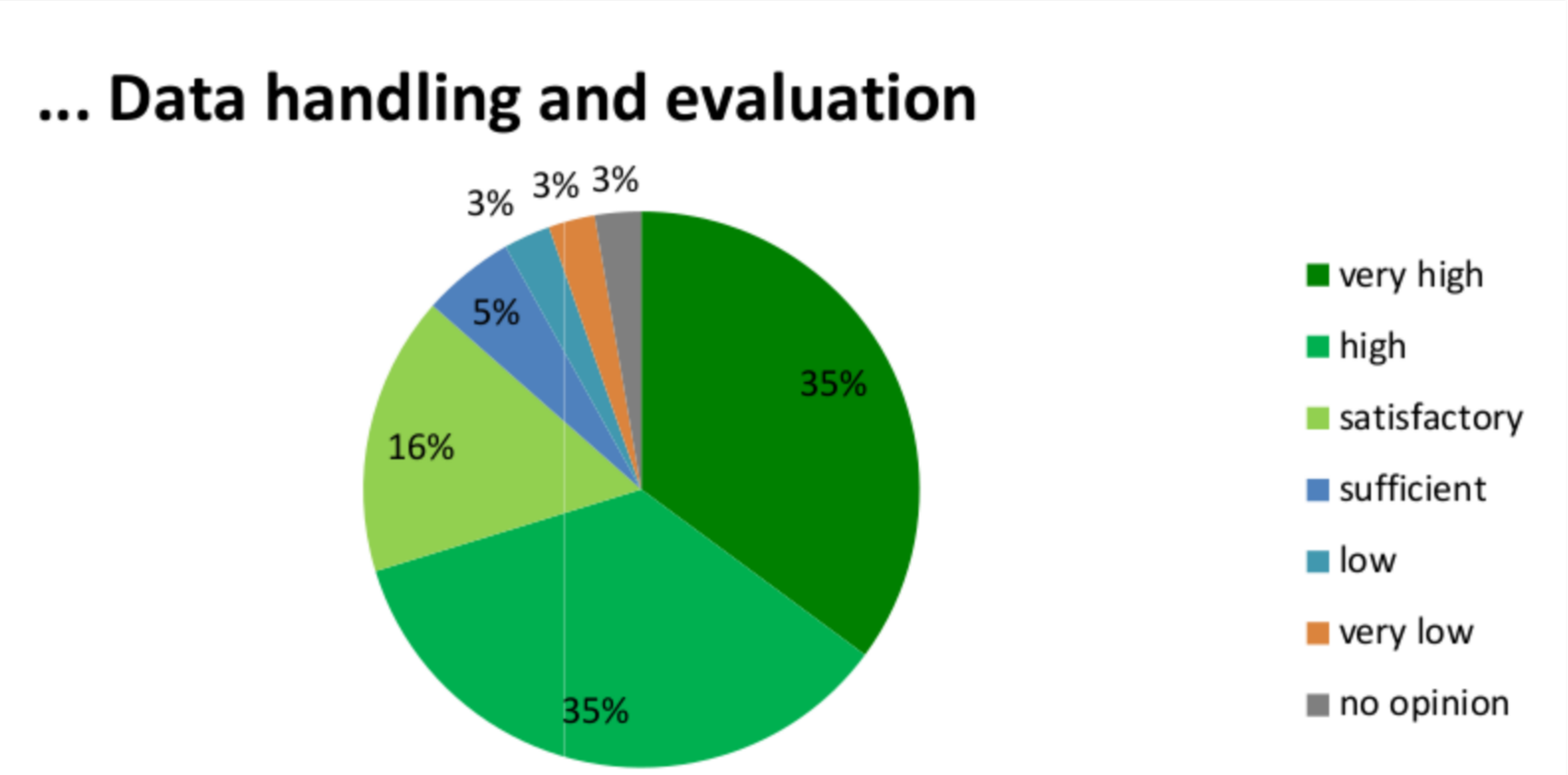

Figure 11: Acquired Competence in Data handling and evaluation

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1.3.4 Scientific and Group Work

Also the assesment of the scientific work as well as of the more soft parameter group work were enquired. As cann be seen fromFigure 12and Figure 13 56% of apprentices were encouraged to independent scientific work and 71% perceived the group work as fruitful.

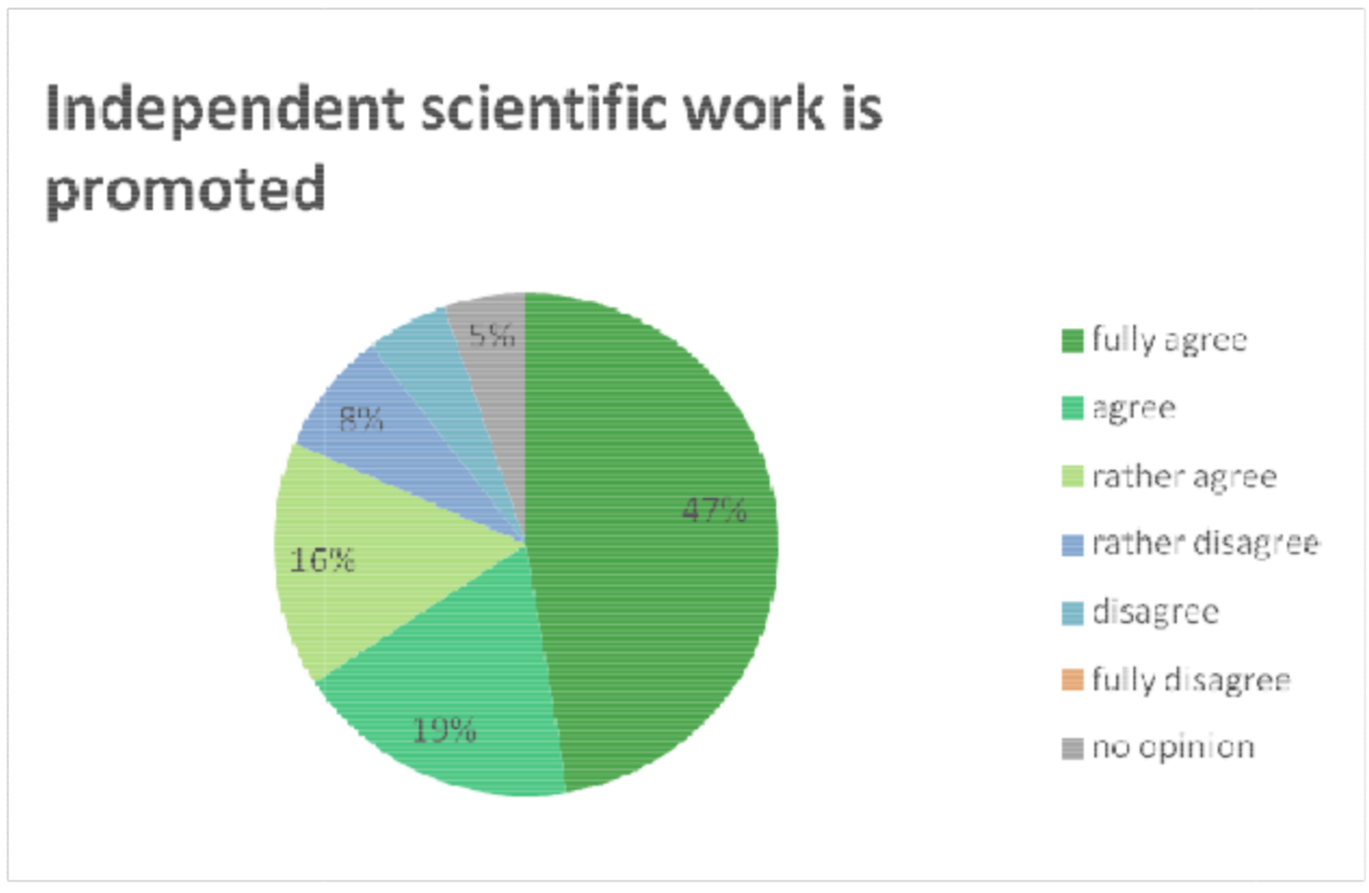

Figure 12: Assessment of independent scientific work

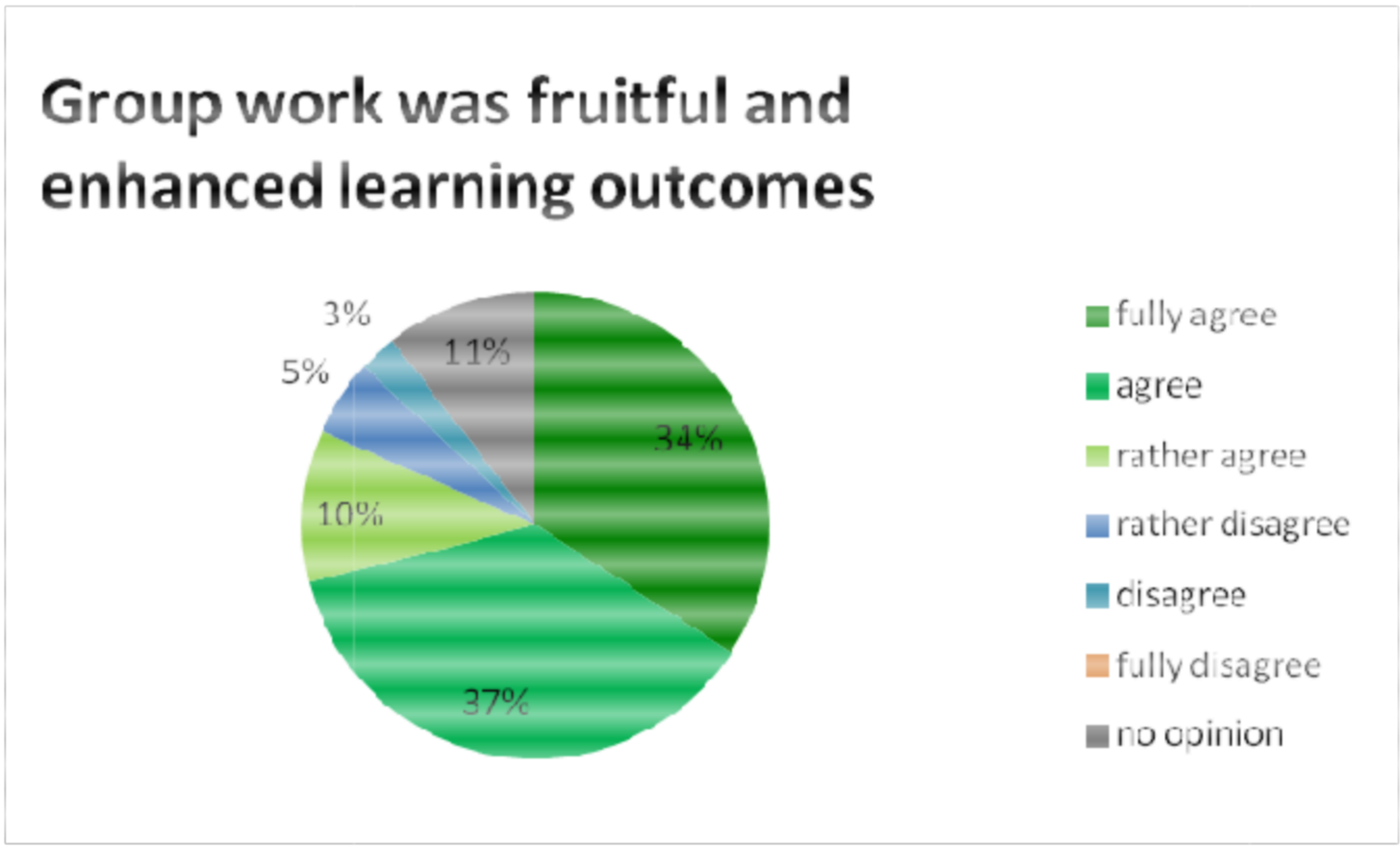

Figure 13: Assessment of group work

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Although from our experience at the beginning of the modules the apprentices partly were afraid from working with English materil at the end 66% rate that as beneficial and only 3% disagree in this question.

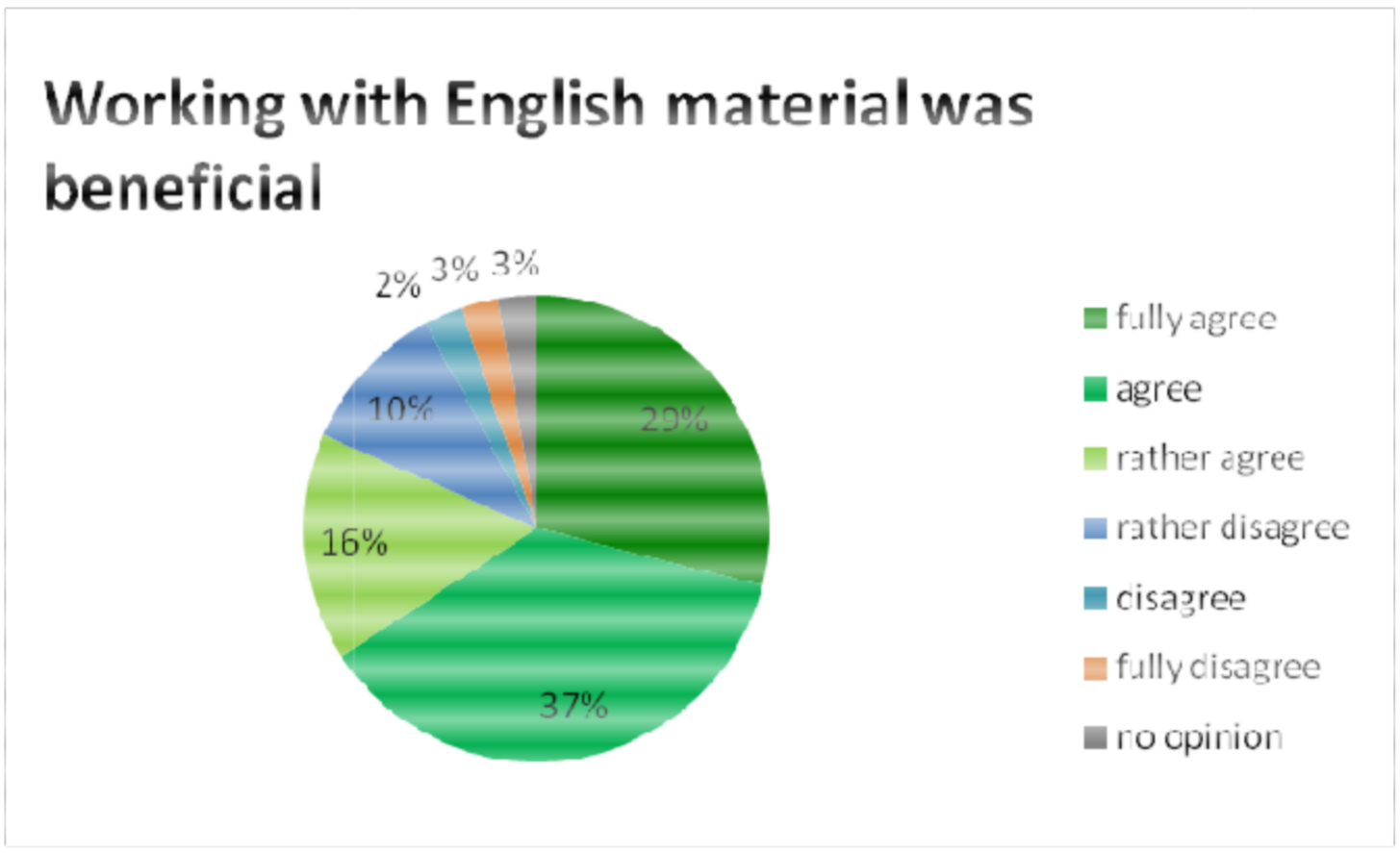

Figure 14: Assessment of benefit of working with English material

1.3.5 Overall Assessment of the module

The assessement of the concept supports our concept of the modules, since it was rated as very good to godd by 82% of the apprentices. Also when asking for a grade 78% would assign Grade A or B to the overall module.

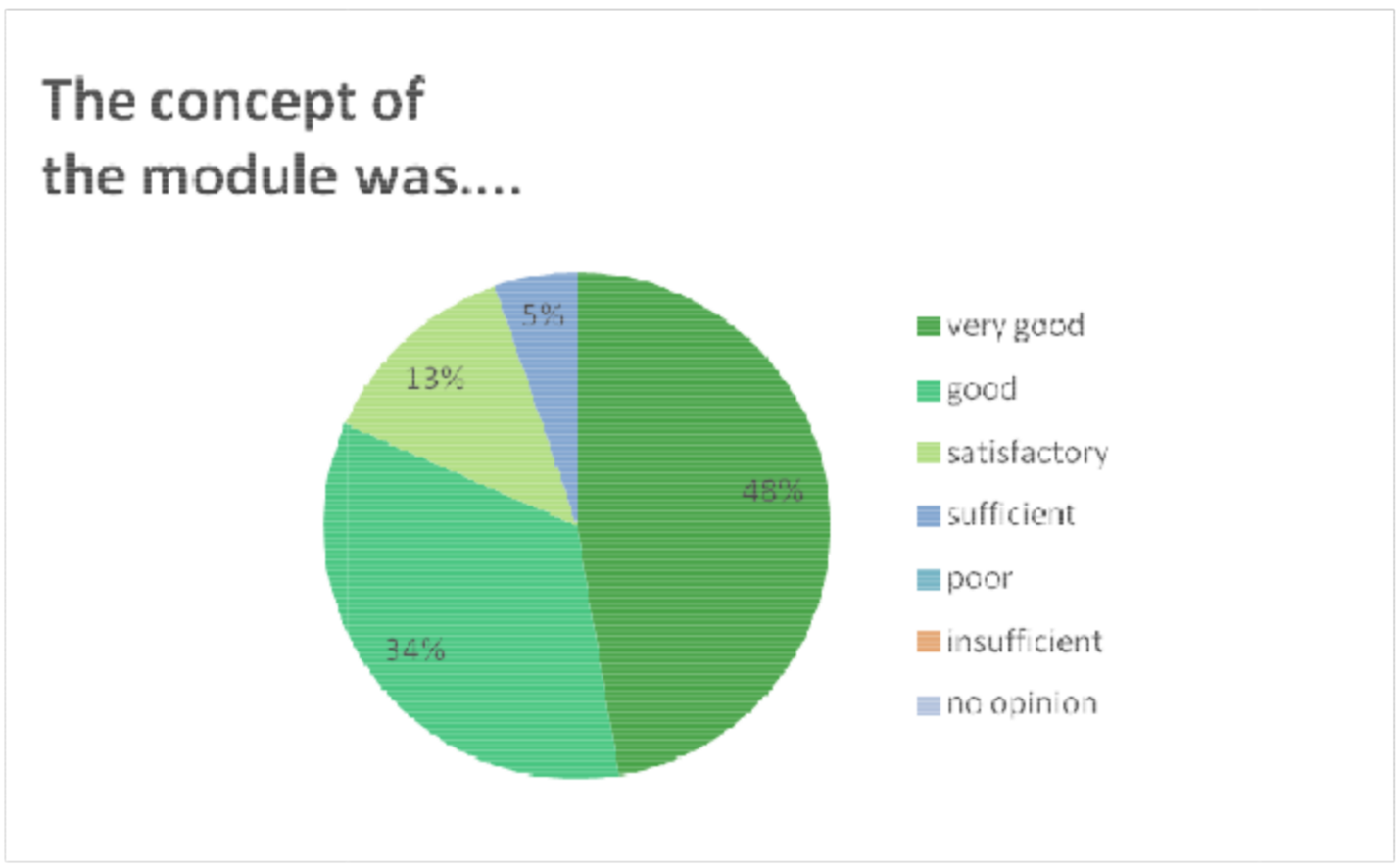

Figure 15: Assessement of the modules concept

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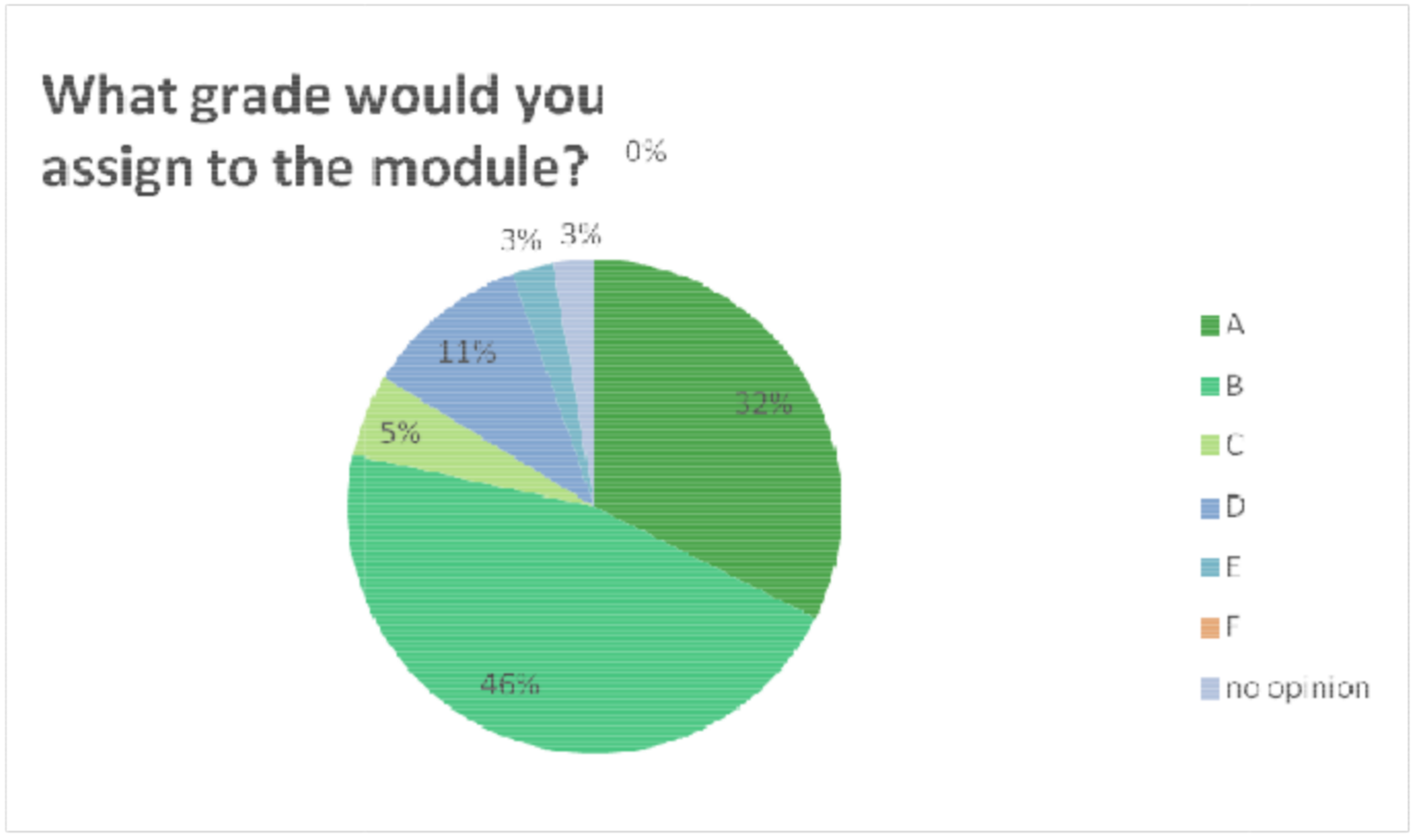

Figure 16: Assessement ba assigning a grade

The good assessement of the modules is also reflected in the question whether the apprentices would recommend the module (Figure 17).

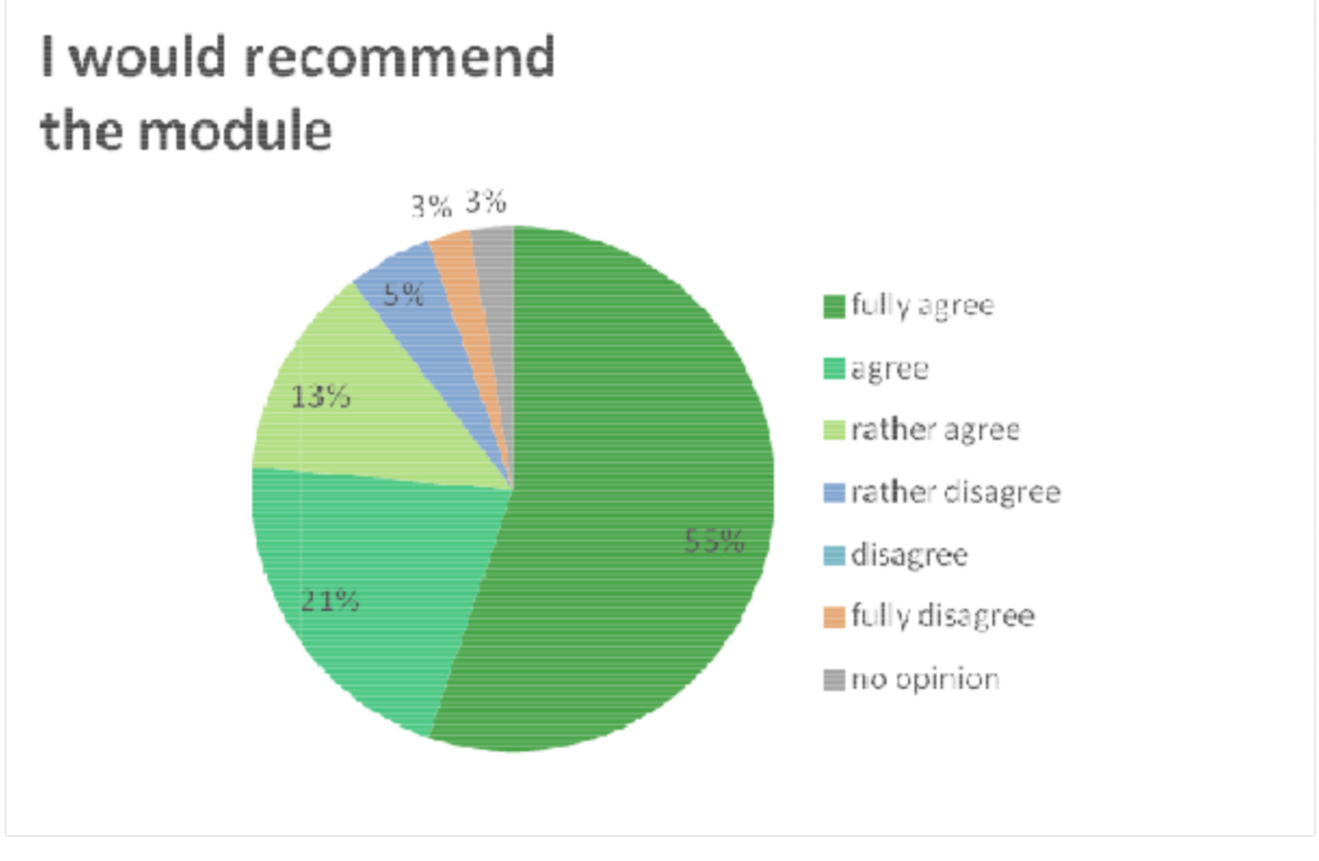

Figure 17: Recommendation of the module

To conclude the development and proving of the new ECVET modules was quite successful. The large majority of apprentices took benefit from attending the module and aquired new knowledge, comeptences and skills.

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Appendix A Social Report from a supervisors view

SOCIAL REPORT ABOUT THE ECVET-MODULES (CHEMLAB 2)

After three completed ECVET-modules, our experiences could be described as followed:

4 participants joined each ECVET-module for 4 weeks. All of them do an apprenticeship as chemical laboratory assistant in the third year. Considering the practical experiences in diverse institutes before, e.g. brewery technology, analytics, organic chemistry, we expected different knowledge in practice and theory.

The first project they worked on was arranged from the supervisors, where the students should learn sample preparation techniques for analytical measurements and evaluation of data.

After the first days in lab we recognized, the practical experience of all the participants was approximately the same. In this way they could work self-employed when they started with the sample preparation. It was very good that they arranged themselves in teams but also worked together for the result report.

In the second part of the module the task for the participants was to work out an own project.

First of all a literature search was necessary. This was obviously new and we asserted that it was hard at the beginning for all of them. But at the end they were successful in finding scientific literature for analyzing polyphenols in food. The sense of achievement contributes to an increased enjoyment of work, especially when they evaluated the data and found some expected and non-expected compounds. The introduction in new techniques like mass spectrometry was well-understood and used.

In conclusion the project developed very well. First, the modules were a little bit confused but got more and more structured till the end.

Our last statement relating to the project is that they had fun, we had fun and of course we hope they took some new experiences for their future.

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Appendix B Social Report from an apprentices view

Ecvet-Modul Deutschland – Vitamin- und Polyphenolanalytik mit HPLC-MS

Als Auszubildende zur agrartechnischen Assistentin mache ich mein praktisches Jahr am Institut für Siedlungswasserwirtschaft der TU München in der analytischen Forschungsgruppe.

Gleich zu Beginn meines praktischen Jahres habe ich erfahren, dass ich eine der glücklichen Teilnehmerinnen am Ecvet-Modul sein werde.

Ich habe mich sehr gefreut, auch als Auszubildende zur agrartechnischen Assistentin die Chance zu bekommen, dieses Praktikum mitzumachen. Allerdings war ich auch sehr aufgeregt, was mich dort erwarten würde – nach nur 4 Monaten schulischer Vorbildung, während die anderen Teilnehmer bereits im 2. Lehrjahr zum Chemielaboranten waren.

Viele Fragen wie etwa: sind die anderen nett? Wird man das Geforderte erfüllen können und alles verstehen – und das auch noch auf Englisch? Wie viel Vorkenntnisse haben die anderen, kann ich da überhaupt mithalten? Werden alle Versuche funktionieren? Wie wird das vierwöchige Praktikum überhaupt sein? Ist wirklich alles auf Englisch oder nur ein Teil? Werden wir genug Unterstützung von den Praktikumsleitern bekommen und vor allem: wird die im Labor so wichtige Teamarbeit mit den Mitpraktikanten möglich sein?

Gleich die erste Frage wurde beim Kennenlernen beantwortet: in meiner Praktikumsgruppe waren außer mir zwei männliche und zwei weibliche Teilnehmer/innen. Dreie kannten sich schon aus der Laborantenschule und beim Vorstellen machten alle einen netten Eindruck, auch wenn sie noch eher zurückhaltend waren.

Als es dann endlich im Labor losging waren wir alle voller Erwartung auf das was kommt, und sehr gespannt. Wir hätten am liebsten sofort losgelegt. Die Zusammenarbeit gerade in der ersten Woche lief freundlich und kameradschaftlich ab. Jeder hat so gut es ging den anderen unterstützt. Ein Teilnehmer hat sich manchmal etwas schwergetan mit Berechnungen und war auch eher schüchtern, aber sehr nett, so dass sofort immer einer der anderen Teilnehmer zur Stelle war und die Arbeit übernommen hat, ihn unterstützt hat oder es ihm nochmal erklärt hat. Manchmal war es allerdings nicht so ganz klar, was wir als

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nächstes machen werden oder ob wir jetzt schon die richtige Methode haben, so dass die etwas selbstbewussteren Teilnehmer/innen gerne auch mal ihren Unmut darüber in den Mittagspausen geäußert haben. Das hat aber dem Enthusiasmus der Gruppe über die nächsten Versuche und die nächsten Theoriestunden keinen Abbruch getan. Die Begeisterung etwas neues zu lernen und im Labor stehen zu dürfen war das ganze Praktikum über sehr groß, auch wenn es gerade am Anfang oftmals Rückschläge gegeben hat, wenn etwas wieder nicht funktioniert hat und spontan der Versuch umgeändert werden musste.

Gerade die Teilnehmerinnen haben aber ab der zweiten Woche, und je mehr das Praktikum voranschritt eine Abneigung gegen einen der männlichen Teilnehmer entwickelt, da derjenige oft alles besser wusste und sich aufgespielt hat und dann doch keine Ahnung hatte. Auch hat der Rest der Gruppe die zum Teil sehr ungehörigen Sprüche und Witze nicht immer so gut vertragen können. Dadurch ist dann immer mehr eine Aufteilung in eine „Frauengruppe“ und eine „Männergruppe“ entstanden, wobei die Aufteilung was die Stärken und Schwächen der Teilnehmer angeht sehr unglücklich war. Wenn die „Männergruppe“ dann etwas falsch gemacht hat, wurde heimlich der eine Teilnehmer bemitleidet und bei dem anderen wurde sich zum Teil hämisch gefreut, dass etwas schiefgegangen ist. Die „Frauengruppe“ hat sich untereinander sehr gut verstanden und viel Freude im Labor und auch bei der Auswertung der Messergebnisse gehabt.

Entspannung in die Gruppe haben immer die Vorlesungen zu den theoretischen Inhalten des Praktikums gebracht; jeder war sehr interessiert an den Vorlesungen und wir alle haben uns gewünscht es würde noch mehr davon geben. Wir waren immer schon ganz begierig auf die nächste Vorlesung und es hätte auch ruhig noch mehr davon geben können. Nach den Vorlesungen waren alle immer wieder besänftigt, egal ob es vorher in der Gruppe kleine Unstimmigkeiten gegeben hatte oder ob im Labor etwas nicht funktionierte.

Als es dann ans Protokollschreiben ging, wurde es in der Gruppe mit der Zeit immer schwieriger, da wir nicht so gut in der Zeit lagen, da gerade bei den ersten Versuchen zur Vitaminanalytik am Anfang einiges nicht auf Anhieb funktioniert hatte. Die Stimmung war Teils sehr angespannt, da die Frauen der Meinung waren die Männer würden nicht genug beitragen oder nur das Vorankommen mit Kommentaren stören, dazu kam plötzlich zunehmender Ärger auf die Organisatoren und widersprüchliche Arbeitsanweisungen. Zum Ende des Praktikums hin waren wir leider fast gar nicht mehr im Labor und haben überwiegend ein sehr ausführliches Protokoll geschrieben. Da allen Teilnehmern die ausschließliche Computerarbeit nicht so lag und es so gut wie keine Abwechslung gab und

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unglaublich viel diskutiert und debattiert wurde wie man nun etwas (auch noch auf Englisch!) im Protokoll schreibt, hat sich die Stimmung zunehmend aufgeheizt, denn alles hat eine Ewigkeit gedauert, bis jeder seinen Vorschlag gemacht hat und alle mit dem Text einverstanden waren und das Protokoll nicht mehr korrigiert zurückkam. Dazu kam noch der „drohende“ Abschlussvortrag und die dazugehörigen Fragen und natürlich die schwindende Zeit zum Ende des Protokolls hin. In der letzten Woche war leider zum Teil bei einigen Teilnehmern das Gemüt derart erhitzt, dass es zum Teil schon schwierig wurde zu schlichten, aber glücklicherweise war das Protokoll zur rechten Zeit fertig und ein Teil der Anspannung und Aggressivität ist gewichen. Viel Zeit um den Vortrag mit Powerpoint vorzubereiten war dann nicht mehr, was aber bis auf einen weiblichen und einen männlichen Teilnehmer, die gerne die Aufteilung des Vortrags etwas eher organisiert und etwas besser vorbereitet hätten, die Gruppe nicht mehr großartig aufgeregt hat. Plötzlich ist uns allen auch klargeworden, dass ja schon sehr bald nach dem Vortrag die gemeinsame Arbeit zu Ende ist, das hat dann doch bei fast allen ein bisschen Wehmut geweckt, denn in dieser gemeinsamen intensiven Zeit ist man ja doch ganz schön zusammengewachsen. Und ohne die anderen weiterarbeiten – irgendwie unvorstellbar und auch schade. Die Gruppe hat sich kurz vor dem Vortrag gegenseitig gut unterstützt, da zwei Teilnehmer doch recht aufgeregt waren und ein bisschen Angst hatten den Vortrag zu halten. Als der Vortrag dann vorbei war, war die Erleichterung groß, aber auch ein Gefühl von „und was nun, wie geht’s jetzt weiter?“ hat sich breitgemacht. Wir haben dann noch mit unseren Betreuern ein letztes Beisammensein bei belegten Brötchen und Berlinern genossen und waren dann doch alle recht stolz auf das, was wir im Praktikum geschafft hatten. Die Verabschiedung war dann auch emotionaler als gedacht, und obwohl es manchmal im Praktikum hoch herging und man sich vielleicht auch mal geärgert hat, hat das positive doch deutlich überwogen. Wir haben sehr viel gelernt und auch die Laborarbeit noch besser kennen und lieben gelernt als ohnehin schon. Die meisten haben auch noch ein halbes Jahr später Kontakt behalten, und die Fahrt ins Ausland zum zweiten Teil des ECVET-Moduls wird uns alle bestimmt noch fester zusammenschweißen, wir freuen uns schon darauf wieder zusammen im Labor zu stehen und hoffentlich ein so schönes Praktikum zu haben, wie wir es in Deutschland hatten.

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Appendix C Learning Units and Learning Outcomes in the different modules

ECVET Module Environmental Analysis in Greece

Title of the field of action	**Environmental Analysis**	
EQF Level		
Total ECVET points		
Units of Learning outcomes	**U1**	**Sampling of different environmental samples (water, air, soil, sediments)**
	U2	**Sample pretreatment and preconcentration**
	U3	**Chromatographic separation of pollutants**
	U4	**Identification of pollutants**
	U5	**Quantification of pollutants**
	U6	**Calculation, evaluation and presentation of data**
Cross sectional Learning Outcomes	To acquire the learning outcomes the following quailfications are essential: he/she is able to apply and adopt different analysis methods use and control different analysis apparatus apply different kinds of software for data acquisition and evaluation	

LO1_ Sampling of different types of environmental samples (water, air, soil, sediments)	**LO2_ Sample pretreatment and preconcentration**	**LO3_Liquid-chromatographic separation of pollutants**
Sampling planning Handling of sampling devices Lyophilization Homogenization Sieving Drying	Liquid-Liquid Extraction Solid Phase Extraction Solid phase microextraction Removal of solvent Microwave assisted extraction Microwave assisted digestion	HPLC / UPLC GC Stationary phases, normal phase, reverse phase Gradient/Isocratic elution Retention time Resolution of chromatogram
LO4_Identification of pollutants (Detection)	**LO5_Quantification of pollutants**	**LO6_Data handling**
UV-Vis spectra Mass Spectrometric identification Basics of IR and NMR	Calibration Curves External/Internal Standard Calculation of recovery rates Quantification of compounds	Software handling Evaluation and interpretation of data Presentation of results

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Unit of Learning Outcome 1: Sampling of different types of environmental samples (water, air, soil, sediments)			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Prepare environmental samples according to instructions	He/she is able to: • Sample diverse environmental samples (water, soil, sediment) • Apply lyophilisation and homogenization methods • Apply drying and sieving on solid samples	He/she knows about: • Significance of sample size • Sample preparation of different samples – advantages and disadvantages • Suitability of different sample methodologies for diverse environmental pollutants
Competence Level B	He/she is able to: • Choose the appropriate methods depending on the respective sample characteristics • Recognize and work out typical problems regarding sampling and sample preparation	He/she is able to: • Calculate necessary sample size • Apply the appropriate preparation procedure • Choose the appropriate sampling device • Make the necessary sampling plan and grid	

Work task	**Competence Level**
Sampling of surface water	A
Sampling of sediment samples	A
Lyophilization of sediment	A
Homogenization / drying and sieving of freeze dried sediment	A
Sampling of a (unknown) project sample	B
Lyophilization a (unknown) project sample	B
Homogenization a (unknown) project sample	B

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Unit of Learning Outcome 2: Sample pretreatment and preconcentration			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Pretreat environmental samples according to instructions	He/she is able to: • Extract target analytes from environmental samples • Apply extraction methods	He/she knows about: • Differences between extraction methods • Advantages/Disadvantages of extraction methods • Suitability of extraction methods for diverse target analytes
Competence Level B	He/she is able to: • Choose the appropriate extraction methods depending on the respective sample characteristics and target analytes • Recognize and work out typical problems regarding extraction methods	He/she is able to: • Extract diverse analytes from different samples • Apply the appropriate extraction procedure	

Work task	**Competence Level**
Extraction of a selected pesticide class from water samples using SPE	A
Microwave assisted extraction of PAHs from sediments	A
Microwave assisted digestion of heavy metals from sediments	A
Removal of solvent	A
Choose a method for extraction for water/sediments of another group of pollutants	B
Extraction of another group of pollutants for water/sediments, e.g. pharmaceuticals	B
Removal of solvent	B

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Unit of Learning Outcome 3: Liquid-chromatographic separation of pollutants			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Separate pesticides by UPLC	He/she is able to: • Apply UPLC methods to separate organic pollutants	He/she knows about: • Assembly and function of chromatographic devices • Chromatographic parameters • Different stationary phases and their fields of use • Characteristics of different eluting solvents • Gradient and isocratic elution • Retention/separation behavior of different pollutants
Competence Level B	He/she is able to: • Choose the appropriate separation method depending on the target analytes • Recognize and work out typical problems regarding chromatographic methods	He/she is able to: • Separate diverse pollutants by different separation methods • Choose the appropriate separation methods depending on the target analytes	

Work task	**Competence Level**
Prepare extracted samples for UPLC analysis (dissolve, filtrate)	A
Separate pesticides by UPLC (retention time, resolution)	A
Choose and develop a suitable method for separation of other environmental pollutants	B
Separate other pollutants by the developed method	B

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Unit of Learning Outcome 4: Identification of pollutants (Detection)			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Detect and identify pesticides by UV-Vis and mass spectrometry	He/she is able to: • Interprete UV-Vis and mass spectra	He/she knows about: • Characteristics of common detectors and their fields of use • Characteristics of pollutants regarding detection • Use of UV-Vis and mass spectra to identify compounds
Competence Level B	He/she is able to: • Choose the appropriate detector depending on the target analytes • Recognize and work out typical problems regarding detection issues	He/she is able to: • Apply different detection methods	

Work task	**Competence Level**
Identify pesticides by UV-Vis and mass spectra	A
Choose the appropriate detector for other pollutants	B
Identify other environmental constituents	B

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Unit of Learning Outcome 5: Quantification of pollutants			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Calculate calibration curves • Quantify pollutants by use of external standards	He/she is able to: • Prepare calibration curves • Work with external standards	He/she knows about: • Relevance of concentration ranges for calibration curves • Regression lines • Prerequisites for internal standards
Competence Level B	He/she is able to: • Choose suitable internal standards • Calculate recovery rates • Quantify pollutants by combination of external and internal standards	He/she is able to: • Work with external and internal standards	

Work task	**Competence Level**
Quantification of pesticides in environmental samples	A
Choose of a suitable internal standard	B
Calculate recovery rates	B
Quantification of pollutants using external and internal standards	B

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Unit of Learning Outcome 6: Data handling			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Evaluate data quality • Handle data according to Good Scientific Practice • Understand graphs	He/she is able to: • Work with different acquisition software • Transfer raw data to evaluation software • Work with standard software for data evaluation (e.g. Microsoft Excel) • Prepare standard graphs • Conduct appropriate data storage and backup	He/she knows about: • Principles for the Handling of Research Data • Use of different software solutions for data evaluation • Mean Values and deviations • Basic Statistic and data transformation
Competence Level B	He/she is able to: • Apply and interpret mean values, standard deviation • Apply and interpret appropriate regression functions • Choose appropriate statistic calculations • Choose appropriate data transformation if necessary	He/she is able to: • Prepare appropriate graphs depending on nature of data • Calculate means and deviations • Calculate regression functions • Conduct statistic and data transformation processes	

Work task	**Competence Level**
Transfer raw data to evaluation software	A
Preparation of standard graphs	A
Calculations on data (Mean values, standard deviation, regression functions)	B
Data transformation and statistics	B
Preparation of advanced graphs and of presentations	B

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ECVET Module Water Analysis in Turkey

Title of the field of action	**WaterAnalysis**	
EQF Level		
Total ECVET points		
Units of Learning outcomes	**U1**	**Sampling and preparation of water samples**
	U2	**In situ and at site analyses**
	U3	**Volumetry and Gravimetry in water analysis**
	U4	**Spectrophotometry in water analysis**
	U5	**Atomic absorption spectrophotometry in water analysis**
	U6	**Chromatographic analysis of selected parameters**
Cross sectional Learning Outcomes	To acquire the learning outcomes following qualifications are essential He/she is able to apply and adopt different analysis methods use and control different analysis apparatus apply different kinds of software for data acquisition and evaluation	

LO1_Sampling and preparation of water samples	**LO2_In situ and at site analyses**	**LO3_Volumetry and Gravimetry in water analysis**
Sampling rules Sampling devices Preservations of samples Preparation of samples to analysis	Instrumentation pH measurement Dissolved oxygen measurement Salinity, conductivity, temperature measurement Turbidity, color measurement Carbonate/hydrogen carbonate analysis	Suspended matter Total solid matter Ignition residue Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD) Oil and grease Kjeldahl (organic+ammonia) Nitrogen Complexometry-EDTA etc. (Ca/Mg)
LO4_Spectrophotometry in water analysis	**LO5_Atomic absorption spectrophotometry in water analysis**	**LO6_Chromatographic analysis of selected parameters**
Spectrophotometry (UV-Visible) Nitrite, Phosphate analysis Basics of IR and NMR Evaluation and interpretation of data Presentation of results	Instrumentation Calibration curves of Zn, Cu, Ni, Pb Standard addition method Enrichment of metals diethyldithiocarbamate by extraction	GC HPLC Gradient – iso cratic elution

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Unit of Learning Outcome 1: Sampling and preparation of water samples			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Prepare water samples according to instructions	He/she is able to: • Sample diverse water • Apply preservation and perparation methods	He/she knows about: • Significance of sample number and size • Sample preparation methods for different analytical applications • Suitability of different sample methodologies for diverse water contents
Competence Level B	He/she is able to: • Choose the appropriate methods depending on the respective sample characteristics • Recognize and work out typical problems regarding sampling and sample preparation	He/she is able to: • Calculate necessary sample size • Apply the appropriate preservation procedure • Apply the appropriate preparation procedure	

Work task	**Competence Level**
Sampling of drinking water / waste water	A
Preservation of drinking water / waste water	A
Preparation of the sample for AAS	A
Sampling of a (unknown) project sample	B
Preservation a (unknown) project sample	B
Preparation a (unknown) project sample for AAS	B

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Unit of Learning Outcome 2: In situ and at site analyses			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Select the analytical method and appropriate instruments for diverse aquatic media.	He/she is able to: • Prepare standard water samples to calibrate the instrument performance. • Use instruments designed for in situ measurements.	He/she knows about: • The properties of acidic, turbid, colored and oxygen-deficient waters. • Advantages/Disadvantages of instrumental methods in in situ analyses. • Suitability of instrumental equipment for diverse aquatic media.
Competence Level B	He/she is able to: • Choose the appropriate instrumental methods depending on the respective sample characteristics and target analytes • Recognize and work out typical problems regarding instruments.	He/she is able to: • Analyze critical parameters which are sensitive against temperature, pressure, atmospheric gases, etc. • Apply the appropriate analytical procedure.	

Work task	**Competence Level**
Preparation of standard solutions for volumetric analysis of carbonate/hydrogen carbonate in water samples	A
Preparations of oxygen-free water and artificial seawater	A
Calibration of a pH meter with reference solutions	B
Oxygen analysis of a (unknown) project sample	B
pH analysis of a (unknown) project sample	B
SCT analysis of a (unknown) project sample	B
SCT analysis of a (unknown) project sample	B
Carbonate/hydrogen carbonate analysis of a (unknown) project sample	B
Turbidimetric analysis of a (unknown) project sample	B

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Unit of Learning Outcome 3: Volumetry and Gravimetry in water analysis			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Analyze appropriate water parameters by Volumetry and Gravimetry.	He/she is able to: • Interpret the data and present the results.	He/she knows about: • The principles of volumetry and gravimetry in water analysis. • The use of complexometry in water analysis. • The importance of oxygen demands of water samples. • The evaluation and interpretation of the data.
Competence Level B	He/she is able to: • Choose the appropriate volumetric or gravimetric method depending on the target analytes • Recognize and work out typical problems regarding selectivity and sensitivity of the methods. • Evaluate the data.	He/she is able to: • Apply volumetric methods in water analysis. • Apply gravimetric methods in water analysis.	
Work task			**Competence Level**
Preparation of standard solutions for biochemical, chemical oxygen demands (BOD, COD) and kjeldahl nitrogen analyses.			A
BOD analysis of a water sample.			A
COD analysis of a water sample.			A
Gravimetric analysis of total solids of water			A
Preparation of complexometric titration solutions (EDTA, indicators, etc.)			A
Application of comparison of complexometric and gravimetric calcium analysis			B
Kjeldahl nitrogen analysis of a project			A

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Unit of Learning Outcome 4: Spectrophotometry in water analysis			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Select the appropriate reagent for diverse analytes depending on the working electromagnetic wavelength range and sensitivity. • Calculate calibration curves. • Quantify analyte contents by use of external standards.	He/she is able to: • Prepare calibration curves. • Work with external standards. • Interpret the data and present the results.	He/she knows about: • Use of UV-Vis. to identify the compounds. • Relevance of concentration ranges for calibration curves. • Regression lines. • Prerequisites for external standards. • Basics of IR and NMR • The evaluation and interpretation of the data.
Competence Level B	He/she is able to: • Choose suitable external standards. • Evaluate the data. • Calculate recovery rates.	He/she is able to: • Work with UV-Vis. spectrophotometers.	
Work task			**Competence Level**
Preparation of reagent solutions and external standard solutions for nitrate, nitrite and phosphate analysis			A
Nitrate analysis in (unknown) project sample			B
Nitrite analysis in (unknown) project sample			B
Phosphate analysis in (unknown) project sample			B
IR spectra of individually phenol and … contaminated silica gel samples			B
Calculation of recovery rates			B

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Unit of Learning Outcome 5: Atomic absorption spectrophotometry in water analysis			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Select appropriate technique depending on the concentration and the matrix of the analyte. • Prepare standard solutions for AAS. • Analyze metals in water by flame AAS.	He/she is able to: • Preconcentrate metals of water. • Use flame AAS. • Interpret the data and present the results.	He/she knows about: • Principles of atomic absorption spectrophotometry (AAS). • Different techniques in AAS. • Preconcentration of the analyte. • Standard addition method. • Basic statistical approaches in evaluation of the data.
Competence Level B	He/she is able to: • Prepare the instrument for analysis. • Apply standard addition method. • Choose appropriate statistical calculations.	He/she is able to: • Use standard solutions to prepare appropriate graphs. • Conduct statistical data.	
Work task			**Competence Level**
Prepare standard metal solutions of Cu, Zn and Pb			A
Prepare the instrument for analysis			B
Analyze Cu, Zn and Pb content of water by use of external standards			A
Analyze Cu, Zn and Pb content of water by use of standard addition method			B
Analyze Cu, Zn and Pb in a (unknown) project sample			B
Calculation of recovery rate of Cu after preconcentration			A

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Unit of Learning Outcome 6: Chromatographic analysis of selected parameters			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Separate and identify selected pesticides by GC-MS.	He/she is able to: • Apply GC-MS methods to appropriate pesticide containing extracts. • Apply RP-HPLC methods to extracts. • Interpret the data and present the results.	He/she knows about: • Assembly and function of chromatographic devices. • Chromatographic parameters. • Different stationary phases and their fields of use • Characteristics of different eluting solvents / gases. • Gradient and isocratic elution in HPLC. • Retention/separation behaviour of different organic pollutants.
Competence Level B	He/she is able to: • Choose the appropriate separation conditions depending on the analyte types. • Recognize and work out typical problems regarding chromatographic methods. • Select external or internal standard. • Evaluate the data.	He/she is able to: • Separate water contents by different separation methods. • Choose the appropriate separation and identification methods depending on the target analytes.	

Work task	**Competence Level**
Prepare extracted samples for GC and HPLC analysis	A
Separate phenolic compounds by RP-HPLC	A
Separation and identification of selected pesticides by GC-MS	A
Choose and develop suitable method for separation of phenolic contents of water	A
Choose and develop suitable method for separation of pesticides in water	B
Separation and identification of a (unknown) project sample	B

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ECVET Module Cosmetic Analysis in Poland

Title of the field of action	**Cosmetics Analysis**	
EQF Level		
Total ECVET points		
Units of Learning outcomes	**U1**	**Sampling and preparation of cosmetic samples**
	U2	**Chromatographic and spectroscopic analysis of cosmetics**
	U3	**Identification of active compounds**
	U4	**Quantification of compounds**
	U5	**Activity control of cosmetic formulations**
	U6	**Stability tests of cosmetics products**
	U7	**Calculation, evaluation and presentation of data**
Cross sectional Learning Outcomes	To acquire the learning outcomes following qualifications are essential He/she is able to • apply and adopt different analytical methods used in analysis of particular cosmetic categories; • select and use the proper instrumental method (analytical equipment) to analyze a given group of cosmetic products • apply methods for evaluation of cosmetic activity, stability, quality monitoring and control • apply different kinds of software for data acquisition and evaluation • differentiate between safety of use and quality assessment of cosmetic products.	

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LO1_Sampling of cosmetic samples	**LO2_Preparation for analysis of different cosmetic products**	**LO3_chromatographic separation of cosmetic contents**
Sampling Homogenization Drying Dissolution	Extraction by microwave; SPME Removal of solvent	RP-HPLC GC Stationary phases, normal phase, Gradient/Isocratic elution
LO4_Identification of cosmetic contents	**LO5_Quantification of cosmetic contents**	**LO6_Quantification of cosmetic ingredients activity**
IR-NIR-UV-Vis spectra Mass Spectrometric identification	Calibration Curves External/Internal Standard Calculation of recovery rates Quantification of compounds	Dissolution methods – skin permeation – diffusion coefficients Skin condition assessments
LO7_Stability of cosmetic contents	**LO8_Data handling**	
UV factor analysis Stability of emulsion Factors affecting shelf-life of the products Basics of microbiology	Software handling Evaluation and interpretation of data Presentation of results	

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Unit of Learning Outcome 1:_Sampling of cosmetic samples			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Prepare cosmetics samples according to instructions	He/she is able to: • Sample diverse products • Apply homogenization methods	He/she knows about: • Significance of sample size • Sample preparation of different cosmetics– advantages and disadvantages • Suitability of different sample methodologies for diverse cosmetic contents
Competence Level B	He/she is able to: • Choose the appropriate method depending on the respective sample characteristics • Recognize and work out typical problems regarding sampling and sample preparation	He/she is able to: • Calculate necessary sample size, number • Apply the appropriate preparation procedure	
Work task			**Competence Level**
Sampling of creams; liquid samples			A
Homogenization of sample			A
Sampling of a (unknown) project sample			B
Homogenization a (unknown) project sample			B

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Unit of Learning Outcome 2: Preparation for analysis of different cosmetic products			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Extract active substances according to instructions	He/she is able to: • Extract target analytes from cosmetics • Apply extraction methods (SPME, microwave)	He/she knows about: • Differences between extraction methods • Advantages/Disadvantages of extraction methods • Suitability of extraction methods for diverse target analytes
Competence Level B	He/she is able to: • Choose the appropriate extraction methods depending on the respective sample characteristics and target analytes • Recognize and work out typical problems regarding extraction methods	He/she is able to: • Extract diverse analytes from different cosmetics • Apply the appropriate extraction procedure	
Work task			**Competence Level**
Extraction of carotenoids compounds from cosmetics;			A
Removal of solvent			A
Choose a method for extraction of another group of cosmetics			B
Extraction of another group of cosmetic contents, e.g. aroma volatiles			B
Removal of solvent			B

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Unit of Learning Outcome 3: chromatographic separation of cosmetic contents			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Separate carotenoids by RP- HPLC • Separate aroma volatiles by GC	He/she is able to: • Apply RP-HPLC, GC methods to separate cosmetics contents	He/she knows about: • Assembly and function of chromatographic devices • Chromatographic parameters • Different stationary phases and their fields of use • Characteristics of different eluting solvents • Gradient and isocratic elution • Retention/separation behaviour of different food contents
Competence Level B	He/she is able to: • Choose the appropriate separation method depending on the target analytes • Recognize and work out typical problems regarding chromatographic methods	He/she is able to: • Separate diverse cosmetic contents by different separation methods • Choose the appropriate separation methods depending on the target analytes	

Work task	**Competence Level**
Prepare extracted samples for HPLC analysis (dissolve, filtrate)	A
Separate carotenoids by RP-HPLC	A
Choose and develop a suitable method for separation of other cosmetic ingreadientss	B
Separate other cosmetic contents by the developed method	B

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Unit of Learning Outcome 4: Identification of cosmetic contents			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Detect and identify carotenoids by UV-Vis and volatilities mass spectrometry	He/she is able to: • Interpretate UV-Vis and mass spectra	He/she knows about: • Characteristics of common HPLC/GC detectors and their fields of use • Characteristics of cosmetic contents regarding detection • Use of UV-Vis and mass spectra to identify compounds • Basics of IR, NIR spectrometry
Competence Level B	He/she is able to: • Choose the appropriate detector depending on the target analytes • Recognize and work out typical problems regarding detection issues	He/she is able to: • Apply different detection methods	
Work task			**Competence Level**
Identify carotenoids by UV-Vis and volatilities mass spectra			A
Choose the appropriate detector for other cosmetic contents			B
Identify other cosmetic contents			B

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Unit of Learning Outcome 5: Quantification of cosmetic contents			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Make calibration curves • Quantify cosmetic contents by use of external standards	He/she is able to: • Prepare calibration curves • Work with external standards	He/she knows about: • Relevance of concentration ranges for calibration curves • Regression lines • Prerequisites for internal standards
Competence Level B	He/she is able to: • Choose suitable internal standards • Calculate recovery rates • Quantify cosmetic contents by combination of external and internal	He/she is able to: • Work with external and internal standards	

Work task	**Competence Level**
Quantification of carotenoids/volatilities compounds	A
Choose of a suitable internal standard	B
Calculate recovery rates	B
Quantification of food contents using external and internal standards	B

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Unit of Learning Outcome 6: Quantification of cosmetic ingredients activity			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Analyse skin condition • Choose suitable permeation membrane for release of active substance	He/she is able to: • Calculate skin hydration, TEWL, sebum level, elasticity	He/she knows about: • release kinetics (order, coefficient)
Competence Level B	He/she is able to: • Calculate diffusion coefficients • Quantify the rate of active substance release	He/she is able to: • Work with different cosmetic formulations	

Work task	**Competence Level**
Choose suitable permeation membrane for release of active substance	A
Choose of a suitable technique to anlyse skin condition	B
Calculate release rates	B

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Unit of Learning Outcome 8: Data handling			
Competence		Skills	Knowledge
Competence Level A	He/she is able to: • Evaluate data quality • Handle data according to Good Scientific Practice • Understand graphs	He/she is able to: • Work with different acquisition software • Transfer raw data to evaluation software • Work with standard software for data evaluation (e.g. Microsoft Excel) • Prepare standard graphs • Conduct appropriate data storage and backup	He/she knows about: • Principles for the Handling of Research Data • Use of different software solutions for data evaluation • Mean Values and deviations • Basic Statistic and data transformation
Competence Level B	He/she is able to: • Apply and interpret mean values, standard deviation • Apply and interpret appropriate regression functions • Choose appropriate statistic calculations • Choose appropriate data transformation if necessary	He/she is able to: • Prepare appropriate graphs depending on nature of data • Calculate means and deviations • Calculate regression functions • Conduct statistic and data transformation processes	

Work task	**Competence Level**
Transfer raw data to evaluation software	A
Preparation of standard graphs	A
Calculations on data (Mean values, standard deviation, regression functions)	B
Data transformation and statistics	B
Preparation of advanced graphs and of presentations	B

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Appendix D – Presentations about the ECVET Modules on the Final Meeting

ECVET in Greece

Lifelong Learning Programme

Research Team EnviLab
Department of
Environment Pollution Control
University of Thessaloniki

Chemlab

ECVET MODULE

European Credit System for Vocational Education and Training

Environmental Analysis

Lifelong Learning Program Leonardo DaVinci
Environmental Pollution Control Laboratory

CHEMLAB II
Mitsika Elena, MSc, PhD Student

Goal of ECVET

- Geographical mobility
- Acquisition of expertise
- Exchange of views working environment
- Contact with other work practices
- Practical application in different instrumentation
- Adapting to the requirements of each employee
- Direct practice

1) **Greece: Environmental technologies**
2) **Turkey: Water Analysis**
3) **Germany: Food analysis technologies**
4) **Poland: Cosmetic analysis technologies**
5) *Georgia: Biochemical or Pharmaceutical analysis technologies*

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Greece: Environmental Technologies

✓**Analytical preconcentration techniques, separation and determination forms of heavy metals on various substrates** (surface water and groundwater plants , biological samples, sediment and soil) .

✓**Analysis of organic pollutants** (pesticides, pharmaceutical substances, organic solvents , etc.) on various substrates (surface , water and groundwater , vegetables , fruit)

✓ **Study of toxicity of environmental samples** (organic substances and metabolites and heavy metals) in biomarkers .

✓**Processes removal of heavy metals and organic pollutants from groundwater** (reduction , precipitation and adsorption) in various active and passive materials processing .

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Greece: Environmental Technologies

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Different extraction methods and analysis of pesticides in water, wastewater and sediment samples in Greek lakes and drinking water

SEDIMENTS from

I. DOIRANI LAKE
II. KERKINI LAKE
III. VOLVI LAKE

DRINKING WATER from

Municipality of Thessaloniki

WASTEWATER from

Wastewater treatment plant from Municipality of Thessaloniki

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Units of Learning outcomes	**U1**	**Sampling of different types of environmental samples (water, air, soil, sediments)**
	U2	**Sample pretreatment and preconcentration**
	U3	**Chromatographic separation of pollutants**
	U4	**Identification of pollutants**
	U5	**Quantification of pollutants**
	U6	**Calculation, evaluation and presentation of data**

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Lessons

- 5 to 7 hours per day (evening hours for Greeks)
- Theoretical principles of each technique
- Presentation and discussion of the methods from the trainer
- Practice from the students – Independent work was promoted
- Daily Reports
- Final Report

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Time Table (4 weeks)

	WEEK 1	WEEK 2	WEEK 3	WEEK 4
U1	**Sampling of different types of environmental samples** Sampling Principles Lyophilization Homogenization Sieving			
U2		**Sample pretreatment and preconcentration** Solid Phase Extraction (watersample, wastewater) Microwave assisted extraction (sediments)		
U3			**Chromatographic separation of pollutants** UPLC and LC-MS/MS (mix of 18 Pesticides) Gradient - Solvent Selection Calibration Curves	
U1			**Identification of pollutants** Detection, Tuning - Retention time of pesticides Resolution of chromatogram	
U5				**Quantification of pollutants** Software handling
U6				**Calculation, evaluation and presentation of data**
	LITERATURE RESEARCH			

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ECVET Courses

THEORY

- Necessary and helpful for the later practice
- Understandable
- Notes-Books-Scientific papers-Masters-PhDs
- The students needed more scientific information and literature

PRACTICE

- Useful and in harmony with the theory
- The students asked for more hours of practicing – Extra hours from the courses, individually

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ECEVET Project

- The difficulty was sufficiently high
- The concept was interesting and scientifically updated (organic pollutants, LC-MSMS, Extraction techniques, targeted analysis)
- The techniques learned were helpful for the students future work
- Satisfactory number of instructors (1 trainer and 2 assistants) and equipment/glass material

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ECVET Exams

Mr.Donisleiter was the German examiner from the German Agency IHK (Berufsbildungswerk Burghausen) for the purpose of certification of skills and technical training.

- ✓ Difficult theoretical questions
- ✓ Easy practical examination with focus on details though
- ✓ Limited time for many people

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Evaluation of the *ECVET Module (A)*

I. Nice opportunity to work in a laboratory
II. Learning of new techniques
III. Learning of handling new scientific equipment
IV. Collaboration with new people, exchange ideas and development of new professional and friendly relations

New motivations and skills at work

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Evaluation of the *ECVET Module (B)*

- More laboratory time (intermediate courses
- Restricted schedule
- More organization and information from the responsible organization committee. Constant Changes
- Mobility denied for Greek Students

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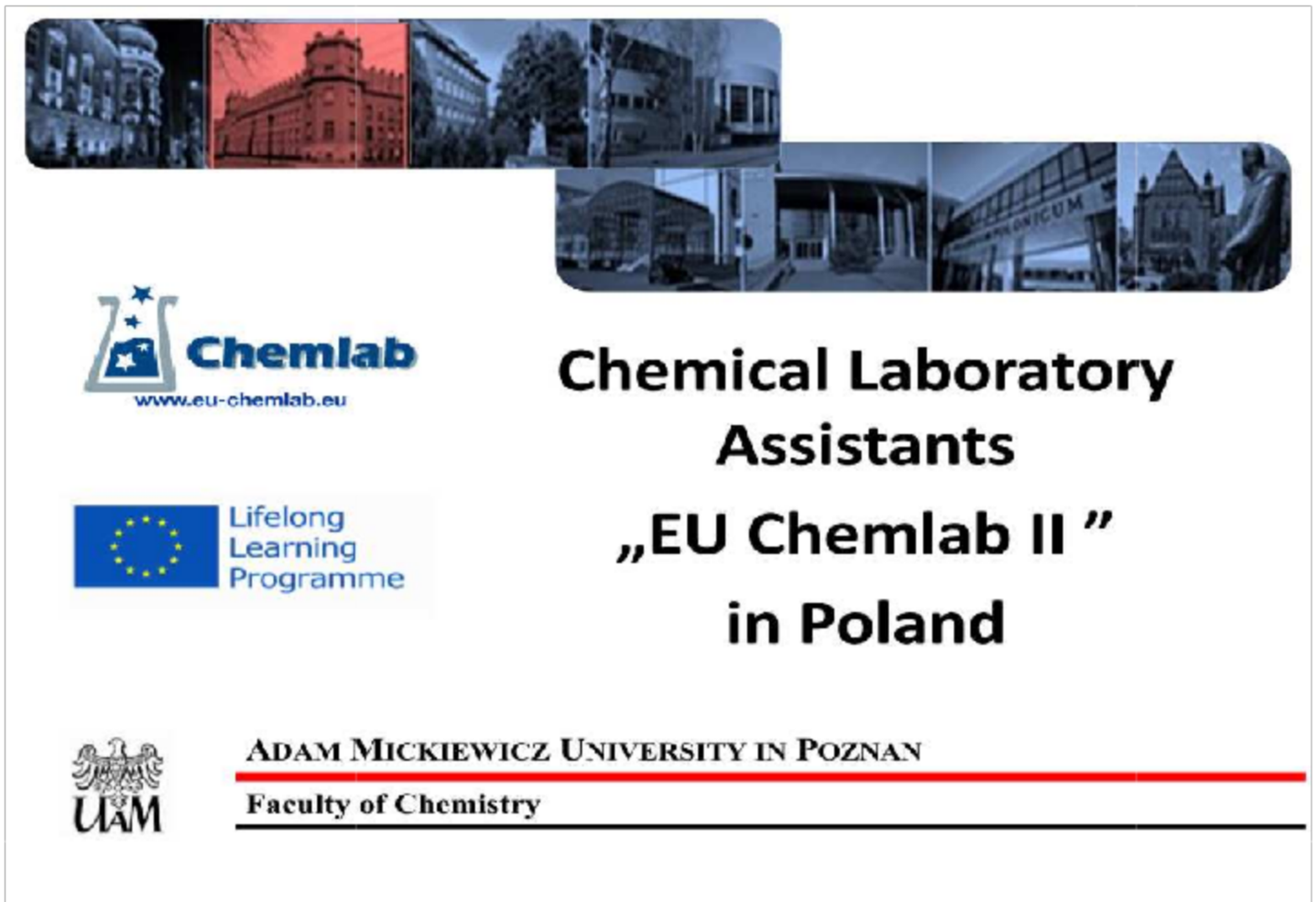
ECVET in Poland



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Apprentice	Graduation of apprentice	Trainer in School/University	Trainer in Company	Company
Daleszyński Paweł	Poznan Technical University; Inżynieria Chemiczna i Procesowa (mgr inż., 2012 r.)			Nivea Poznań
Janus Łukasz	Akademia Rolnicza w Poznaniu; Biotechnologia, specjalność: biotechnologia przemysłowa (mgr inż., 2007 r.)			
Jaśkiewicz Patrycja	Uniwersytet Wrocławski; Wydział Chemii (mgr, 2012 r.)			
Krezymon Katarzyna	Uniwersytet Technologiczno-Przyrodniczy w Bydgoszczy; Technologia Chemiczna, specjalność: technologia procesów chemicznych (mgr inż., 2011 r.)			Intership at Ocenic (cosmetic company)
Nowaczyk Magdalena	Uniwersytet im. Adama Mickiewicza w Poznaniu; Wydział Chemii (mgr, 2006 r.)			Sanepid Poznań
Ronowicz Bożena	Uniwersytet im. Adama Mickiewicza w Poznaniu; Wydział Biologii i Nauk o Ziemi, specjalność: biochemia (mgr, 1982 r.)			
Szymankiewicz Karolina	Uniwersytet im. Adama Mickiewicza w Poznaniu; Wydział Biologii, specjalność: biologia doświadczalna (mgr, 2011 r.)			Intership at Pharmacy Leszno

ADAM MICKIEWICZ UNIVERSITY IN POZNAN

Faculty of Chemistry

Lifelong Learning Programme

Chemlab

ECVET Module: COSMETICS ANALYSIS

Title of the field of action	Cosmetics Analysis	
Units of Learning outcomes	U1	Sampling and preparation of cosmetic samples
	U2	Chromatographic and spectroscopic analysis of cosmetics
	U3	Identification of active compounds
	U4	Quantification of compounds
	U5	Activity control of cosmetic formulations
	U6	Stability tests of cosmetics products
	U7	Calculation, evaluation and presentation of data
Cross sectional Learning Outcomes	To acquire the learning outcomes following qualifications are essential He/she is able to • apply and adopt different analytical methods used in analysis of particular cosmetic categories; • select and use the proper instrumental method (analytical equipment) to analyze a given group of cosmetic products • apply methods for evaluation of cosmetic activity, stability, quality monitoring and control • apply different kinds of software for data acquisition and evaluation • differentiate between safety of use and quality assessment of cosmetic products.	

Faculty of Chemistry

Lifelong Learning Programme

Chemlab

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Technische Universität München Analytical Research Group PD Dr. Thomas Letzel; PD Dr. Johanna Graßmann	**The ECVET Modules in the partner countries**

LO1_Sampling of cosmetic samples	LO2_Preparation for analysis of different cosmetic products	LO3_chromatographic separation of cosmetic contents
Sampling Homogenization Drying Dissolution	Extraction by microwave; SPME; Headspace	RP-HPLC GC Stationary phases, normal phase, Gradient/Isocratic elution
LO4_Identification of cosmetic contents (Detection)	**LO5_Quantification of cosmetic contents**	**LO6_Quantification of cosmetic ingredients activity**
IR-NIR-UV-Vis spectra Mass Spectrometric identification	Calibration Curves External/Internal Standard Quantification of compounds	Dissolution methods – skin permeation – diffusion coefficients Skin condition assessments
LO7_Stability of cosmetic contents	**LO8_Data handling**	
UV factor analysis Stability of emulsion Factors affecting shelf-life of the products Basics of microbiology	Software handling Evaluation and interpretation of data Presentation of results	

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Responsibility

GC/MS, fragrances, essential oils – Izabela

GC/MS, SPME, headspace, fragrances, essential oils – Agnieszka

Microwave extraction, cosmetics preparation – Agata

Cosmetic preparation, cream stability, evaluation of cosmetic aplicability (sensing properties) – Joanna

Cosmetic preparation, cream stability, active substance realese (kinetics) - Anna

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Quantitative comparison of the volatile flavour compounds in natural and commercial citrus products by GC/MS

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Quantitative comparison of the volatile flavour compounds in natural and commercial citrus products by GC/MS

- The main objective of our study was to compare the volatile flavor compounds in natural and commercial citrus products, using different sample preparations like Microwave extraction, Solid-phase micro extraction and Headspace-GC/MS.

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Quantitative comparison of the volatile flavour compounds in natural and commercial citrus products by GC/MS

- **Mars Microwave extractor:**
- Manufacturer: CEM
- **Varian 430-GC/FID System Tekmar HT3 Headspace Autosampler**
- Manufacturer: (Varian) Agilent
- **SPME Fibers:**
  - **Blue** 65µm **Polydimethylsiloxane / Divinylbenzene** (PDMS/DVB)
  - **White** 85µm **Poliacrylate**
  - **Yellow** 30µm **Polydimethylsiloxane** (PDMS)
- Manufacturer: Supelco

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Quantitative comparison of the volatile flavour compounds in natural and commercial citrus products by GC/MS

Lemon peel

retention time	Compound
3,9 min	α-Pinene
4,7 min	β-Ocimene
5,9 min	Limonene
6,6 min	3-Carene

Lemon juice – additional compounds

retention time	Compound
4,1 min	2,5-Furandione,-3-methyl
4,4 min	2-Formyl-5methylfuran
6,1 min	Ethylallene
6,4 min	Tropilidene
7,1 min	Maltol
7,4 min	Furil
9,4 min	1 Naphtanzol
12,5 min	2-Butyn-1-ol diethyl acetal
13,6 min	4-Hepten-3-one, 2,6-dimethyl
15,3 min	Column bleeding
15,8 min	2-Furancarboxaldehyde;5(hydroxymethyl)

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Quantitative comparison of the volatile flavour compounds in natural and commercial citrus products by GC/MS

Lemon essential oil – additional compounds

retention time	Compound	retention time	Compound
3,741 min	a-Thujone	11,614 min	3-Noryne
4,636 min	Sabinen	12,199 min	Cis-Verbenol
4,883 min	Bicyclo(3.1.1)hept-2-ene,2,6,5-triemethyl	12,343 min	Ocimene
6,301 min	2,6-Dimethyl-1,3,6-heptatriene	12,965 min	2-Pinen-10-ol
7,506 min	g-Terpinen	14,322 min	b-Pinene oxide
7,863 min	Santolina Triene	16,848 min	4-Noryne
8,022 min	Isothujol	17,620 min	2-Carene
9,052 min	Sabino	18,936 min	Neoclorene
9,636 min	Isogeranlol	19,315	a-Longipinene
10,763 min	Bicyclo(3.1.0)hexan-2-ol,methyl-5-(1-methylethl)	22,267	Valencene
11,301 min	Camphene		

In all of the citrus fruits we found the same four compounds (a-Pinene, β-Ocimene, Limonene and 3-Carene).
In the essential oil of the citrus fruits we could identify more compounds than in the juice or the extract of the peel.

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Preparation and analysis of cosmetics with the special emphasis on the stability of products

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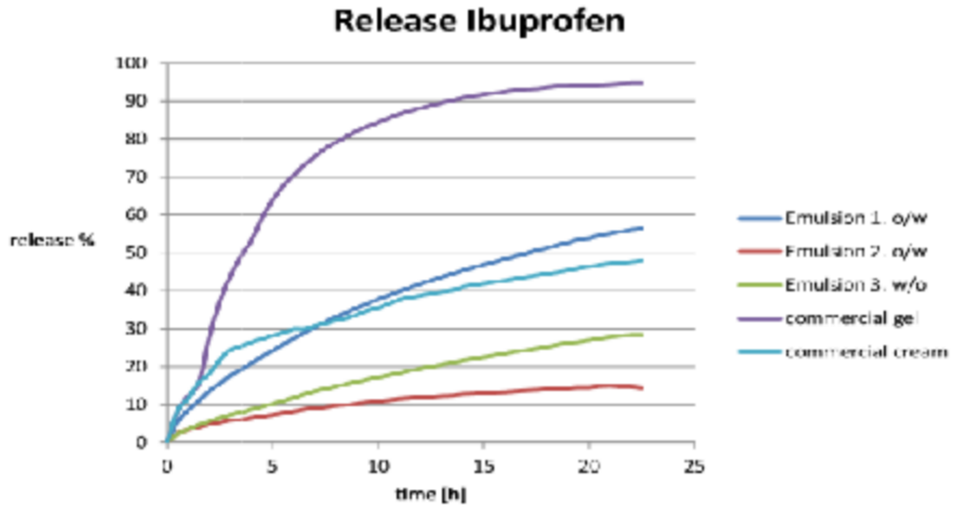
Comparison of Coco Chanel´s Mademoiselle and N°5 using GC/MS



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Comparison of Coco Chanel´s Mademoiselle and N°5 using GC/MS

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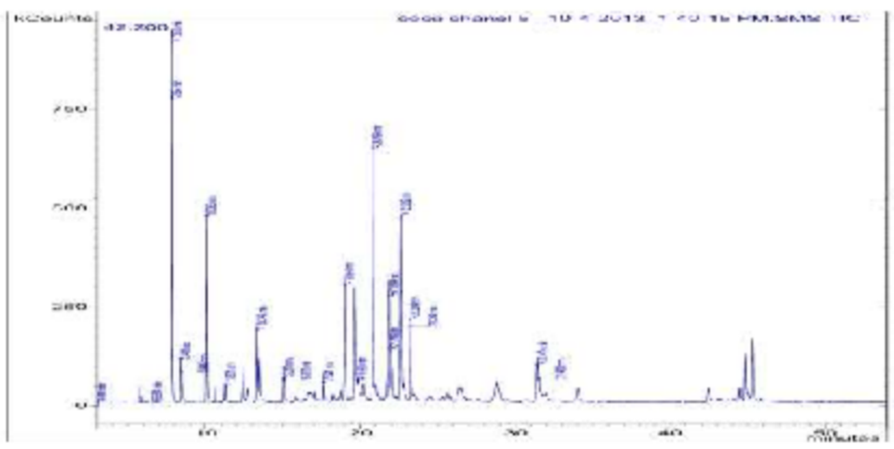
Comparison of Coco Chanel´s Mademoiselle and N°5 using GC/MS

- The main objective of our study was to compare the volatile flavor compounds in Coco Chanel´s Mademoiselle and N°5 using GC/MS.



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IHK exams – 25.10.2013

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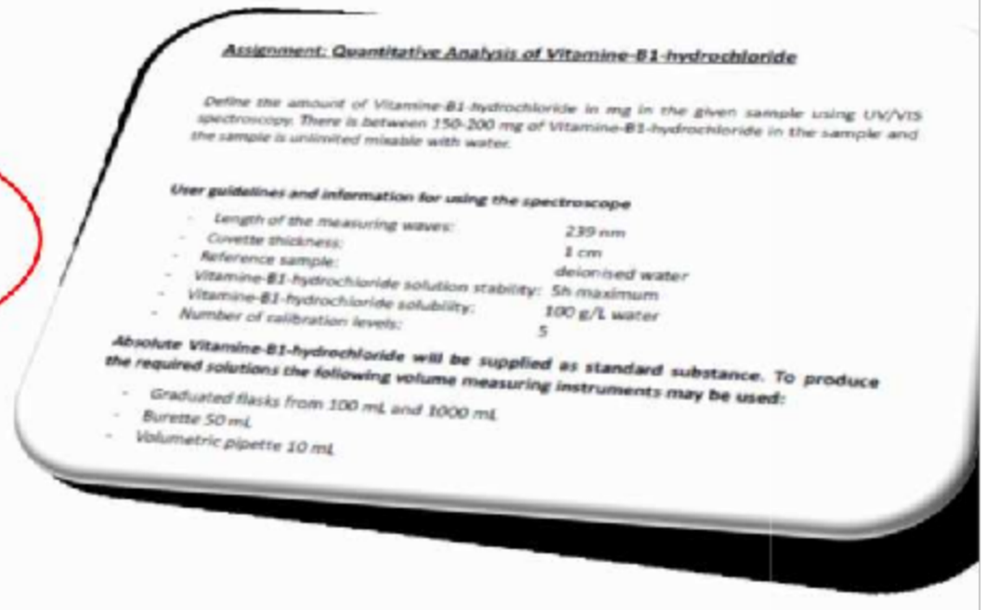
IHK exams – 25.10.2013

- Valentin Galle

Apprentice	Graduation of apprentice
Daleszyński Paweł	Poznan Technical University Inżynieria Chemiczna i Procesowa (mgr inż., 2012 r
Janus Łukasz	Akademia Rolnicza w Poznan Biotechnologia, specjalność biotechnologia przemysłow (mgr inż., 2007 r.)
Jaskiewicz Patrycja	Uniwersytet Wrocławski; Wydział Chemii (mgr, 2012 r
Krezymon Katarzyna	Uniwersytet Technologiczno Przyrodniczy w Bydgoszczy Technologia Chemiczna, specjalność: technologia procesów chemicznych (mg inż., 2011 r.)
Nowaczyk Magdalena	Uniwersytet im. Adama Mickiewicza w Poznaniu; Wydział Chemii (mgr, 2005 r
Ronowicz Bożena	Uniwersytet Im. Adama Mickiewicza w Poznaniu; Wydział Biologii i Nauk o Zier specjalność: biochemia (mg 1982 r.)
Szymankiewicz Karolina	Uniwersytet im. Adama Mickiewicza w Poznaniu; Wydział Biologii, specjalność: biologia doświadczalna (mgr, 2011 r.)



Assignment: Quantitative Analysis of Vitamine-B1-hydrochloride

Define the amount of Vitamine-B1-hydrochloride in mg in the given sample using UV/VIS spectroscopy. There is between 150-200 mg of Vitamine-B1-hydrochloride in the sample and the sample is unlimited mixable with water.

User guidelines and information for using the spectroscope

- Length of the measuring waves: 239 nm
- Cuvette thickness: 1 cm
- Reference sample: deionised water
- Vitamine-B1-hydrochloride solution stability: 5h maximum
- Vitamine-B1-hydrochloride solubility: 100 g/L water
- Number of calibration levels: 5

Absolute Vitamine-B1-hydrochloride will be supplied as standard substance. To produce the required solutions the following volume measuring instruments may be used:

- Graduated flasks from 100 mL and 1000 mL
- Burette 50 mL
- Volumetric pipette 10 mL

at Pharmacy Leszno

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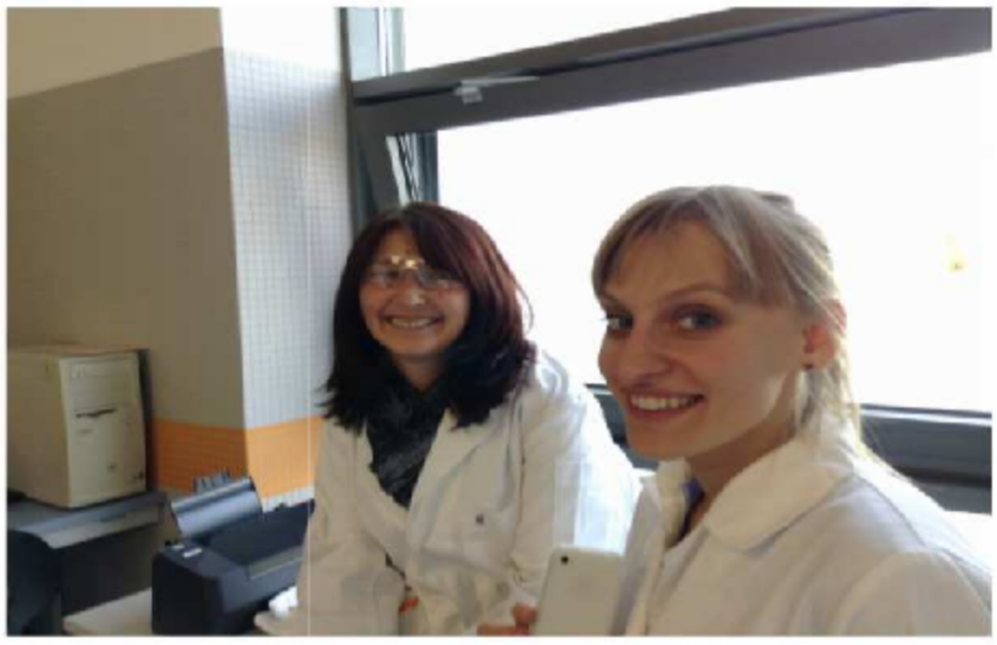
IHK exams



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Features of the ECVET success: retaining focus, advancing through stages, communication (feedback).

Among others:

- satisfaction after the training;
- able to use the equipment by themselves;
- passed successfully the practical exam;
- familiar with the polish culture and polish traditions.

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Appendix E – Questionnaire for Evaluation of the ECVET Modules

EvaSys	ECVET Questionnaire for apprentices	Electric Paper
Technische Universität München	PD Dr. Johanna Graßmann	Chemlab
Analytical Research Group	PD Dr. Thomas Letzel	

Markieren Sie so: ☐☒☐☐☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.
Korrektur: ☐■☐☒☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

Dear participants,
with this questionnaire you have the opportunity to give us feedback on the ECVET module "Food analysis". All answers are anonymous and you may answer all or just some of the questions as you wish. The goal of the evaluation is to improve the ECVET module.
Thank you for you support

1. General

1.1	The concept of the module was	very good	☐	☐	☐	☐	☐	☐	very bad	☐	no opinion
1.2	The level of difficulty was	too high	☐	☐	☐	☐	☐	☐	too low	☐	no opinion
1.3	The learning content was	too much	☐	☐	☐	☐	☐	☐	too little	☐	no opinion
1.4	The level of prior knowledge required was	too low	☐	☐	☐	☐	☐	☐	too high	☐	no opinion
1.5	The speed of the module was	too high	☐	☐	☐	☐	☐	☐	too low	☐	no opinion

2. Theoretical Lessons

	The lecture...										
2.1	... had a clear structure	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.2	... contributes to a better understanding of the topic	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.3	... is probably useful for my later professional praxis	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.4	The content was communicated clearly and understandable	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.5	The slides were clear and understandable	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
	The lecturers....										
2.6	... were well prepared	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.7	...were readily available for questions and suggestions of the participants	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.8	... encouraged my interest in the topic	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
2.9	... showed interest in participant´s success	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion

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EvaSys	ECVET Questionnaire for apprentices	Electric Paper

3. Practical Course

3.1	The practical course had a clear structure and schedule	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
3.2	Theory and practical course were well harmonized	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
3.3	The practical course is probably useful for my later professional praxis	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion

4. Project

4.1	The obtained scientific information was sufficient to handle the project	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.2	The literature study was successful and helpful	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.3	The project work fitted to the covered topics	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.4	The theoretical learning outcomes were useful for the project	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.5	The learned practical techniques could be effectively transferred into the project	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.6	The group work was fruitful and enhanced my learning outcomes	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.7	Working with English material was beneficial	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
4.8	The project was well strucured	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion

5. Laboratory and scientific work

5.1	The time for conducting the experiments was sufficient	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
5.2	The available equipment and materials were sufficient	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
5.3	Work places and working environment were sufficient	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
5.4	Independent scientific work is promoted	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion

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6. Instructors

6.1	The number of instructors was sufficient	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
	The instructors...										
6.2	... were competent	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
6.3	... showed interest in participant´s learning success	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
6.4	... were readily available for questions and suggestions of the participants	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
6.5	Discussions with the instructors were helpful	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion
6.6	The feedback of the instructors was satisfactory	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion

7. Acquired Competence

	The acquired competence in										
7.1	... food sampling is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion
7.2	... food extraction is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion
7.3	... liquid chromatographic separation is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion
7.4	... mass spectrometry is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion
7.5	... identification and detection techniques is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion
7.6	... quantification techniques is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion
7.7	... data handling and evaluation is	high	☐	☐	☐	☐	☐	☐	low	☐	no opinion

8. Overall Opinion

8.1	What overall grade would you assign to the modul?	Grade A (very good)	☐	☐	☐	☐	☐	☐	Grade F (insufficient)	☐	no opinion
8.2	I would recommend the modul	fully agree	☐	☐	☐	☐	☐	☐	fully disagree	☐	no opinion

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9. Comments

9.1 What did you like about the module?

9.2 What suggestions do you have for improvement?

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