

# EACH Evaluation Report 2024

In this report we have evaluated the design, implementation and continued progress of the EU-funded Erasmus Mundus Excellence in Analytical Chemistry Joint Master Programme, EACH. As in 2020, the evaluation is divided into four parts, covering the relevance of the programme, its design, implementation and continued development, the partners and their cooperation, and the impact and dissemination of the programme. We sincerely hope our report will contribute to sustaining and improving an already highly successful programme.

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Franck Baco-Antoniali,  
Axel'One, Solaize, France.

Todd Pagano,  
Rochester Institute of Technology, Rochester, New York, USA.

Magnus Palmblad,  
Leiden University Medical Center, Leiden, The Netherlands.

Reiner Salzer,  
Technische Universität Dresden, Dresden, Germany.

## Relevance of the project

The joint master's programme Excellence in Analytical Chemistry (EACH) attracts excellent students from around the globe. These students appreciate the high educational and scientific standard of the EACH programme and in the learning mobility incorporated in this programme. The combination of field-specific competences and skills plus generic competences is seen as prerequisite for any analytical chemist on today's international job market.

Modern techniques of Analytical Chemistry cover an extremely wide area, from remote sensing in the environment via process analysis in industrial mass processes to single-molecule detection in biological systems. No single institution is able to cover all this challenge in their educational programmes. For this task, a consortium of closely cooperating, is required. The EACH programme is a unique programme worldwide, a role model for integration of educational and non-academic institutions within the European Higher Education Area and an excellent example for its worldwide attractiveness.

The programme structure takes into account distinct differences in the educational background of the accepted students by offering a common first year at the same place for all students. This strategy harmonises the knowledge level of all students and the same time extends their intercultural horizon. Together with the top-level teaching of fundamentals in Analytical Chemistry, this first year is an important cornerstone of the academic programme and the related learning outcomes. Of outstanding importance is the omnipresence of online tools in the learning environment. These online tools also permit the extension of EACH tools and experiences into the European community and beyond.

An important component of the first year of the EACH programme at the University Tartu is metrology. This component is one of the innovative parts of the EACH programme as it is hardly found in university programmes on Analytical Chemistry. All crucial skills like e-skills, problem-solving skills, social skills and self-management skills are imparted by the EACH programme. The second study year is specialisation-oriented and is spent either at Uppsala University, University Claude Bernard Lyon or Åbo Akademi University.

Another innovative element in the EACH programme is the Winter School. It brings knowledge and skills of the diverse set of first-year students to the same level. At the same time, the Winter School serves as a mid-term evaluation point for students of both years. The Winter School helps the academic teachers to strengthen the cooperation with the non-academic partners of the programme, in particular with respect to offering dedicated internships. These internships are an outstanding part of the EACH programme. Students consider the Winter School as particularly valuable for their development.

Mandatory part of the first year of the EACH programme is an internship placement yielding 6 ECTS credits. Among the first three intakes, roughly half of the students carried out their Master thesis at companies, the other half at a university. Students consider both mandatory internship and work in a company as helpful in getting new connections and as beneficial for their future career. For their further career, almost 50% consider professional networks as important, followed by exploiting personal contacts. Both are developed in the EACH programme.

Analytical Chemistry dominates more jobs of chemists and chemical engineers than any other chemical sub-discipline, both in Europe and in Northern America (Salzer et al.; DOI: 10.1002/chem.201804764). This situation is observed since a couple of decades, but the profile of academic education did not yet follow this development in the job world. It results in a shortage of well-educated analytical chemists. The need for educated analytical chemists is even more serious in emerging economies. Other deficits among graduates concern a lack of entrepreneurial attitude as well as a lack of information about the wide field of industrial research. All these issues are tackled by the innovative EACH programme.

Students appreciate the entrepreneurial and innovation-prone structure of the EACH programme. Complementary modules of the programme enable all universities to contribute their specific strengths. The integrated mobility and three study tracks enable the acquisition of a diverse skillset and boost the competitiveness of EACH graduates in the job market. The competitiveness is further supported by an employability session. According to the last survey, almost half of the current EACH students want to go for a higher degree, some more intend to work in industry.

Common university education focuses on academic research careers of the graduates. The EACH programme offers in addition foundations for further careers in industry, either industrial research or administration, or for careers in regulatory laboratories. Both industry and regulatory laboratories have a high demand for analytical chemists. Chemical analysis is one of the cornerstones of guaranteeing security and public safety. Offering these additional and highly demanded branches is a real advantage of the EACH programme and a key component for optimal employability of the students.

A large number of non-academic players are associated partners of the EACH programme. These non-academic partners are very diverse in size, work sector and activity area. The largest non-academic partners are globally active, and they are market-leaders in their field. This will contribute to the excellent employability of the international EACH students in areas of high importance for the EU. EACH graduates are known to be of high competence for industry, trade, healthcare, and environment.

## Quality of the Programme Design

The EACH programme has sustained a successful delivery since its implementation. Students in the programme take a rigorous two year, 120 ECTS combination of coursework and research credits. These are similar to other M.Sc. programmes in the EU (with perhaps the EACH programme being a bit more intensive than the average traditional programme). An aim of the EACH programme is to assure that graduates are able gain employment and student feedback has indicated that it is “very helpful for future careers” and “competitiveness in the job market”.

The programme’s design allows students in the first year to take intensive analytical chemistry coursework at the University of Tartu. This allows students to form a somewhat uniform cohort, and provides them with the foundational knowledge for success in the programme. This is further a strength, given the University of Tartu’s recognized focus in Measurement Science/Metrology, as well as it being the central university to this grant. Recent student feedback has indicated that the first year of the programme does indeed provide a strong foundational knowledge for continuation in the second year, though some students have indicated that there is overlap in the curriculum with prior (pre-graduate) or with the second year of the EACH programme. It should be noted that overlap with prior coursework/degrees is variable to the students’ prior experiences, and would not be possible to predict the knowledgebase of every incoming student.

Student participants attend Winter School between the Fall and Winter semesters of both their first and second years in the programme. This experience has been highlighted by students as one of the best parts of the programme. The Winter School allows different cohorts/intakes of students to interact and allows the first-year students to learn more about the second-year universities from the students who have been placed there for a semester already.

Students apply for placement in one of the second-year host universities. In the second year of the programme, students transition to one of the partner institutions to continue their studies. Each of the partner universities have specialized areas of focus, allowing students with different interests (ex- sensors, mass spectrometry, or industrial chemistry) to complete the EACH programme with different application expertise. The completion of thesis research projects occurs at the second-year university. **There does seem to be some student feedback related to certain logistical issues concerning transitioning to the second-year universities.** However, students expressed appreciation for efforts made in assigning students to their preferred second-year site.

This structure (first-year, Winter School, and second-year) of the EACH programme is a strength. Overall, students in the programme generally rate it favourably, with a few isolated areas for improvement (which appear to be addressed by the programme leadership team). The analytical chemistry content, internship opportunities, and “discovering new countries, multicultural environment” were listed as strengths. The quality of instruction was also generally rated favourably, though naturally, different courses/instructors can be evaluated less favourably.

there are some known and recurring problems. One is cheap student accommodation. There is no shortage of accommodation in the private market, but there is shortage of the cheapest options. Eventually all EACH students have always found accommodation, although it is sometimes more expensive than they would like.

Typically, if the students arrive to the 2nd year universities on the right days (i.e. the days when the welcome events take place) then they are taken very good care of. And the things have been improving at all fronts.

## Impact and Dissemination

The EACH programme has a website that is both attractive and professional, serving prospective and current students, alumni and teaching staff. It also hosts an actively maintained (long-form) blog with news from the programme. The content excellently showcases programme activities, both academic and social. **However, the programme has only a limited social media presence, despite students (and sometimes teachers) mentioning the programme in posts.** This may represent a missed opportunity, if even to post short summaries of the blog posts and bring attention (“drive traffic”) to the programme website.

On the publication front, we notice two peer-reviewed publications with EACH students and teachers in the author lists from 2022. Blidi et al. published a paper in *Membranes* on “Long-Time Evaluation of Solid-State Composite Reference Electrodes”, acknowledging support from the Erasmus Mundus programme, and Palmblad et al. published an *Analytical Chemistry* paper on “Semantic Annotation of Experimental Methods in Analytical Chemistry”. The latter also made the cover of the journal. Commendably, both papers are open access. To our knowledge, these are the first, peer-reviewed, scientific papers published by *current* students and teaching staff in the EACH programme since 2017, and thus represent an improvement. While Winter School exercises are generally too short to end up in a publication (with the one exception above), **thesis projects could and should more often be disseminated in some form in addition to the report itself,** at least if the project was successful and there are no intellectual property considerations. Scientific and technical writing are important skills expected to be mastered by all students in the programme.

Since it is now more than five years the programme itself was highlighted in a publication, **we would also encourage Leito et al. to revisit their analyses and conclusions in their 2019 *Analytical and Bioanalytical Chemistry* paper,** either in this journal, another analytical chemistry outlet, or a journal for higher education. Perhaps a former student on the programme willing to do the necessary data wrangling to summarize statistics about the programme and its alumni could even be involved?

This is already greatly improving by the EACH Dissemination committee that was established in Autumn 2024.

This is gradually improving and in recent years the number of peer-reviewed papers is on the increase. True, a lot of these are done in private companies. Those these typically cannot be published.

This has been in process in the recent weeks and the "update" manuscript has been submitted to Anal Bioanal Chem on 01.11.2024.

## Cooperation Arrangements

The program's association with industry leaders is one of its key strengths, offering students valuable insights and practical experience that would be difficult to obtain otherwise. Industry partners not only offer internships but also collaborate with universities to guide the curriculum, ensuring that students learn skills directly relevant to the job market.

These partnerships cover a wide array of sectors, including: life science, Energy, pharma, chemistry, data treatment, polymers, biotech, etc. For instance, collaboration with Axel 'One has led to the introduction of treatment of data and optimisation [specific module in Chemometric and optimization in Lyon], where students work on solving real-world issues. This integration of industry-based learning ensures that graduates are well-prepared to meet the demands of their chosen field and often have a competitive edge in the job market.

For many years, the EACH program has cultivated strong relationships with industry partners and research laboratories, providing students with valuable final placements, such as the 6-month Industrial Analysis Masters placement in Lyon. These industrial partners know they will be hosting highly motivated students with a solid scientific background and expertise in high-demand specializations. The placements offer significant benefits to the students, as they become integrated into multidisciplinary teams, and in many cases, students have been offered permanent positions after completing their placements (e.g., SERVIER, IFPEN, ELKEM, etc.).

For those interested in pursuing a PhD, numerous opportunities are also available. Each year, industrial partners eagerly anticipate the arrival of Erasmus students, recognizing their potential and including them in their annual programs. An indication of the trust placed in the EACH program. In Lyon, Axel 'One plays a key role in facilitating student placements in leading companies like IFPEN, SERVIER, ELKEM, etc. The Winter School is an important tool for identifying students' skills and expectations, ensuring they are matched with the most suitable placements.

The ongoing and strong connections between industry and the EACH program are invaluable, and there is significant potential to expand these ties to include additional industry partners. Especially as many multinational companies seek rare, adaptable profiles that can thrive in diverse working environments and cultures.

## Quality of the Teams

The high caliber of faculty and industry mentors in the Erasmus Mundus program contributes significantly to students' academic and professional development. The program's teaching staff and associated partners provide both breadth and depth of knowledge, creating an environment conducive to innovation and learning.

Feedback from current students and alumni highlights the value of studying under such a distinguished team, who inspire students through their expertise and commitment. The collaborative spirit and intercultural competence fostered by this diverse team equip students with skills essential for global careers. Additionally, regular evaluations and feedback mechanisms ensure that teaching methods, curriculum, and partner contributions remain aligned with the program's goals and student expectations.

## Conclusion

In conclusion, the Erasmus Mundus Master's program demonstrates a remarkable commitment to high-quality education through its carefully selected team of university professors, industry experts, and academic collaborators. The strengths of each member contribute to an interdisciplinary and international learning environment, setting a high standard for global academic programs. By leveraging the expertise of this team, the program provides students with a well-rounded education that prepares them for success in academia and industry alike. The collaborative, intercultural experiences offered by the program are invaluable, enhancing both personal and professional growth for each participant.