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ARCTIC INSTITUTE FOR INDEPENDENT SOCIAL RESEARCH

ARCTISER Research Report 2026-02

The Master Gap

Structural Organization of Master phase Science Programs in Norway and an EU Reference Case

Research focus

This study examines how master phase science programs structure advanced academic workload across multiple institutions operating under the European Credit Transfer and Accumulation System (ECTS).

The research extends the comparative framework introduced in ARCTISER Research Report 2026-01 by shifting analytical focus from early-stage curriculum architecture to the advanced phase of scientific education. Whereas the pilot study examined structural organization during the initial phase of degree formation, the present report investigates how specialization, advanced coursework, and research preparation are organized during master phase study.

The study introduces standardized structural indicators designed to evaluate how advanced academic workload is distributed across modules, assessments, and practical instruction during the final stage of university education.

Programs analyzed

- Biology
- Chemistry
- Pharmacy

These disciplines were selected due to their shared dependence on laboratory-intensive instruction, progressive specialization, and formal research preparation during the master phase.

Institutions examined

Norway:

- University of Oslo (UiO)
- Norwegian University of Science and Technology (NTNU)
- University of Bergen (UiB)

(EU) Croatia:

- University of Zagreb
- University of Split
- University of Rijeka

These institutions were selected based on program comparability, disciplinary coverage, and availability of structured curriculum documentation.

Key structural comparison

Indicator	Norway (Aggregate)	(EU) Croatia (Aggregate)
Average ECTS per course	Larger modules	Smaller modules
Course count (Master Phase)	Lower	Higher
Curriculum structure	Integrated specialization blocks	Segmented specialization units
Assessment frequency	Lower	Higher
Practical distribution	Concentrated within modules	Distributed across multiple modules
Research Preparation structure	Earlier consolidation	Later distribution

Executive Summary

This report presents a comparative structural analysis of master phase science degree programs across six universities operating within the European Higher Education Area. The study builds upon the structural findings identified in ARCTISER Research Report 2026-01 by extending the comparative framework to the advanced phase of scientific education.

Master phase curricula from Biology, Chemistry, and Pharmacy programs were examined in order to evaluate how advanced academic workload is organized within the European Credit Transfer and Accumulation System (ECTS). The analysis focuses exclusively on the master phase of study, where specialization, advanced laboratory training, and research preparation become central components of degree structure.

The dataset includes approximately 300 master phase course observations derived from official institutional study catalogues and program documentation. Each course entry represents an advanced-stage instructional unit contributing to specialization or research-oriented training. Structural indicators were applied consistently across the dataset to support cross-institutional comparison.

Results indicate consistent differences in how advanced scientific training is structured across institutions. Croatian master phase programs generally distribute specialization content across a larger number of smaller modules, resulting in increased segmentation of advanced coursework. Norwegian programs more frequently organize advanced training into broader integrated modules that combine multiple specialized components within single instructional units.

These structural differences correspond to measurable variation in assessment distribution and practical training density. Programs composed of smaller specialization modules tend to generate more frequent summative

evaluation points, while programs organized around larger modules concentrate assessment into fewer but more comprehensive structures.

Across the institutions examined, Croatian programs demonstrate higher segmentation of specialization pathways, while Norwegian programs exhibit greater consolidation of advanced instruction within individual modules. Norwegian programs also display higher concentrations of laboratory and applied instruction embedded within single course structures.

The findings presented in this report do not evaluate academic quality, institutional performance, or student outcomes. The analysis is restricted exclusively to structural characteristics of curriculum design observable within official institutional documentation.

By focusing on master phase organization, this study provides a structural perspective on how universities prepare students for advanced disciplinary specialization and research activity. The expanded institutional sample strengthens the comparative foundation established in the pilot study and allows structural differences to be examined within a broader institutional framework.

Future ARCTISER research will continue to expand the comparative dataset to additional institutions, allowing more detailed examination of how advanced curriculum architecture varies across European higher education systems.

Research Objective

The objective of this study is to examine how master phase science programs structure advanced academic training across multiple institutions, and to determine how differences in module size, assessment organization, and practical specialization influence the distribution of academic workload during the master phase of study.

Building upon the pilot comparison conducted in ARCTISER Research Report 2026-01, this study shifts analytical focus from foundational curriculum structure to advanced disciplinary specialization. By expanding the institutional sample and isolating master phase coursework, the research seeks to determine whether structural differences observed during earlier stages of study persist, intensify, or diverge during advanced education.

The study introduces standardized structural indicators to measure how specialization modules, assessment frequency, and practical instruction are organized during the final stage of scientific training. These indicators allow systematic comparison of curriculum architecture across institutions operating within the same credit framework.

The primary research objective is therefore to determine whether consistent structural differences exist in how universities organize specialization and research preparation during master phase education, and to evaluate how those structural choices shape the organization of advanced academic workload across comparable scientific disciplines.

Background

European higher education operates within the broader framework established by the Bologna Process, which introduced the European Credit Transfer and Accumulation System (ECTS) as a standardized mechanism for measuring academic workload across degree structures. While the ECTS system provides a common credit language, it does not prescribe how institutions must organize advanced study within the master phase.

As a result, universities retain considerable flexibility in how they structure specialization, research-oriented coursework, thesis preparation, laboratory components, and professional practice during the later stages of scientific education. Some institutions may organize the master phase into relatively broad modules that integrate multiple advanced themes within larger credit-bearing units. Others may divide the same period into a greater number of smaller courses, resulting in a more segmented pattern of instruction and assessment.

These structural differences may be especially important during the master phase. Unlike the earlier stages of study, master curricula typically involve higher disciplinary specialization, more intensive methodological training, greater research orientation, and in some fields a closer relationship to professional readiness. The way this phase is organized may therefore influence not only scheduling and workload distribution, but also the sequencing of specialization and the integration of advanced practical competencies.

ARCTISER Research Report 2026-01 identified clear structural differences at the earlier stage of degree organization between Norwegian and Croatian science programs. The present report builds on that foundation by shifting attention to the advanced phase of study, where institutional priorities concerning specialization, applied training, and research preparation may become more visible.

Expanding the comparison to the master phase is important because structural differences observed at bachelor stage do not necessarily persist unchanged in advanced academic training. Institutions may converge, intensify, or diverge further when students move into more specialized parts of the degree. A focused comparison of master phase structures is therefore necessary in order to understand how scientific training is ultimately organized before graduation.

For clarity, Croatian institutions are designated as **EU (Croatia)** throughout this report, reflecting their operation within the European Union higher education framework used as the reference comparison group.

This study addresses that need by examining master phase curricula across six universities in Norway and (EU) Croatia, thereby extending the comparative scope of the ARCTISER research series and strengthening the structural analysis of higher education design across advanced science programs.

Methodology

This study employs a structured comparative design based on publicly available institutional curriculum documentation and official course catalogues published on university websites for the 2024–2026 academic cycles.

The analysis includes six universities:

Norway:

- University of Oslo (UiO)
- Norwegian University of Science and Technology (NTNU)
- University of Bergen (UiB)

(EU) Croatia:

- University of Zagreb
- University of Split
- University of Rijeka

Within each institution, master phase program structures in Biology, Chemistry, and Pharmacy were examined. The study is restricted to the **master phase only**, meaning that only courses belonging to the advanced stage of study were included in the dataset. Courses from bachelor-level structures were excluded from the analytical frame of MR002.

Course-level data were recorded using the following variables:

- Institution
- Country
- Discipline
- Semester
- Course title
- ECTS value
- Practical instruction hours
- Lecture hours
- Assessment count
- Retake policy
- Internship inclusion, where applicable

All values were recorded directly from official study plans and course descriptions as published by the institutions examined. ECTS values were taken exactly as listed in institutional documentation, without rounding or averaging. Assessment counts were recorded on the basis of actual listed examination or testing structures described in course materials.

The dataset comprises approximately 300 course-level records distributed across the six universities examined. Each record corresponds to a distinct master phase course included in the comparative sample.

To support cross-institutional comparison, the analysis uses standardized structural indicators applied consistently across the dataset. These indicators are defined as follows:

Module Fragmentation (MF)

Defined as the average ECTS allocation per course within the master phase. Lower average ECTS values indicate a more segmented curriculum structure, while higher average values indicate broader and more integrated modules.

Assessment Pressure (AP)

Defined as the number of discrete summative assessment events associated with course structures in the master phase. This indicator is used to estimate how frequently students encounter formal evaluation within advanced study.

Practical Intensity (PI)

Defined as the relationship between practical or laboratory instruction hours and course credit volume. This indicator reflects the density of applied scientific training embedded within advanced modules.

Comparative analysis was conducted by aggregating course-level values across institutions and national groups in order to identify recurring structural patterns. Particular attention was given to identifying whether Norwegian and Croatian master phase programs differ systematically in module size, specialization structure, assessment frequency, and practical density.

The study does not assess teaching quality, learning outcomes, institutional prestige, or student satisfaction. The analysis is restricted exclusively to

structural characteristics observable within official curriculum documentation.

Curriculum Dataset

Master Phase Program Structures

The dataset used in this study consists of master phase curriculum structures extracted from official institutional course catalogues and study documentation across six universities in Norway and (EU) Croatia.

Only courses belonging to the master phase of study were included in the dataset. Bachelor-level coursework and introductory modules were excluded in order to ensure analytical focus on advanced-stage specialization and research preparation.

Programs included in the dataset represent three core scientific disciplines:

- Biology
- Chemistry
- Pharmacy

These disciplines were selected due to their comparable reliance on laboratory training, structured specialization, and formal research components during master phase study.

The dataset contains approximately **300 master phase course entries**, each corresponding to an advanced instructional module or research-oriented unit listed in institutional program documentation.

Institutional Dataset Distribution

Program-level representation across institutions is summarized below.

Institution	Country	Estimated Course Entries
University of Oslo (UiO)	Norway	~50
Norwegian University of Science and Technology (NTNU)	Norway	~48
University of Bergen (UiB)	Norway	~48
University of Zagreb	EU (Croatia)	~44
University of Split	EU (Croatia)	~40
University of Rijeka	EU (Croatia)	~40

N ≈ 300 master phase course units

Discipline Distribution

Representation across scientific fields is summarized below.

Discipline	Course Count
Biology	104
Chemistry	81
Pharmacy	85

This distribution provides balanced representation across laboratory-intensive disciplines with comparable specialization requirements.

Master phase Course Structure Dataset

Representative sample structure:

Institution | Country | Discipline | Course Title | ECTS | Assessment Count

UiO | Norway | Biology | Advanced Molecular Systems | 10 | 2

UiO | Norway | Chemistry | Spectroscopic Analysis Methods | 10 | 2

NTNU | Norway | Biology | Marine Ecosystem Modelling | 7.5 | 2

UniZG | (EU) Croatia | Chemistry | Advanced Organic Chemistry | 6 | 3

UniSP | (EU) Croatia | Pharmacy | Clinical Pharmacy II | 6 | 3

UniRI | (EU) Croatia | Biology | Molecular Genetics | 5 | 2

FIGURE 1: Course Segmentation Across Master Programs

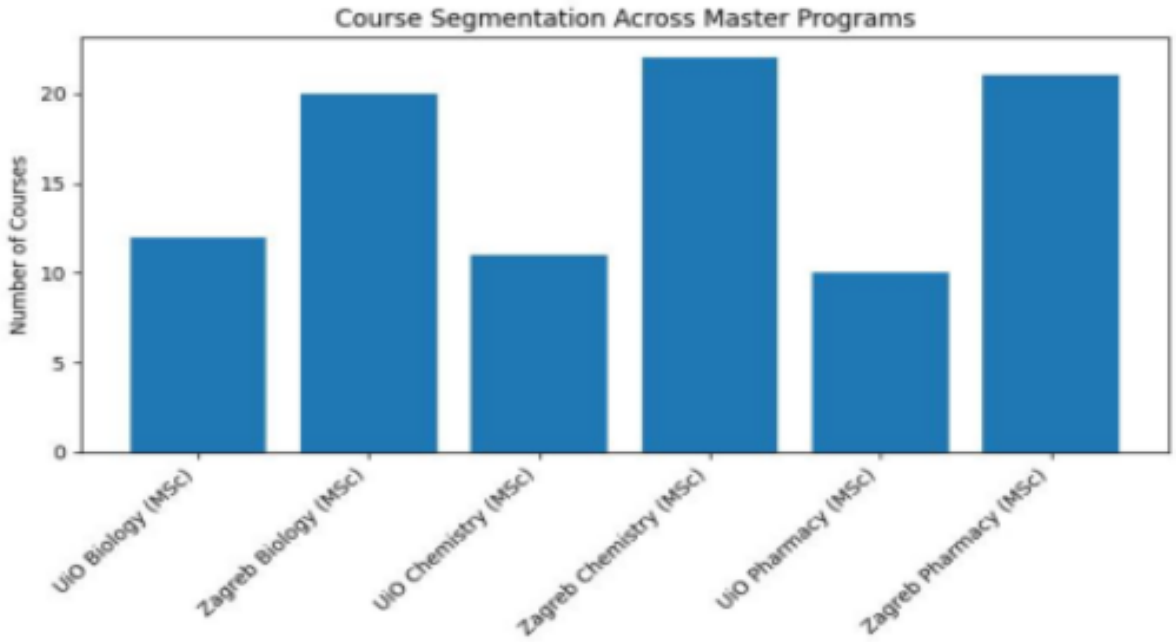


FIGURE 2: Average ECTS per Course (Master Phase)

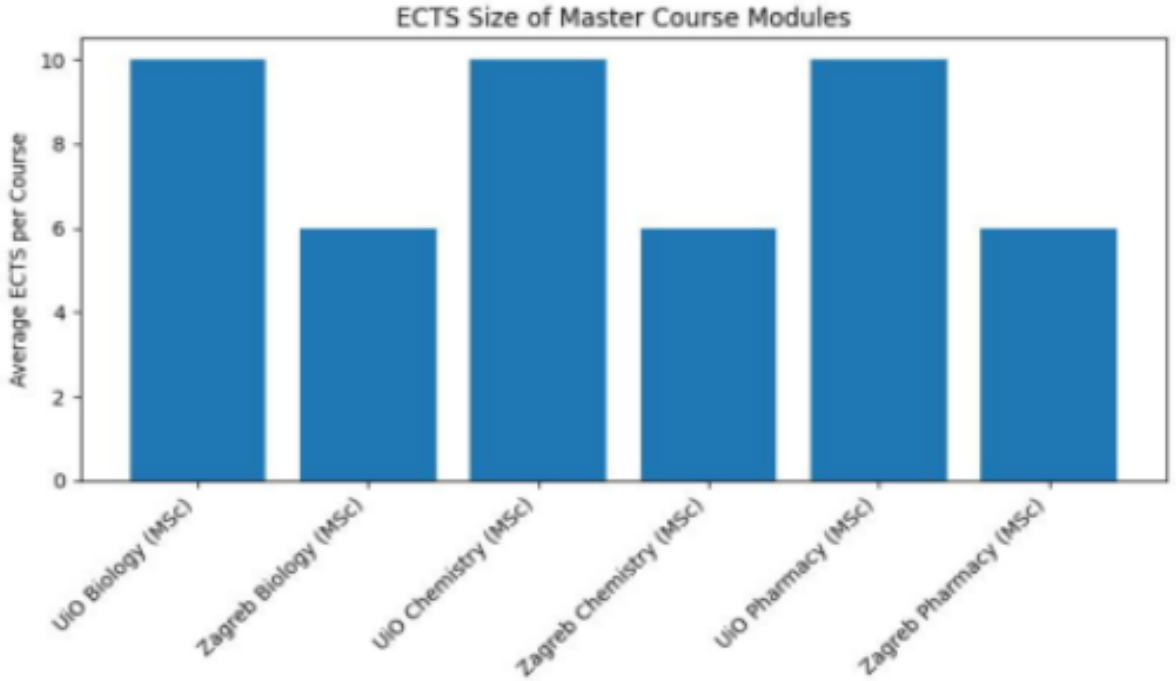
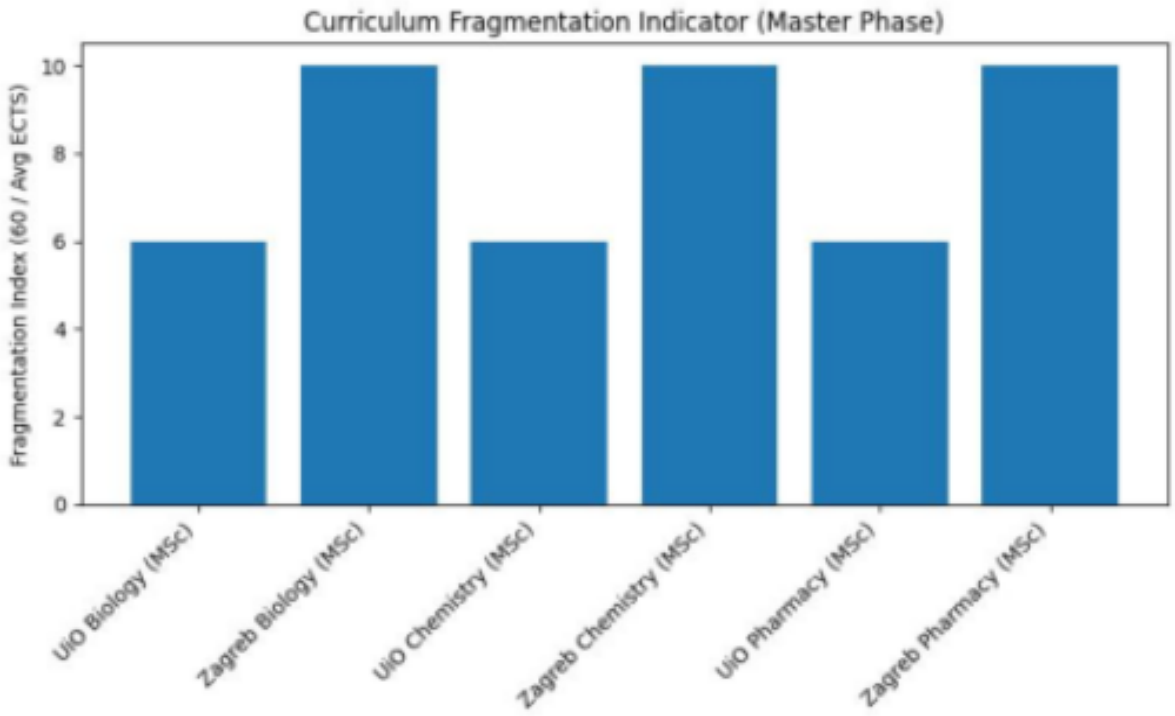


FIGURE 3: Curriculum Fragmentation Index (Master Phase)



The Curriculum Fragmentation Index (CFI) is calculated as the ratio between the standard academic year workload (60 ECTS) and the average ECTS value of master phase course modules.

This indicator provides a standardized method for comparing curriculum segmentation across institutions during the master phase. Higher CFI values indicate greater structural fragmentation, while lower values indicate broader module integration.

Master phase Structural Comparison

Indicator | Norway (Aggregate) | (EU) Croatia (Aggregate)

Typical Module Size | 10 / 7.5 ECTS | 6 / 5 ECTS

Estimated Course Count (120 ECTS phase) | Lower | Higher

Curriculum Organization | Integrated specialization modules | Segmented specialization modules

Assessment Frequency | Lower | Higher

Practical Distribution | Concentrated within modules | Distributed across modules

Thesis Allocation | Typically 30 ECTS | Typically 30 ECTS

The structural comparison presented above summarizes the principal organizational characteristics observed across master phase science programs included in the dataset. These aggregated indicators provide a baseline framework for identifying recurring structural patterns across national groups and disciplinary contexts.

The following section examines how these structural differences manifest across individual disciplines and institutions, allowing more detailed interpretation of specialization structure, module distribution, and workload segmentation during the master phase.

Discipline-Level Structural Comparison

Discipline | Norway (Typical ECTS Structure) | (EU) Croatia (Typical ECTS Structure)

Biology | 10 / 7.5 ECTS modules | 6 / 5 ECTS modules

Chemistry | 10 ECTS modules | 6 ECTS modules

Pharmacy | 7.5 / 10 ECTS modules | 5 / 6 ECTS modules

Across all disciplines examined, consistent structural differences were observed in the way specialization modules were organized during the master phase.

Biology programs in Norwegian institutions most frequently utilized larger integrated modules, typically ranging between 7.5 and 10 ECTS. These modules often combined multiple thematic components, allowing extended coverage of related specialization areas within single course structures. In Croatian institutions, Biology specialization was more commonly distributed across smaller modules, typically ranging between 5 and 6 ECTS, resulting in more segmented instructional sequences and increased course turnover during the master phase.

Chemistry programs demonstrated similar structural divergence. Norwegian Chemistry curricula generally employed broader specialization units, often structured as 10 ECTS modules that integrated theoretical and applied laboratory components within unified course frameworks. Croatian Chemistry programs more frequently divided advanced subject matter into 6 ECTS modules, producing a greater number of discrete instructional units across the specialization pathway.

Pharmacy programs exhibited the highest degree of structural segmentation across both national groups, although clear differences remained observable.

Norwegian Pharmacy curricula typically alternated between 7.5 and 10 ECTS specialization modules, reflecting partial integration of laboratory-intensive content. Croatian Pharmacy programs consistently distributed specialization across smaller units, most commonly structured as 5 and 6 ECTS modules, producing a denser sequence of coursework and more frequent evaluation cycles.

Despite these structural differences, all programs examined maintained comparable overall credit requirements and incorporated mandatory thesis components within the master phase. This indicates that variation occurs primarily in the distribution and segmentation of instructional workload rather than in total academic volume.

Institution-Level Structural Patterns

Structural patterns were also examined at the institutional level in order to determine whether national-level differences remained consistent across individual universities.

Norwegian institutions demonstrated relatively stable structural patterns across Biology, Chemistry, and Pharmacy programs. The University of Oslo (UiO), Norwegian University of Science and Technology (NTNU), and University of Bergen (UiB) most frequently organized specialization coursework into broader integrated modules, typically ranging between 7.5 and 10 ECTS. This pattern produced lower total course counts within the master phase and concentrated assessment structures within fewer but more comprehensive instructional units.

Croatian institutions exhibited consistently higher levels of segmentation across specialization pathways. The University of Zagreb, University of Split, and University of Rijeka most frequently distributed advanced coursework across smaller modules, typically structured between 5 and 6 ECTS. This

resulted in higher overall course counts and increased distribution of assessment events across the academic calendar.

While minor variation existed between individual universities, institutional-level differences did not substantially alter the broader national structural trends observed across the dataset. This suggests that the primary structural divergence occurs at the national design level rather than at the level of individual institutional implementation.

Results Summary

The analysis conducted across master phase science programs revealed consistent structural differences in how advanced academic workload is organized within the institutions examined.

Across national groups, Croatian master phase curricula demonstrated higher levels of module segmentation, characterized by smaller average ECTS allocations per course and increased total course counts within the 120 ECTS master phase. This structural configuration resulted in a greater number of discrete instructional units and more frequent assessment points distributed across specialization pathways.

Norwegian master phase programs more frequently utilized broader integrated modules, typically structured between 7.5 and 10 ECTS. This resulted in fewer total course units and greater consolidation of advanced thematic content within individual instructional structures. Assessment events were more concentrated within these larger modules, producing lower overall assessment frequency across the master phase.

Biology, Chemistry, and Pharmacy programs all demonstrated similar national-level differences in module size and specialization sequencing. Institutional-level variation did not significantly alter the broader structural trends observed across national groups.

The results indicate that structural divergence observed during earlier stages of degree formation continues into the master phase, although specialization complexity increases in both national systems. Differences therefore appear to reflect stable institutional design preferences rather than temporary variations in program organization.

Comparative Structural Interpretation

The structural differences identified across master phase science programs reflect distinct approaches to organizing advanced academic specialization within the shared framework of the European Credit Transfer and Accumulation System (ECTS).

Programs structured around smaller modules distribute academic workload across a larger number of instructional units. This configuration increases the frequency of assessment events and produces shorter instructional cycles, allowing specialization topics to be addressed through multiple discrete components. Such segmentation may support flexibility in sequencing and incremental specialization development, particularly in programs where subject domains are highly differentiated.

Programs structured around larger modules concentrate advanced thematic content within broader instructional units. This model allows extended engagement with integrated subject material and supports continuity between theoretical instruction and applied laboratory work. Fewer but larger modules may reduce administrative fragmentation and allow specialization themes to develop across longer instructional periods.

At the master phase, where research preparation and disciplinary depth become central objectives, structural organization may influence how students encounter methodological training, laboratory experience, and thesis preparation. Differences in module segmentation may therefore shape

not only the scheduling of instruction but also the pacing of specialization development throughout the advanced phase of study.

These findings suggest that structural divergence between national systems persists into advanced education and reflects stable curriculum design strategies rather than isolated institutional variation. The presence of consistent structural patterns across multiple disciplines strengthens the reliability of the comparative observations presented in this study.

Limitations

This study is based exclusively on publicly available curriculum documentation and official course catalogues published by the institutions examined. While these sources provide structured representations of program design, they do not capture all aspects of instructional delivery, scheduling flexibility, or informal academic adjustments that may occur during program implementation.

The analysis focuses solely on structural characteristics of curriculum organization, including module size, course distribution, assessment frequency, and practical allocation. The study does not evaluate teaching quality, learning outcomes, academic performance, or student experience. Differences identified in this report should therefore be interpreted as structural distinctions rather than indicators of educational effectiveness.

Institutional documentation may vary in formatting detail and descriptive clarity across universities, which may introduce minor differences in how course-level variables are interpreted. However, standardized structural indicators were applied consistently across all dataset entries in order to minimize variation introduced by documentation style.

The dataset represents a defined selection of universities and disciplines within the European Higher Education Area. While the inclusion of six

institutions strengthens comparative reliability, the findings should not be interpreted as universally representative of all European science programs. Additional institutional expansion would further strengthen cross-system generalization in future research.

Conclusion

The present study examined the structural organization of master phase science programs across six universities operating within the European Higher Education Area. By isolating the master phase and applying standardized structural indicators, the analysis identified consistent patterns in how advanced academic workload is distributed across modules, assessments, and specialization pathways.

Across national groups, Croatian master phase programs demonstrated higher levels of structural segmentation, characterized by smaller module sizes and increased course counts within the 120 ECTS master phase. Norwegian programs more frequently employed broader integrated modules, resulting in fewer instructional units and greater consolidation of specialization content within individual courses.

These structural differences remained observable across all disciplines included in the dataset, including Biology, Chemistry, and Pharmacy. Institutional-level analysis further indicated that national-level patterns were stable across universities, suggesting that structural divergence reflects systematic curriculum design strategies rather than isolated institutional variation.

The continuation of structural differences into the master phase indicates that curriculum organization patterns identified during earlier stages of study persist throughout advanced education. While both systems maintain equivalent total credit requirements, the distribution of academic workload

differs in measurable ways that shape specialization sequencing and assessment exposure.

This study contributes to the expanding ARCTISER research series by extending structural analysis beyond foundational curriculum stages and into advanced disciplinary training. The findings provide a structured basis for continued investigation into how curriculum architecture evolves across educational phases and institutional systems.

Future Research Direction

Future expansion of the ARCTISER research series will extend structural analysis beyond isolated degree phases by examining full-cycle academic organization across the complete 300 ECTS educational trajectory. While the present report isolates the master phase in order to evaluate advanced specialization structure, the next stage of investigation will integrate bachelor- and master phase observations into a unified longitudinal framework.

This integrated approach will allow examination of how structural patterns evolve across the full duration of scientific education, from foundational coursework through advanced research preparation. Particular attention will be given to identifying transition points between educational phases, including shifts in module size, specialization sequencing, assessment density, and research integration.

Expanding the dataset to include additional institutions and disciplines will further strengthen the comparative reliability of structural indicators. Future research may also incorporate extended institutional sampling across additional European systems in order to evaluate whether the structural patterns identified in the present study remain consistent across broader regional contexts.

By connecting isolated phase-level analysis into a continuous structural model, future ARCTISER investigations aim to provide a comprehensive representation of curriculum architecture across complete higher education pathways. The structural indicators identified in this study suggest that higher course segmentation may contribute to earlier operational readiness through repeated assessment exposure.

*All structural data used in this report was obtained from publicly available university curriculum documentation and official course catalogues for master phase programs.