Assessment report
Limited Framework Programme Assessment

Master Drug Discovery and Safety

VU Amsterdam

Contents of the report

1. Executive summary

In this executive summary, the panel presents the main considerations which led to the assessment of the quality of the Master Drug Discovery and Safety programme of VU Amsterdam, which has been assessed according to the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, as published on 20 December 2016 (Staatscourant nr. 69458).

The panel considers the programme objectives to be very sound. The panel regards the programme profile to be very strong, the programme occupying a unique place among the programmes in this domain in the Netherlands and abroad. The panel recommends for the programme to remain within this niche and not to broaden the scope. The panel advises to communicate the programme profile and features more clearly.

The panel characterises the programme as being geared toward the study of the chemical dimensions of drug discovery, especially in the first phases of the drug discovery and development process. The panel regards the programme to be scientifically sound and up-to-date.

The programme objectives are within the boundaries of the domain-specific reference framework for academic chemical sciences programmes. The panel appreciates the efforts by the joint programmes in chemical sciences in the Netherlands to draft this framework and regards this to be a sound and up-to-date description of this domain. The programme profile may be clearly distinguished within the framework.

The panel greets the comparison to other programmes in the Netherlands, demonstrating the profile and the specific features of the programme.

The panel is positive about the programme objectives to prepare students for positions in industry or for PhD trajectories. The panel appreciates students having the options to become managers, fully-qualified teachers in chemistry in Dutch secondary education or science communication specialists.

The panel suggests to intensify the interaction with the professional field advisory committee.

The intended learning outcomes of the programme correspond to the programme objectives, are well-articulated and are conform to the master level.

The student inflow numbers of the programme are adequate. The panel considers the entry requirements to be clear and strict. The admission procedures are appropriate. The panel proposes to try and admit students from a wider range of bachelor programmes.

The panel is positive about the contents of the curriculum, meeting the programme intended learning outcomes. The courses and projects are up to standard, with a pronounced and strong focus on chemistry subjects. The number of practical classes is adequate. The panel is positive about the coherence of the curriculum. The panel advises to reduce the number of specialisations, as five specialisations seem to be too many in view of the size of the programme. The panel proposes to promote external research internships further and to assist students in finding these and in applying for them, in line with current initiatives on the part of the programme.

The panel regards the lecturers in the programme to be both skilled and motivated. In the panel's view, the lecturers know how to bridge the disciplines in the curriculum. The educational capabilities of the lecturers are up to standard, as may be deduced from the proportion of BKO-certified lecturers. As the workload is very demanding for lecturers, the panel advises to balance the workload by making the programme more transparent and by providing considerably more support from the Faculty departments and VU central departments. The educational concept and study methods are in line with the programme characteristics. Educational innovation in the programme is pursued strongly, lecturers having adopted blended learning, web-lectures and flipped classrooms. The number of hours of face-to-face education and the class sizes are adequate. The panel regards the student success rates to be appropriate.

The panel approves of the programme examinations and assessment rules and regulations, but advises to harmonise the rules and regulations of the two Examination Boards of the Faculty.

The examination methods in the programme are consistent with the goals and contents of the courses. In the Master projects, students are offered appropriate supervision. The assessment procedures are up to standard. Although the oral feedback by examiners on the Master project results may be adequate, the panel suggests to provide more extensive written feedback. The panel considers the measures ensuring the validity, reliability and transparency of examinations and assessments to be adequate.

The course examinations are quite challenging. The Master theses match the intended learning outcomes and are appropriate scientific research projects. The level and quality of the theses differ, which is reflected in the grades. As the subjects in some of the projects are rather narrowly defined, the panel proposes to monitor the breadth and the multidisciplinary dimensions of the Master projects.

The panel regards the programme graduates to have reached the intended learning outcomes and to be qualified to either find PhD positions or to be employed in industry at appropriate positions.

The panel that conducted the assessment of the Master Drug Discovery and Safety programme of VU Amsterdam assesses this programme to meet the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, judging the programme to be satisfactory. Therefore, the panel advises NVAO to accredit the programme.

Rotterdam, 25 February 2019

Prof. dr. M.A. Cohen Stuart
(panel chair)

drs. W. Vercouteren
(panel secretary)

2. Assessment process

The evaluation agency Certiked VBI received the request by VU Amsterdam to manage the limited framework programme assessment process for the Master Drug Discovery and Safety programme of this University. The objective of the programme assessment process was to assess whether the programme would conform to the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, published on 20 December 2016 (Staatscourant nr. 69458).

Having conferred with management of the VU Amsterdam programme, Certiked invited candidate panel members to sit on the assessment panel. The panel members agreed to do so. The panel composition was as follows:

- Prof. dr. M.A. Cohen Stuart, professor emeritus, chair of Physical Chemistry & Colloid Chemistry, Wageningen University, professor emeritus of Physical Surface Chemistry, University of Twente, professor East China University of Science and Technology, Shanghai, China (panel chair);
- Prof. dr. A.H.T. Boyen, associate professor emeritus, Faculty of Sciences and Bio-engineering Sciences, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel (panel member);
- Prof. dr. R.M.J. Liskamp, professor, chair Chemical Biology and Medicinal Chemistry, School of Chemistry, University of Glasgow, United Kingdom, professor of Molecular Medicinal Chemistry, Utrecht University (panel member);
- Prof. dr. K. Augustyns, professor of Medicinal Chemistry, Dean Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp (panel member)
- Dr. M. Monshouwer, senior director and EU head Pharmacokinetics, Dynamics and Metabolism, Johnson & Johnson, Janssen Pharmaceuticals (panel member);
- A.E.M. Melcherts BSc, student Master in Nanomaterials Science, Utrecht University (student member).

On behalf of Certiked, drs. W. Vercouteren served as the process coordinator and secretary in the assessment process.

All panel members and the secretary confirmed in writing being impartial with regard to the programme to be assessed and observing the rules of confidentiality. Having obtained the authorisation by the University, Certiked requested the approval of NVAO of the proposed panel to conduct the assessment. NVAO have given their approval.

To prepare the assessment process, the process coordinator convened with management of the programme to discuss the outline of the self-assessment report, the subjects to be addressed in this report and the site visit schedule. In addition, the planning of the activities in preparation of the site visit were discussed. In the course of the process preparing for the site visit, programme management and the Certiked process coordinator regularly had contact to fine-tune the process. The activities prior to the site visit have been performed as planned. Programme management approved of the site visit schedule.

Well in advance of the site visit date, programme management sent the list of final projects of graduates of the programme of the most recent years. Acting on behalf of the assessment panel, the process coordinator selected the theses of 15 graduates from the last few years. The grade distribution in the selection was ensured to conform to the grade distribution in the list, sent by programme management.

The panel chair and the panel members were sent the self-assessment report of the programme, including appendices. In the self-assessment report, the student chapter was included. In addition, the expert panel members were forwarded a number of theses of the programme graduates, these theses being part of the selection made by the process coordinator.

Several weeks before the site visit date, the assessment panel chair and the process coordinator met to discuss the self-assessment report provided by programme management, the procedures regarding the assessment process and the site visit schedule. In this meeting, the profile of panel chairs of NVAO was discussed as well. The panel chair was informed about the competencies, listed in the profile. Documents pertaining to a number of these competencies were presented to the panel chair. The meeting between the panel chair and the process coordinator served as the briefing for panel chairs, as meant in the NVAO profile of panel chairs.

Prior to the date of the site visit, all panel members sent in their preliminary findings, based on the self-assessment report and the final projects studied, and a number of questions to be put to the programme representatives on the day of the site visit. The panel secretary summarised this information, compiling a list of questions, which served as a starting point for the discussions with the programme representatives during the site visit.

Shortly before the site visit date, the complete panel met to go over the preliminary findings concerning the quality of the programme. During this meeting, the preliminary findings of the panel members, including those about the theses were discussed. The procedures to be adopted during the site visit, including the questions to be put to the programme representatives on the basis of the list compiled, were discussed as well.

On 29 and 30 October 2018, the panel conducted the site visit on the VU Amsterdam campus. The site visit schedule was as planned. In a number of separate sessions, the panel was given the opportunity to meet with Faculty Board representatives, programme management, Examination Board members, lecturers and final projects examiners, and students and alumni.

In a closed session at the end of the site visit, the panel considered every one of the findings, weighed the considerations and arrived at conclusions with regard to the quality of the programme. At the end of the site visit, the panel chair presented a broad outline of the considerations and conclusions to programme representatives.

Clearly separated from the process of the programme assessment, assessment panel members and programme representatives met to conduct the development dialogue, with the objective to discuss future developments of the programme.

The assessment draft report was finalised by the secretary, having taken into account the findings and considerations of the panel. The draft report was sent to the panel members, who studied it and made a number of changes. Thereupon, the secretary edited the final report. This report was presented to programme management to be corrected for factual inaccuracies. Programme management were given two weeks to respond. Having been corrected for these factual inaccuracies, the Certiked bureau sent the report to the Board of VU Amsterdam, to accompany their request for re-accreditation of this programme.

3. Programme administrative information

Name programme in CROHO:	M Drug Discovery and Safety
Orientation, level programme:	Academic Master
Grade:	MSc
Number of credits:	120 EC
Specialisations:	Drug Discovery and Target Finding Drug Disposition and Safety Assessment Drug Design and Synthesis Computational Medicinal Chemistry and Toxicology Biomarkers and Clinical Chemical Analysis
Location:	Amsterdam
Mode of study:	Full-time (language of instruction English)
Registration in CROHO:	66989
Name of institution:	VU Amsterdam
Status of institution:	Government-funded University
Institution's quality assurance:	Approved

4. Findings, considerations and assessments per standard

4.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings
The Master Drug Discovery and Safety programme is offered by the Department of Chemistry & Pharmaceutical Sciences of the Faculty of Science of VU Amsterdam. The dean of the Faculty has the responsibility for all programmes of the Faculty. This Master programme is part of the Graduate School of Natural Sciences and Mathematics of this Faculty. The programme director is responsible for the delivery and quality of the programme. The programme director is assisted by the programme coordinator and study advisor. The Programme Committee for both the Bachelor Farmaceutische Wetenschappen and Master Drug Discovery and Safety programmes, being composed of three lecturers and three students, advises programme management on quality issues. The sub-committee of the Faculty Examination Board for the Bachelor Farmaceutische Wetenschappen and the Master Drug Discovery and Safety programmes has the responsibility to ensure the quality of examinations and assessments of the programme.

The Master Drug Discovery and Safety programme is a two-year, research-based, multi-disciplinary academic master programme in the field of pharmacochemistry and drug discovery, synthesis and development, geared toward the first stages of the drug discovery and development process. The programme is rooted in the research done at the Department of Chemistry & Pharmaceutical Sciences of VU Amsterdam. The objectives of the programme are to educate students thoroughly in the molecular sciences for health and medicinal purposes. Students are also trained in academic skills and attitudes.

The objectives of the programme are conform to the domain-specific reference framework for the chemical sciences in the Netherlands, which has been drafted by the joint programmes of this assessment cluster in the Netherlands. In this domain-specific framework, reference has been made to international frameworks and benchmark statements. This VU Amsterdam programme may be regarded to be positioned in the pharmaceutical sciences sub-domain of chemical sciences.

Students may select one of the specialisations offered in the programme, being Drug Discovery and Target Finding, Drug Disposition and Safety Assessment, Drug Design and Synthesis, Computational Medicinal Chemistry and Toxicology or Biomarkers and Clinical Chemical Analysis. The specialisations are directed towards specific areas of research within the domain of the programme. Students may also opt for the double degree programme of VU Amsterdam and University of Copenhagen, studying one year at each of these universities.

Programme management compared this programme to other programmes in the Netherlands in the pharmaceutical sciences sub-domain. From this comparison, this programme emanates as being very strongly chemistry-based and as having a quite unique position in the chemical sciences domain.

The programme aims in the Research variant at preparing students both to enter the labour market or to pursue PhD trajectories. Students are also offered the Societal, Education or Communication variants, preparing them for positions as managers in this domain, fully-qualified teachers in chemistry in Dutch secondary education or science communication specialists.

The professional field advisory committee meets with programme management to discuss the alignment of the programme with professional field requirements, especially in the case of curriculum adaptations.

The programme objectives have been translated into intended learning outcomes, specifying theoretical and practical understanding of pharmaceutical sciences, requisite knowledge of other disciplines, thorough theoretical and practical knowledge of research methods and techniques, application of pharmaceutical sciences in the wider, multidisciplinary context, knowledge of safety and environmental aspects, academic literacy, communication skills and social responsibility awareness. For the Societal, Education or Communication variants, variant-specific intended learning outcomes have been added. The intended learning outcomes of the programme have been related to the Dublin descriptors for the master level.

Consideration
The panel considers the programme objectives to be very sound. The panel regards the programme profile to be very strong, the programme occupying a unique place among the programmes in this domain in the Netherlands and abroad. The panel recommends for the programme to remain within this niche and not to broaden the scope. The panel advises to communicate the programme profile and features more clearly.

The panel characterises the programme as being geared toward the study of the chemical dimensions of drug discovery, especially in the first phases of the drug discovery and development process. The panel regards the programme to be scientifically sound and up-to-date.

The programme objectives are within the boundaries of the domain-specific reference framework for academic chemical sciences programmes. The panel appreciates the efforts by the joint programmes in chemical sciences in the Netherlands to draft this framework and regards this to be a sound and up-to-date description of this domain. The programme profile may be clearly distinguished within the framework.

The panel welcomes the comparison to other programmes in the Netherlands, demonstrating the profile and the specific features of the programme. The panel is positive about the programme objectives to prepare students for positions in industry or for PhD trajectories. The panel appreciates students having the options to become managers, fully-qualified teachers in chemistry in Dutch secondary education or science communication specialists. The panel suggests to intensify the interaction with the professional field advisory committee. The intended learning outcomes of the programme correspond to the programme objectives, are well-articulated and are conform to the master level.

Assessment of this standard
These considerations have led the assessment panel to assess standard 1, Intended learning outcomes, to be good.

4.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings
The number of incoming students in the last few years grew from about 30 students in 2013 to nearly 50 students in 2017. The number may rise, but the influx of 100 students or more would be problematic. The entry requirements list in detail the disciplines and textbooks to be mastered by applicants. About 50 % to 70 % of the incoming students completed the VU Amsterdam Bachelor Farmaceutische Wetenschappen programme, about 10 % to 20 % are from abroad, about 10 % to 15 % have hbo-bachelor degrees and the remainder have academic bachelor degrees from other Dutch universities. Applications are screened by the programme Admission Board, consisting of the master specialisations coordinators. The Admission Board advises the Examination Board. Applicants may be interviewed.

The curriculum of the programme takes two years, the total study load being 120.0 EC. Programme management presented a table, showing the mapping of the intended learning outcomes to the courses. The curriculum of the Research variant is composed of four compulsory courses, to be taken by all students, two or three additional compulsory courses per specialisation, optional courses, the literature thesis and colloquium and the Master research project. The compulsory courses are scheduled to give students the comprehensive view on the early phases of drug discovery research, to allow them to collaborate with other experts in the field and to give them the theoretical foundation for the practical work. In the specialisations, students take specific courses (minimum 12 EC), introducing them to the essentials of the specialisation. Students draft a literature thesis related to their specialisation and present the results at a colloquium. In the courses, students are acquainted with ethical dimensions, are trained in academic skills, are taught skills to apply for internships and are informed about career options. At the end of the curriculum, students do one or two research internships (42 to 60 EC for major internships, and 18 to 36 EC for the minor internships). Usually, students do the major internship within VU Amsterdam and the minor internship externally. The programme promotes external internships. About 20 % of the students go abroad. In the other variants, 60 EC are spent on variant-specific courses, preparing students for positions in education (first-degree teacher Chemistry), communication or management.

A total number of 34 lecturers are involved in the programme. The lecturers are researchers at one of the research groups of the Department of Chemistry & Pharmaceutical Sciences. These research groups are part of the Amsterdam Institute of Molecules, Medicines and Systems, which received scores excellent in the 2018 external research evaluation. Practically all staff members have PhDs. Of the total number of lecturers about 65 % obtained the BKO-certificate and another 15 % of them is expected to become BKO-certified in 2018/2019. Guest lecturers from industry teach in courses. PhD students and postdocs are involved in the programme as teaching assistants and daily supervisors of Master projects. Lecturers are proficient in English. Lecturers experience the work load as challenging, particularly regarding administrative matters, the support by the central VU department having diminished considerably. Junior lecturers are recruited to alleviate lecturers' work load.

The educational concept of the programme is research-based education. The total number of hours of face-to-face education is on average 300 hours per year, leading to about 7.5 hours of face-to-face education per week. The study methods adopted in the programme are lectures, tutorials, case studies, practical courses, and self-study. Educational innovation in the programme is pursued strongly, lecturers having adopted blended learning, web-lectures and flipped classrooms. The mean students-to-staff ratio proved to be difficult to compute. The number of students in the lectures are about 25 to 50 students per lecturer. Students may turn to the programme study advisor or master coordinator for study guidance, study skills or personal circumstances. The curriculum is demanding, but doable in the students' view. The student success rates for the last years are on average about 45 % after two years and over 80 % after three years.

Considerations
The student inflow numbers of the programme are adequate. The panel considers the entry requirements to be clear and strict. The admission procedures are appropriate. The panel proposes to try and admit students from a wider range of bachelor programmes.

The panel is positive about the contents of the curriculum. The curriculum meets the intended learning outcomes of the programme. The courses and projects are up to standard, with a pronounced and strong focus on chemistry subjects. The number of practical classes is adequate. The panel is positive about the coherence of the curriculum. The panel advises to reduce the number of specialisations, as five specialisations seem to be quite numerous in view of the size of the programme. The panel proposes to promote external research internships further and to assist students in finding these and in applying for them, in line with current initiatives on the part of the programme.

The panel regards the lecturers in the programme to be both skilled and motivated. In the panel's view, the lecturers know how to bridge the disciplines in the curriculum. The educational capabilities of the lecturers are up to standard, as may be deduced from the proportion of BKO-certified lecturers. As the workload is challenging for lecturers, the panel advises to balance the workload by making the programme more transparent and by providing considerably more support from the Faculty departments and VU central departments.

The panel considers the educational concept and the study methods to be in line with the programme characteristics. The programme is working on new study methods, which is positive. The number of hours of face-to-face education and the class sizes are adequate. The panel regards the student success rates to be appropriate.

Assessment of this standard
These considerations have led the assessment panel to assess standard 2, Teaching-learning environment, to be satisfactory.

4.3 Standard 3: Student assessment

The programme has an adequate system of student assessment in place.

Findings
The programme examination and assessment procedures are aligned with the VU Amsterdam policies and the Faculty of Science policies. As has been indicated, the Examination Board for the programme has the authority to monitor the quality of examination and assessment processes and products. As the Faculty of Science is the outcome of the recent merger of two VU Faculties, there are still two Examination Boards in the Faculty. These boards are working to achieve one set of rules and regulations. The examination sub-committee for this programme specifically monitors the examinations and assessments quality.

The examination methods for the courses are selected in line with the courses' contents. In most of the courses, multiple examinations are scheduled to promote students study pace. The examination methods in the programme include written examinations, practical work, and reports and presentations. Free-riding in case of group work is countered by peer review among students, but this procedure has not yet been institutionalised.

The Master research projects are internal internships at one of the research groups contributing to the programme or external internships. Students are guided by the supervisor. PhD students or postdocs may be involved in the day-to-day supervision. In due time, the go/no-go procedure in the first part of the projects will be implemented, to determine if students may proceed. The programme internship coordinator and, in case of internal internships, the research group coordinator oversee the process. Draft theses are discussed with the supervisors. Master projects are assessed by the project supervisor and the second reader independently, using assessment scoring forms. They meet to determine the grade. External internships are assessed by VU examiners. The assessment components include execution of the work, written report and oral presentation. To pass, all components have to be at least satisfactory. In case the assessments of the examiners differ more than 1.5 points or in case one of the examiners judges the project to be unsatisfactory, a third examiner determines the grade. All theses are checked for plagiarism.

Programme management and the Examination Board have taken a number of measures to promote the quality of examinations and assessments. The Examination Board appoints examiners, in practice being the course coordinators. Draft examinations are peer-reviewed on both formal and material aspects. Examination matrices have been adopted. The validity of all multiple-choice examinations and of open-ended question examinations with deviant grade distributions are checked. On behalf of the Examination Board, the assessment committee on a regular basis reviews samples of examinations and samples of Master theses.

Considerations
The panel approves of the examinations and assessment rules and regulations of the programme, these being in line with VU Amsterdam and Faculty of Science policies. The panel recommends to harmonise the rules and regulations of the two Examination Boards of the Faculty.

The panel approves of the examination methods adopted by the programme. The methods are consistent with the goals and the contents of the courses.

The supervision and assessment processes for the Master projects have been well-organised. Students are offered appropriate supervision. The assessment procedures are up to standard, involving two examiners assessing the work separately and on the basis of assessment scoring forms. Although the oral feedback by examiners on the Master project results may be adequate, the panel suggests to provide more extensive written feedback.

The panel considers the measures ensuring the validity, reliability and transparency of examinations and assessments to be adequate.

Assessment of this standard
The considerations have led the assessment panel to assess standard 3, Student assessment, to be satisfactory.

4.4 Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings
The panel studied the examinations of a number of courses of the programme.

The panel reviewed 15 Master theses of programme graduates of the last two years. The average grade for these Master projects was about 7.8 in 2016/2017 and 8.0 in 2017/2018. Students are regularly co-authors of publications in scientific journals.

The career perspectives of graduates of the programme are very good. Most of them find jobs within three months after graduation. More than 50 % of the graduates proceed in PhD trajectories in pharmaceutical sciences, chemistry, life sciences or medical sciences in the Netherlands or abroad. The other graduates find positions at one of the growing number of pharmaceutical of biotechnology companies or at health care organisations. Few of the graduates find positions as teachers.

Considerations
The panel considers the course examinations to include relevant questions and to be quite challenging.

The Master theses the panel studied, match the intended learning outcomes and are appropriate scientific research projects. No theses were found by the panel to be unsatisfactory. The level and quality of the theses differ, which is reflected in the grades. The panel supports the grades given by the programme examiners. As the subjects in some of the projects are rather narrowly defined, the panel proposes to monitor the breadth and the multidisciplinary dimensions of the Master projects.

The panel considers the programme graduates to have reached the intended learning outcomes and to be qualified to either find PhD positions or to be employed at appropriate positions in industry.

Assessment of this standard
The considerations have led the assessment panel to assess standard 4, Achieved learning outcomes, to be satisfactory.

5. Overview of assessments

Standard	Assessment
Standard 1. Intended learning outcomes	good
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	satisfactory
Programme	satisfactory

6. Recommendations

In this report, a number of recommendations by the panel have been listed. For the sake of clarity, these have been brought together below. These panel recommendations are the following.

- For the programme to remain within this niche and not to broaden the scope.
- To communicate the profile and features of this programme more clearly.
- To intensify the interaction with the professional field advisory committee.
- To try and admit students from a wider range of bachelor programmes.
- To reduce the number of specialisations, as five specialisations in this programme seems to be too many in view of the size of the programme.
- To promote external research internships further and to assist students in finding these and in applying for them, in line with current initiatives on the part of the programme.
- To balance the workload of the lecturers by providing considerably more support from the Faculty and VU central departments.
- To harmonise the examination and assessment rules and regulations of the two Examination Boards of the Faculty.
- To provide more extensive written feedback on the Master project results.
- To monitor the breadth and the multidisciplinary dimensions of the Master projects.