Assessment report
Limited Framework Programme Assessment

Master Bio-Pharmaceutical Sciences

Leiden University

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 Bio-Pharmaceutical Sciences programme of Leiden University. The programme was 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, published on 20 December 2016 (Staatscourant nr. 69458).

The programme objectives are sound. The panel regards the programme to have very broad objectives, ranging from synthetic, organic chemistry to drug discovery. The panel welcomes the options open to students to study different areas within drug research, also areas not specifically referring to innovative drug discovery. The panel welcomes the strong research orientation of the programme. The programme is closely aligned with current scientific, international research in this field.

The objectives of the programme 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 profile of this Leiden University programme can be clearly distinguished within the framework.

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

The panel welcomes students being trained for both academic careers and professional careers. The panel also appreciates students being given opportunities to prepare for positions as managers, fully-qualified teachers in chemistry in Dutch secondary education or science communication specialists. Students may also become Qualified Persons, having taken the Industrial Pharmacy specialisation.

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

The panel notes the number of incoming students to be adequate. The entry requirements and admission procedures of the programme are appropriate.

The curriculum matches the intended learning outcomes of the programme. The curriculum contents are regarded by the panel to be solid and up to standard. The curriculum is coherent, the specialisations being well-organised and well-integrated. The panel greets the strong research orientation of the programme, including students being required to attend colloquia and seminars in this field. The academic skills are well-represented, as students write literature reviews and give oral presentations in the research projects.

The lecturers in the programme are reputed researchers. The panel considers their educational capabilities up to standard, given the proportion of BKO-certified lecturers. The number of staff in the programme is sufficient. The panel welcomes the organisation of the programme with the core lecturing team and notes lecturers frequently discussing the programme.

The educational concept and the study methods are adequate, promoting research-oriented and student-activating learning. The number of hours of face-to-face education is adequate. The study guidance by the study advisors is welcomed by the panel. The panel advises to reinforce study guidance in selecting Research Project 1. The programme is feasible. The student success rates are adequate, but the panel supports study advisors' efforts to limit the time needed for the research projects.

The examination and assessment rules and regulations for the programme are considered by the panel to be appropriate.

The examination methods adopted in the programme are consistent with the goals and the contents of the courses. The panel welcomes the procedures for the assessments of group projects to counter free-riding. The panel is positive about the usage of rubrics scoring forms for assignments.

The supervision and assessment procedures for both Research Projects 1 and 2 are very much up to standard. The assessment procedures are very effective, involving two examiners, who assess the work separately and use elaborate rubrics scoring forms.

The panel considers the measures to ensure the validity, reliability and transparency of examinations and assessments to be adequate. The procedures have been implemented, examiners comply and the Board of Examiners is pro-active in monitoring these.

The examinations of the courses are very much up to standard. The panel considers the research projects to be definitely at master level. The panel endorses the grades awarded to the research projects by the programme examiners.

The panel is convinced that students having completed the programme reached the intended learning outcomes. The panel very much appreciates the high proportion of graduates proceeding to PhD trajectories. The panel considers the career perspectives of the programme graduates to be very favourable. Graduates obtain positions in the broad range of small- and middle-sized drug development companies. Only few graduates find their way into innovative drug research.

The panel which conducted the assessment of the Master Bio-Pharmaceutical Sciences programme of Leiden University 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 recommends NVAO to accredit this programme.

Rotterdam, 7 March 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 Leiden University to support the limited framework programme assessment process for the Master Bio-Pharmaceutical Sciences 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).

Management of the programmes in the assessment cluster WO Scheikunde convened to discuss the composition of the assessment panel and to draft the list of candidates.

Having conferred with management of the Master Bio-Pharmaceutical Sciences programme of Leiden University, 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. C.G. Kruse, special professor emeritus Medicine Research, University of Amsterdam (panel member);
- Drs. O. de Vreede, head Innovation and Human Capital, VNCI, Association of the Dutch Chemical Industry (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 has given the 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 fifteen 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 preliminary 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 11 October 2018, the panel conducted the site visit on the Leiden University 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, Board of Examiners members, lecturers and final projects examiners, students and alumni, and professional field representatives.

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.

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 Leiden University, to accompany their request for re-accreditation of this programme.

3. Programme administrative information

Name programme in CROHO:	M Bio-Pharmaceutical Sciences
Orientation, level programme:	Academic Master
Grade:	MSc
Number of credits:	120 EC
Specialisations:	BioTherapeutics Drug & Target Discovery Systems Pharmacology Bio-Pharmaceutical Sciences and Business Studies Bio-Pharmaceutical Sciences and Education Bio-Pharmaceutical Sciences and Science Communication and Society Industrial Pharmacy
Location:	Leiden
Mode of study:	Full-time (language of instruction English)
Registration in CROHO:	21PB-60207
Name of institution:	Leiden University
Status of institution:	Government-funded University
Institutions' 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 Bio-Pharmaceutical Sciences programme is offered by Leiden Academic Centre for Drug Research of the Faculty of Science of Leiden University. The dean of the Faculty has the responsibility for all programmes of the Faculty. Leiden Academic Centre for Drug Research offers the programmes Bachelor Bio-Farmaceutische Wetenschappen, Master Bio-Pharmaceutical Sciences and, in collaboration with Leiden University Medical Center, Master Pharmacy. The programme director of the Master Bio-Pharmaceutical Sciences programme is responsible for the delivery and quality of the programme. The Programme Committee for both Bachelor Bio-Farmaceutische Wetenschappen and Master Bio-Pharmaceutical Sciences programmes, being composed of five lecturers and five students, advises programme management on quality issues. The Board of Examiners is responsible for ensuring the quality of examinations and assessments of both programmes. The Board of Admissions of the programme screens the applications of students.

The Master Bio-Pharmaceutical Sciences is a two-year, research-based, multi-disciplinary academic master programme in the field of bio-pharmaceutical sciences and drug discovery. The objectives of the programme are to educate students in research in drug discovery and drug development, the research area within this domain being quite extensive. Students are introduced to knowledge and skills of chemistry, life sciences, medical sciences and computational research. Students may select one of the seven specialisations offered, three of these being research specialisations and the other four being non-research specialisations. The research specialisations are related to the three Leiden Academic Centre for Drug Research Divisions, being BioTherapeutics (development of therapeutic approaches using biologicals), Drug & Target Discovery (targeting cancer) or Systems Pharmacology (personalised medicine). The non-research Education specialisation trains students to become fully-qualified teachers in chemistry in Dutch secondary education. In the Business Studies specialisation, students are educated to apply scientific knowledge and skills in commercial settings. The Science Communication and Society specialisation prepares students for careers in science communication and popularisation. In the Industrial Pharmacy specialisation, students are trained for careers in quality control and quality assurance in the biotechnological and pharmaceutical industry.

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 Leiden University programme may be regarded to be positioned in the pharmaceutical sciences sub-domain of chemical sciences.

Programme management conducted a benchmark survey, comparing this programme with programmes in the Netherlands and abroad. From this comparison, the programme emanates as sharing important commonalities with the other programmes, but distinguishing itself especially through the large research component with two research projects.

The programme aims to prepare students in the research specialisations both for PhD trajectories and for careers in industry. Students from the non-research specialisations are trained for positions as teachers in secondary education, managers in industry or science communication specialists or Qualified Persons in industry. The Leiden Academic Centre for Drug Research Advisory Board councils programme management on the alignment with professional field requirements.

The programme objectives have been translated into intended learning outcomes. These specify, among others, theoretical and practical skills in more than one specialist area of drug research, scientific research skills in the programme domain, abilities to integrate areas of drug research, communication skills to present and discuss research results, and understanding the social and ethical dimensions of drug research. For each of the non-research specialisations mentioned, additional intended learning outcomes have been formulated. In a formal sense, the specific education, business, science communication and industrial pharmacy parts of the non-research specialisations are offered under the responsibilities of other institutes, both within and outside of the Faculty of Science. The programme intended learning outcomes have been compared by programme management to the Dublin descriptors for master programmes.

Considerations
The panel considers the programme objectives to be sound. The panel regards the programme to have very broad objectives, ranging from synthetic, organic chemistry to drug intervention. The panel welcomes the options open to students to study different areas within drug research, also areas not specifically referring to innovative drug discovery. The panel welcomes the strong research orientation of the programme. Research is prominent in the programme, the programme being closely aligned with current scientific, international research in this field.

The objectives of the programme 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 profile of this Leiden University programme can be clearly distinguished within the framework.

The panel greets the comparison to other programmes in the Netherlands and abroad, demonstrating the profile and the specific features of the programme. The panel notes the programme to address bio-pharmaceutical sciences, differentiating the programme from other pharmaceutical sciences programmes in the Netherlands.

The panel welcomes students being trained for both academic careers and professional careers. The panel also appreciates students being given opportunities to prepare for positions as managers, fully-qualified teachers in chemistry in Dutch secondary education or science communication specialists. Students may also become Qualified Persons, having taken the Industrial Pharmacy specialisation.

The intended learning outcomes of the programme correspond to the programme objectives. The panel regards the intended learning outcomes to be well-articulated. The intended learning outcomes 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 satisfactory.

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 programme gradually increased over the years, going from 53 students in 2013 to 78 students in 2017. Programme management is content with the influx of 80 to 90 students. About 80 % to 90 % of the students have taken their bachelor programme at Leiden University, the vast majority originating from the Bachelor Bio-Farmaceutische Wetenschappen. The proportions of students coming from other Dutch universities or higher vocational education institutes are very limited. The proportion of international students decreased from about 15 % in previous years to 6 % in 2017. Programme management wants to raise the proportion of international students to about 25 %, in line with Faculty policy. To that effect, the International Summer School is organised, which allows foreign students to prepare for the programme. The vast majority of the incoming students opt for one of the research specialisations. About 20 % go to the Business Studies specialisation. Due to regulations, the number of Industrial Pharmacy students is limited to two students per year. Students holding the Bachelor Bio-Farmaceutische Wetenschappen from Leiden University are unconditionally admitted to the programme. Other applications are screened by the programme Board of Admissions. Students with academic or professional bachelor degrees in, among others, biology, biomedical sciences, chemistry or pharmaceutical sciences or students coming from abroad are admitted, if their programmes are equivalent to the Bachelor Bio-Farmaceutsche Wetenschappen programme.

The curriculum has a study load of 120 EC and takes two years to complete. Programme management presented a table, mapping the intended learning outcomes to the curriculum components. The first year of the curriculum of the research specialisations consists of courses on current research in the programme field, on specific topics and on scientific conduct (total 10 EC). In addition, students have to attend colloquia and seminars in this field, broadening their views on drug research. The major component in the first year is the Research Project 1 (at least 49 EC), requiring students to conduct independently scientific research at one of the Leiden Academic Centre for Drug Research Divisions. In the second year, students do a literature study (7 EC), conduct Research Project 2 (36 EC) and take optional courses or traineeships (15 EC). The non-research specialisations have differently organised curricula. Although the first year is identical, the second year consists of internships and courses, geared to these specialisations.

About 30 staff members are involved in the programme as lecturers. All of them are actively engaged in current, international research in their fields. Most of them work at the Divisions of Leiden Academic Centre for Drug Research. A number of lecturers come from other institutes of the Faculty of Science, such as Leiden Institute of Chemistry or Institute of Biology Leiden. Lecturers from institutions outside of the Faculty of Science are involved in the programme as well. The proportion of lecturers, with appointments of more than two year, being BKO-certified is about 84 %. Guest lecturers from industry highlight specific subjects. In addition to permanent staff, postdocs and PhD students act as daily supervisors in research projects. The core team of lecturers discusses the programme every three weeks. Twice per year all lecturers meet, discussing the programme and proposals for revisions, made by the core team. Although the workload may be challenging, lecturers manage. The last few years, the organisation of the programme improved. Students indicated to be content about the lecturers.

The educational concept of the programme is research-based learning and promotes students to actively engage in research-oriented learning processes. The number of hours of face-to-face education is substantial, as students take part in ongoing research in and outside of Leiden Academic Centre for Drug Research and are daily supervised during their research projects. In the courses, lectures, workgroups and self-study are adopted as study methods. Educational innovation is promoted among lecturers, especially by the educational developers of the programme core team. New facilities are available. Students draft their individual study plans with guidance by the study advisors. Students experience, however, some difficulty in selecting Research Project 1. The study advisors monitor the study progress and may be consulted by students when questions or problems arise. The study load is experienced by students to be adequate. The student success rates are on average 28 % after two years and on average 77 % after three years (figures for last three cohorts). The mean study duration is 2.4 years. The success rates after two years decreased the last few years. To counter this trend, the study advisors will monitor the time needed by students to complete the research projects.

Considerations
The panel notes the number of incoming students to be adequate. The entry requirements and admission procedures of the programme are appropriate.

The curriculum matches the intended learning outcomes of the programme. The curriculum contents are regarded by the panel to be solid and up to standard. The curriculum is coherent, the specialisations being well-organised and well-integrated. The panel greets the strong research orientation of the programme, including students being required to attend colloquia and seminars in this field. The academic skills are well-represented, as students write literature reviews and give oral presentations in the course of the research projects.

The lecturers in the programme are reputed researchers. The panel considers their educational capabilities up to standard, given the proportion of BKO-certified lecturers. The number of staff in the programme is sufficient. The panel welcomes the organisation of the programme with the core lecturing team and notes lecturers frequently discussing the programme.

The panel considers the educational concept and the study methods to be adequate, promoting research-oriented and student-activating learning. The number of hours of face-to-face education is adequate. The study guidance by the study advisors is welcomed by the panel. The panel advises to reinforce study guidance in selecting Research Project 1. The programme is feasible. The student success rates are adequate, but the panel supports study advisors' efforts to limit the time needed for the research projects.

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 examinations and assessments in the programme are governed by the Examination Rules and Regulations for the programme and correspond with the Faculty of Science rules and regulations. The Board of Examiners has the authority to ensure the quality of the examinations and assessments of the programme.

The examination methods in courses are written examinations, oral examinations, written assignments, presentations and participation in class discussions. In most courses and projects, multiple examinations are scheduled. For assessing written assignments, rubrics scoring forms have been adopted. In group projects, assessments take individual performances of students into account and allow for differentiated grading of group members.

Students should submit a letter of motivation to apply for the Research Project 1 internship. Research Project 1 is to be conducted inside of one of the Leiden Academic Centre for Drug Research Divisions. The projects are guided by supervisors of these Divisions. Day-to-day supervisors may be postdocs or PhD students, acting under the responsibility of supervisors. Students present their progress three times during the project. Upon completion of the project, students submit the written report and present their results in the final oral presentation. Reports are checked for plagiarism. Research projects are assessed separately by the supervisor and the second, independent examiner. Rubrics scoring forms are adopted for the assessment with criteria regarding practical work (research skills, knowledge, scientific quality, independence), written report (problem definition, results, discussion) and oral presentation (contents, academic level, structure). Should the examiners' assessments differ more than 0.5 point, a third examiner is called in. Research Project 2 is generally conducted outside of Leiden Academic Centre for Drug Research. The programme supervisor is responsible for the academic quality of these projects. The external supervisor and programme supervisor discuss the assessment, the programme supervisor being responsible for the final assessment. Scoring forms are used for these assessments as well.

In the programme, measures have been taken to ensure the validity, reliability and transparency of examinations and assessments. All examination drafts are peer-reviewed by fellow examiners. Examiners make use of test matrices for the examinations and include answer models. The Board of Examiners reviews samples of course examinations and samples of Research Projects 1 and 2. All of these assignments are checked for fraud and plagiarism. Cases are dealt with by the Board of Examiners.

Considerations
The examination and assessment rules and regulations for the programme are considered by the panel to be appropriate.

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 panel welcomes the procedures for the assessments of group projects to counter free-riding. The panel is positive about the usage of rubrics scoring forms for assignments.

The supervision and assessment procedures for both Research Projects 1 and 2 are very much up to standard. Students are offered appropriate supervision. The assessment procedures are very effective, involving two examiners, who assess the work separately and use elaborate rubrics scoring forms.

The panel considers the measures to ensure the validity, reliability and transparency of examinations and assessments to be adequate. The procedures have been implemented, examiners comply and the Board of Examiners is pro-active in monitoring these.

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 a number of course examinations.

The panel reviewed the Research Projects 1 of fifteen graduates of the programme with different grades. In these projects, students are expected to demonstrate knowing how to execute a substantial research project self-reliant, studying and digesting specialist literature, formulating problem statements, doing practical work, analysing data, and reporting in writing and orally on the results.

A number of programme graduates co-authored scientific publications.

Programme graduates find suitable positions quite easily. About 77 % of the graduates found fitting jobs within three months after graduation. About 50 % of programme graduates proceed to PhD trajectories. About 30 % of the graduates start careers in industry. Students also continue their careers as teachers or communication specialists or Qualified Persons. The programme alumni consider the programme to be a good preparation for their careers (8.3 on 10-point scale). Professional field representatives welcome the self-reliance and practical skills of the graduates.

Considerations
The examinations of the courses studied by the panel are very adequate and up to standard.

The panel considers the research projects to be definitely at master level. The panel endorses the grades awarded to the research projects by the programme examiners.

The panel is convinced that students having completed the programme reached the intended learning outcomes. The panel very much appreciates the high proportion of graduates proceeding to PhD trajectories. The panel considers the career perspectives of the graduates to be very favourable. Graduates obtain positions in the broad range of small- and middle-sized drug development companies. Only few graduates find their way into innovative drug research.

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

5. Overview of assessments

Standard	Assessment
Standard 1. Intended learning outcomes	Satisfactory
Standard 2: Teaching-learning environment	Satisfactory
Standard 3: Student assessment	Satisfactory
Standard 4: Achieved learning outcomes	Good
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.

- To reinforce study guidance in the process of selecting Research Project 1.