

Assessment report
Limited Framework Programme Assessment

Bachelor Chemistry

Radboud University

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1. Executive summary

In this executive summary, the panel presents the main considerations which led to the assessment of the quality of the Bachelor Chemistry programme of Radboud University, 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 programme objectives are sound. The programme has the classical, broad chemistry profile and all parts of chemistry are addressed. The panel welcomes the strong research-orientation of the programme and regards the programme objectives to be 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.

Although the comparison to other programmes in the Netherlands is appreciated, the panel suggests to be more outward looking and to clarify the position of the programme in the Netherlands and international field of chemistry.

The panel finds students to be well prepared to enrol in master programmes in this domain.

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

The student inflow numbers of the programme are appropriate. The panel advises to monitor the student influx in view of material facilities and laboratory constraints. The entry requirements and admission procedures are adequate.

The panel is positive about the contents of the curriculum. The curriculum meets the intended learning outcomes of the programme. The courses are up to standard. The number of practical courses is adequate. The panel is positive about scheduling theoretical and practical knowledge and skills closely related. The training in academic skills is appropriate. The panel is also positive about the breadth of the curriculum and considers the curriculum to be coherent.

The lecturers in the programme are good researchers and are very skilled in the contents of the courses. The lecturers are also very motivated. Their educational capabilities are up to standard, as may deduced from the proportion of BKO-certified lecturers. As the workload is experienced by lecturers to be very demanding, the panel advises to monitor the work load and to arrange productive discussions between programme management and lecturers to design and implement efficient procedures.

The educational concept and the study methods are 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 are very appropriate. The class sizes are adequate. The study guidance is organised well. The panel advises to monitor the actual study load of courses and to consider rearranging the second year of the curriculum in terms of study load. The number of drop-outs in the first year is substantial. Although the student success rates improved over the last years, they are still rather disappointing. The panel recommends to analyse the causes.

The panel approves of the examinations and assessment rules and regulations of the programme, these being in line with Faculty of Science policies. Although the Examination Board, among others, reviews course dossiers on a regular basis, the panel advises for the Board to monitor examination and assessment processes more consistently.

The examination methods adopted by the programme are consistent with the goals and contents of the courses. The measures to counter free-riding are effective. The panel suggests to consider if the portfolio is the most suitable method for assessing academic skills.

The supervision processes for the Bachelor projects are appropriate. The assessment procedures are satisfactory, involving two examiners and assessment scoring forms being adopted. The panel advises to require examiners to substantiate their grades on the Bachelor project assessment scoring forms.

The panel considers the measures ensuring the validity, reliability and transparency of examinations and assessments to be satisfactory. The course dossiers are comprehensive and are to include examination matrices and answer models. As not all examiners do so, the panel advises to require examiners to present examination matrices and answer models. In addition, the panel recommends to analyse examination results more systematically.

The course examinations are up to standard. The Bachelor theses match the intended learning outcomes and are appropriate projects. No theses were found by the panel to be unsatisfactory. The panel supports the grades given by examiners of the programme.

The panel regards the programme graduates to have reached the intended learning outcomes and to be qualified to enrol in master programmes in this domain.

The panel that conducted the assessment of the Bachelor Chemistry programme of Radboud 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 advises NVAO to accredit the programme.

Rotterdam, 13 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 Radboud University to manage the limited framework programme assessment process for the Bachelor Chemistry 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 Radboud University 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. M.K. Van Bael, professor Inorganic and Physical Chemistry, head of Inorganic and Physical Chemistry Research Group, University of Hasselt (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);
- Dr. P. Berben, senior research manager BASF, member leadership team BASF De Meern (panel member);
- A.E.M. Melcherts BSc, student Master in Nanomaterials Science, Utrecht University (student member).

On behalf of Certiked, drs. W. Vercooteren 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 2 and 3 October 2018, the panel conducted the site visit on the Radboud 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, 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 Radboud University, to accompany their request for re-accreditation of this programme.

3. Programme administrative information

Name programme in CROHO: B Chemistry
Orientation, level programme: Academic Bachelor
Grade: BSc
Number of credits: 180 EC
Specialisations: n.a.
Location: Nijmegen
Mode of study: Full-time (language of instruction English)
Registration in CROHO: 56943

Name of institution: Radboud University
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 Bachelor Chemistry programme is offered by the Educational Institute for Molecular Sciences, one of the four educational institutes of the Faculty of Science of Radboud University. The dean of the Faculty has the responsibility for all programmes of the Faculty. The Institute is also the home of the programmes Bachelor Molecular Life Sciences, Bachelor Science, Master Chemistry, Master Molecular Life Sciences and Master Science. The director of the programme is responsible for the delivery and quality of this and the other five programmes. The programme director is assisted by the study coordinator for all programmes and the programme coordinators for each of these programmes. The Programme Committee, being composed of lecturers and students, advises programme management on quality issues with regard to this programme. The Examination Board of the Educational Institute for Molecular Sciences has the authority to ensure the quality of examinations and assessments of all six programmes.

The Bachelor Chemistry programme is a three-year, research-based, academic bachelor programme in the field of chemistry. The programme is rooted in research done at the Institute for Molecules and Materials of the Faculty of Science, but is also nurtured by research done at other research institutes of this Faculty. The objectives of the programme are to educate students broadly in chemistry, covering all subjects in chemistry and highlighting the subjects of structure and reactivity (molecular chemistry), functionality (biochemistry, condensed matter chemistry) and methods (spectroscopy, chemometrics, bioinformatics). Students are educated to acquire both theoretical and practical knowledge about these subjects and are trained in academic skills in this domain.

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 Radboud University programme may be regarded as positioned in the chemistry sub-domain of chemical sciences.

Programme management compared this programme to other programmes in the Netherlands. This analysis shows that there are no major differences with other Chemistry programmes, as the goals of all these programmes are to educate students broadly in chemistry.

The programme primarily aims at preparing students for master programmes in this field. Students may enter the labour market, but not for positions in academia or in industry. These positions require master degrees. Students taking the minor in education (30 EC) may obtain the second-degree teaching qualification in Dutch secondary education for chemistry.

The programme objectives have been translated into intended learning outcomes, specifying, among others, knowledge and understanding of basic concepts and principles of chemistry and of relevant sub-disciplines in this domain, analytical and research skills, knowing how to apply knowledge in solving problems in this field, knowledge of safety, environmental, ethical, societal and economic dimensions, communication and collaboration skills, and competencies for continuing professional development.

Programme management presented the comparison of the intended learning outcomes to the Dublin descriptors for the bachelor level.

Considerations

The panel considers the programme objectives to be sound. The programme has the classical, broad chemistry profile and all parts of chemistry are addressed. The panel welcomes the strong research-orientation of the programme and regards the programme objectives to be 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.

Although the comparison to other programmes in the Netherlands is appreciated, the panel suggests to be more outward looking and to clarify the position of the programme in the Netherlands and international field of chemistry.

The panel finds students to be well prepared to enrol in master programmes in this domain.

The intended learning outcomes of the programme correspond to the programme objectives, are well-articulated and are conform to the bachelor 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 last few years increased from slightly less than 40 students in 2012 to over 60 students in 2017. The entry requirements are the pre-university (vwo) diploma, including Chemistry, Physics and Mathematics B certificates. The vast majority of the students have the vwo-diploma. Students having completed the first year of their higher vocational education programme are admitted, provided they have taken the abovementioned courses. About 30 % of the incoming students are from abroad. Their applications are screened by the Faculty recruitment and admission officer with respect to their prior education and the proficiency in English. The Examination Board approves admission. To facilitate the transition from pre-university education, secondary school chemistry teachers guide students in the first year during tutor hours.

The curriculum of the programme takes three years, the total study load being 180 EC. Programme management presented a table, showing the mapping of the intended learning outcomes and the courses. The first year of the curriculum is common to the Bachelor Chemistry, Molecular Life Sciences and Science programmes, offering students the foundations of structure, function and analysis in chemistry. The second year of the curriculum continues to educate students in these themes and subjects, on a more advanced level. The courses in the first and second year address both theoretical and practical knowledge and skills, which are interrelated. In these years, students take also auxiliary courses in mathematics, physics and programming. The first semester of the third year allows students to select electives or minor programmes (30 EC). They may take the opportunity to go abroad. The programme has set up exchange programmes with foreign universities. Parallel to the courses in all of the years, students take the academic skills course, which includes research skills, problem-solving skills, critical reflection and ethical awareness. This course is intertwined with the regular courses. Parts of this course are seminars on career options. In addition, students take a course on ethics and philosophy of science. At the end of the curriculum, students complete the Bachelor thesis (12 EC). New trends, such as big data, digitalisation and electro-chemistry are addressed in courses. Talented students may take the Faculty of Science honours programme, allowing them to take additional tailor-made, in-depth courses (30 EC) in the second and third year. These students may also take part in the inter-disciplinary University honours programme. Programme management has the intention to reorganise the curriculum from 2019/2020 onwards, especially to improve the feasibility and to accommodate the increased number of students.

A total number of 78 lecturers are involved in the programme. The lecturers are researchers at the Institute for Molecules and Materials, but also at other research institutes of the Faculty of Science. The research institutes received high to very high scores in the most recent research evaluations. Practically all staff members have PhD degrees. Of the total number of permanent staff about 85 % have obtained the BKO-certificate. PhD students, postdocs, technicians, student assistants and pre-university teachers are also involved in the programme. In addition, guest lectures from industry give lectures. Lecturers meet in

teacher meetings, but attendance may be disappointing. Lecturers experience their work load to be quite demanding. New staff is to be recruited.

The educational concept is research-based education. Education is very intensive. The number of hours of face-to-face education per week is about 32 hours per week in the first year and 27 hours per week in the second year. In the third year, this number is difficult to determine, because of the diversity of learning paths among students. The study methods adopted in the programme are quite diverse, including lectures, tutorials, practical courses, computer-aided education, response hours and working in groups. In most courses, students sit with students from other programmes. Programme policy is to promote multi-disciplinary exchange among students. Educational innovation in the programme is pursued, in which lecturers are guided by experts. Web-lectures are used in most courses. The students-to-staff ratio is 20/1 for the Faculty of Science as a whole. The number of students in the tutorials is about 20 students per teaching assistant. In the practical courses, these group sizes are about 10 students. Students are guided by student mentors in the first part of the programme. At the end of each year and as part of the academic skills course, students discuss their plans for the next year with the docent-mentor. Foreign students are guided by senior students in the first year. Students may also turn to the study advisor for assistance. As the first year is common to all three Bachelor programmes of the Educational Institute of Molecular Sciences, students have the chance to change programmes. Courses may carry more study load than the indicated nominal study load. The second year is experienced by students as very demanding. In the first year and in line with the Binding Study Advice, students must obtain 39 EC. About 20 % to 30 % of the students drop out, mainly in the first year. The student success rates for the last years are about 42 % after three years and about 52 % after four years (proportion students re-entering in second year).

Considerations

The student inflow numbers of the programme are appropriate. The panel advises to monitor the student influx in view of material facilities and laboratory constraints. The entry requirements and admission procedures are adequate.

The panel is positive about the contents of the curriculum. The curriculum meets the intended learning outcomes of the programme. The courses are up to standard. The number of practical courses is adequate. The panel is positive about scheduling theoretical and practical knowledge and skills being closely related. The training in academic skills is appropriate. The panel is also positive about the breadth of the curriculum and considers the curriculum to be coherent.

The panel regards the lecturers in the programme to be good researchers and very skilled in the contents of the courses. The lecturers are also very motivated. 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 experienced by lecturers to be very demanding, the panel advises to monitor the work load and to arrange productive discussions between programme management and lecturers to design and implement efficient procedures.

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 is very appropriate. The class sizes are adequate. The study guidance is organised well. The panel advises to monitor the actual study load of courses and to consider rearranging the second year of the curriculum in terms of study load. The number of drop-outs in the first year is substantial. Although the student success rates have improved over the last years, they are still rather disappointing. The panel recommends to analyse the causes.

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.
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Findings

The programme examination and assessment rules and regulations are in line with Faculty of Science policies. As has been indicated, the Examination Board for this programme and the other programmes of the Educational Institute for Molecular Sciences has the authority to monitor the quality of examination and assessment processes and products.

The examination methods for the courses are selected in line with the courses' contents. The examination methods in the programme include written examinations, practical work, oral examinations, written assignments and reports and presentations. Academic skills are assessed by means of students' portfolios. In some courses, formative examinations are scheduled to promote students' study progress. Free-riding in case of group work is countered by peer review among students, close surveillance by supervisors and accompanying individual examinations.

The Bachelor projects or Bachelor internships are individual research projects, conducted under supervision. Students are expected to master relevant scientific literature, formulate research questions, do experiments or do theoretical investigations and report on the findings. Draft theses may be commented on. Students have to present their findings not only in writing but also in a presentation. Bachelor projects are assessed by the project supervisor and the second reader, using assessment scoring forms with evaluation criteria. The assessment scoring forms have been standardised across research groups. 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. For each of the courses, comprehensive course dossiers are available. These dossiers have to include examination matrices and answer models. Draft examinations are peer-reviewed. Papers are checked for plagiarism. Analyses of examinations are not systematically performed. Students are presented with trial examinations and are allowed to inspect their work. The Examination Board checks course dossiers on a regular basis.

Considerations

The panel approves of the examinations and assessment rules and regulations of the programme, these being in line with Faculty of Science policies. Although the Examination Board, among others, reviews course dossiers on a regular basis, the panel advises for the Board to monitor examination and assessment processes more consistently.

The examination methods adopted by the programme are consistent with the goals and contents of the courses. The measures to counter free-riding are effective. The panel suggests to consider if the portfolio is the most suitable method for assessing academic skills.

The supervision processes for the Bachelor projects are appropriate. The assessment procedures are satisfactory, involving two examiners and assessment scoring forms being adopted. The panel advises to require examiners to substantiate their grades on the Bachelor project assessment scoring forms.

The panel considers the measures ensuring the validity, reliability and transparency of examinations and assessments to be satisfactory. As not all examiners include examination matrices and answer models in the course dossiers, the panel advises to require examiners to do so. In addition, the panel recommends to analyse examination results more systematically.

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.
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Findings

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

The panel reviewed 15 Bachelor theses of programme graduates of the last two years. The average grade for the Bachelor projects was about 7.9 in the last five years.

As a rule, programme graduates do not enter the labour market. They proceed to master programmes in this domain. These master programmes include the Master Chemistry, Chemical Sciences or Chemical Engineering programmes of all Universities in the Netherlands. Students may also enter the Master Molecular Life Sciences or Science programmes of Radboud University, provided they have remedied deficiencies. About 15 % to 20 % of the programme graduates go to master programmes outside of Radboud University.

Considerations

The panel considers the course examinations to be up to standard.

The Bachelor theses studied by the panel, match the intended learning outcomes and deal with appropriate chemistry projects. The panel found none of these theses unsatisfactory. The panel supports the grades given by examiners of the programme.

The panel regards the programme graduates to have reached the intended learning outcomes and to be qualified to enrol in master programmes in this domain.

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	Satisfactory
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.

- To be more outward looking and to clarify the position of the programme in the Netherlands and international field of chemistry.
- To monitor the student influx in view of material facilities and laboratory constraints.
- To monitor the work load and to arrange productive discussions between programme management and lecturers to design and implement efficient procedures.
- To monitor the study load of courses.
- To consider rearranging the second year of the curriculum in terms of study load.
- To analyse the causes of the rather low student success rates of the programme.
- For the Examination Board to monitor examination and assessment processes more consistently.
- To consider if the portfolio is the most suitable method for assessing academic skills.
- To require examiners to substantiate their grades on the Bachelor project assessment scoring forms.
- To require all examiners to present examination matrices and answer models and to analyse examination results more systematically.