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Bachelor Biomedical Engineering University of Groningen

Advisory report of the assessment of the existing programme
31 October and 1 November 2024

Colophon

Institution and programme

University of Groningen
Groningen
Institutional audit: yes

Programme: Biomedical Engineering
Site: Groningen
Mode: fulltime
ISAT-number: 56226

Assessment panel

Jos Vander Sloten, chair
Patricia Dankers, expert
Peter Ketelaar, expert
Astrid Hornman, student-member
Linda van der Grijsparde, secretary

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Summary

On 31 October and 1 November 2024, the bachelor's programme Biomedical Engineering of the University of Groningen was assessed. The panel's overall judgement is **positive**.

Intended learning outcomes

The mission of the bachelor's programme is to provide a solid engineering foundation with applications in the broad field of biomedical technology and to prepare students for a career or (usually) a master's degree programme in Biomedical Engineering or Engineering. The specialisations of the programme correspond to the specialisations of the master's programme in Biomedical Engineering of the University of Groningen, namely Biomaterials Science and Engineering, Medical Device Design and Medical Imaging. The profile of the programme is translated into eleven intended learning outcomes. According to the panel, these fit the level and orientation of the programme and are aligned with the expectations of the connecting master's programmes and the (international) professional field. The panel thus concludes that the programme meets this standard.

Teaching-learning environment

The programme starts every year in September. The curriculum consists of 180 EC, of which 130 EC are compulsory courses, supplemented with 20 EC elective courses, a 15 EC free minor, and a Bachelor's project of 15 EC. During the minor, students are free to choose their courses, but the programme offers three deepening minor packages: Biomaterials Science and Engineering, Medical Device Design and Medical Imaging. The contents of the programme enable students to achieve the intended learning outcomes. The panel notes the bachelor's programme has clearly translated the intended

learning outcomes into the educational programme and has actively monitored whether the content and format of the programme was appropriate and aligned with connecting master's programs. Adjustments have been made, for example in terms of the amount of maths in the programme. Engineering and biomedical topics are mixed during the programme; the programme strikes a good balance between academic training and providing an environment that prepares students for real-world challenges through practical applications, collaborative projects and exposure to industry leaders. The programme deploys lecturers from the Faculty of Science and Engineering and the UMCG. The panel values the professional, scientific, and didactic qualities of the staff and the attention paid to their professionalisation. The panel thus concludes that the programme meets this standard.

Student assessment

The programme has an adequate, solid assessment system and assessment procedures. The system is adequately based on the university wide policy. Multiple adequate assessment types are implemented in the programmes: from written exams to (individual and group) project assignments. The panel believes that the variety of assessment formats allows students to develop the necessary knowledge and skills. Quality assurance of assessment is ensured by the Board of Examiners. The board shows a sufficient knowledge of the individual bachelor's programme and its assessment. The panel thus

concludes that the programme meets this standard.

Achieved learning outcomes

The final bachelor project assesses if the intended learning outcomes are achieved. Students apply and integrate the knowledge during their bachelor project by doing research in one of the research groups at the Faculty of Science and Engineering or at the UMCG. Two cohorts of students have now graduated. In general, they continue their studies in a connecting master's programme. Most students choose the master's programme Biomedical Engineering at the University of Groningen, which is the best fit with the bachelor's programme. Based on examining 15 final projects and the corresponding assessments, the panel finds that the students show in their products that they have achieved the bachelor's level in the field of biomedical engineering. The programme keeps track of the programme's alignment with connecting master's programmes and adjusts programme content appropriately where necessary. The panel

All standards of the NVAO framework have been positively assessed. On this basis, the panel provides a [positive recommendation](#) regarding the accreditation of the bachelor's programme Biomedical Engineering of the University of Groningen.

On behalf of the entire site visit panel,
Utrecht, February 2025

Jos Vander Sloten
Chair

thus concludes that the programme meets this standard.

Recommendations

Looking ahead, the panel makes the following recommendations:

- Sharpen and firmly establish the desired and achievable profile. Ensure a tightening of the intended learning outcomes in line with the tightened profile. In the evaluation, determine whether Medical Imaging can and should be an equivalent component alongside the other two specialisations given the desired and possible focus in the bachelor's programme.
- Provide adequate facilities both at the UMCG and in the faculty of Science and Engineering for students' practical activities and assessments.
- Continue to determine accurately whether the connection to the connecting master's programmes is good and take action if adjustment is needed.

Linda van der Grijspaarde
Secretary

Introduction

Profile

The University of Groningen aims to connect education and research with sustainable and economic processes within society. This comes together in its three spearheads: Energy, Healthy Ageing and Sustainable Society. The university has 34,000 students and 7,150 FTE staff, including University Medical Center Groningen (UMCG).

At the University of Groningen research and education are organised within eleven faculties. The bachelor's programme Biomedical Engineering is offered by the Faculty of Science and Engineering in co-operation with the Faculty of Medical Sciences and the UMCG.

The programme started in 2020 with the first cohort of 109 students, followed in 2021 by the second cohort of 128 students. This was about the maximum that the programme could manage, especially in practicals, and therefore for 2022 a Numerus Fixus with a quota of 125 students was approved. After the Numerus Fixus was installed, the programme attracted a steady number of students with a balance in gender. The last cohort under the Numerus Fixus will start in 2024-2025.

The programme is offered in English and has an English title, like all engineering degree programmes of the faculty. The programme justifies this choice as follows. The programme intends to prepare students for a career in research or design at academia or in a company operating in an international context. By nature, research and high-tech business environments are highly international. Also, domestic, or even local companies and even start-ups often operate in a global world via supply chains, business-and-customer-relationships and recruited staff.

For all new scientific staff, proficiency in English is one of the selection criteria. For personnel that might feel uncomfortable using the English language, the University of Groningen Language Centre offers a wide range of English courses and coaching on the job. These can be followed on their own initiative or on the initiative of the (programme) director. The panel considers this a sufficient explanation for offering the programme in English and have an English title.

The assessment

University of Groningen has commissioned AeQui to conduct the current assessment. For this purpose, AeQui, in collaboration with the programme, has assembled an independent and knowledgeable panel. A preparatory meeting with representatives of the programme has taken place.

The assessment was conducted based on the Accreditation Framework for Higher Education in the Netherlands, according to the programme outlined in Appendix 2. The institution has a positive institutional audit decision, and therefore four standards were assessed.

Recommendations for further development were made during the previous assessment. The programme has taken action in response (see Appendix 3). The panel has integrated this follow-up into its considerations for the current assessment.

The panel conducted the assessment independently; the panel received the necessary information to arrive at a judgement. At the end of the assessment, the programme was informed of the findings and conclusions.

This report was sent in draft to the programme; the programme's responses have been incorporated into this final report.

At the initiative of the programme, a development meeting took place during the visit. The results of this development meeting will not affect the assessment presented in this report.

Intended learning outcomes

Standard 1: 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 programme follows the Whitaker Foundation (2006) in adopting the following definition: Biomedical engineering is a discipline that advances knowledge in engineering, biology, and medicine, and improves human health through cross-disciplinary activities that integrate the engineering sciences with the biomedical sciences and clinical practice. It includes:

- 1) The acquisition of new knowledge and understanding of living systems through the innovative and substantive application of experimental and analytical techniques based on the engineering sciences.
- 2) The development of new devices, algorithms, processes, and systems that advance biology, medicine, and improve medical practice and health care delivery.

Students are therefore educated in the multidisciplinary domains of engineering, biology and medicine and are skilled in the abilities described in points 1 and 2 of The Whitaker Foundation.

The mission of the programme is to provide a solid engineering foundation with applications in the broad field of biomedical technology and to prepare students for a career and/or master's degree programme in Biomedical Engineering or Engineering. It is envisaged that most students will opt for a subsequent master's degree in biomedical engineering. Graduates will be engineers who, in interaction with medical specialists, will contribute to improving medical care.

The bachelor's programme is linked to the master's programme in Biomedical Engineering of the University of Groningen. In particular, the specialisations of the bachelor's programme correspond to the master's programme specialisations, namely Biomaterials Science and Engineering, Medical Device Design and Medical Imaging.

The profile of the programme is translated into eleven intended learning outcomes, categorised in knowledge, application of knowledge, decision-making and communication.

Link with the professional field

Each year the Biomedical Engineering Advisory Board meets to discuss the developments in the Biomedical Engineering field, and how this could be implemented in the future curricula. The advisory Board includes representatives from industry and hospitals, lecturers, students, and the three specialisation coordinators.

Considerations

According to the panel, the programme aims for a strong, broad knowledge base that introduces students to the different components of the interdisciplinary biomedical engineering domain. The panel assesses that the intended learning outcomes of the programme fit the level and orientation of the programme and are aligned with the expectations of the connecting master's programmes and the (international) professional field.

The panel notes that the programme has adequately tightened the intended learning outcomes based on the previous panel's observation in 2018 that the bachelor's and master's intended learning outcomes were insufficiently distinctive regarding level. According to the panel, now there is sufficient differentiation between the intended learning outcomes of the bachelor's programme and those of the connecting master's programme. The latter are clearly formulated at a higher level. This is especially clear from the intended learning outcomes that specify the academic and research skills that students need to obtain.

The panel studied the programme's own signature and discussed it in the various interviews with staff members and students. The panel noted a limited ability of staff members and students to give a clear profile and a clear distinction from the other bachelor's programmes Biomedical Engineering. Reference is frequently made to the programme's history as having grown from a major in Biomedical Engineering and its relationship with the University of Groningen's master's programme in Biomedical Engineering. The intention was for the programme to become a heavier engineering programme, but at start-up it was not yet possible to fully shape the engineering part. The panel notes that - understandably - circumstances and opportunities for the programme have partly determined the focus in the programme, but recommends that the programme now, after the first development years, redefine its desired and achievable profile and firmly establish it. In doing so, a clear demarcation from other bachelor's programmes in Biomedical Engineering in the Netherlands is essential. For example, the stronger focus on (and cooperation with) the medical faculty and the academic hospital UMCG could be more strongly reflected in the

programme's profile and place in the Dutch field, the panel believes.

The panel thinks it would help to also make the intended learning outcomes more specific and more in line with the profile of the programme and the three specialisations Biomaterials Science and Engineering, Medical Device Design and Medical Imaging. The panel notes that the intended learning outcomes are now worded generally. The panel understands that this offers advantages, for example to easily adapt the programme to current requirements. However, the panel expects that more specific intended learning outcomes could play a more guiding role in shaping a programme with a specific own colour. The previous panel in 2018 noted as well that the intended integration of research and design could be reflected more clearly in the programme's aims and learning outcomes to avoid a dichotomy between research and design within the programme. The current panel sees that adjustments have been made, but considering the tightening, the panel recommends that the integration of engineering and design should be even more clearly highlighted.

The panel appreciates the programme's contacts with the professional field. The panel notes that the programme's relations with the professional field enable it to monitor current developments and incorporate them into the programme's profile and programme.

The programme is the only English-language bachelor's programme in Biomedical Engineering in the Netherlands. The programme justifies this choice as follows. The programme aims to prepare students for a career in research or design in academia or in an international company. The panel agrees with this focus and again believes that the programme can more strongly articulate and defend this distinction from the

other Biomedical Engineering bachelor's programmes in its profiling and related intended learning outcomes.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Teaching-learning environment

Standard 2: The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

Curriculum

The programme starts every year in September. The curriculum consists of 180 EC, of which 130 EC are compulsory courses, supplemented with 20 EC elective courses, a 15 EC free minor, and a Bachelor's project of 15 EC. During the minor, students are free to choose their courses, but the programme offers three deepening minor packages: Biomaterials Science and Engineering, Medical Device Design and Medical Imaging.

The first years lay the fundamental technical foundation on which further integrated knowledge can be built. Year 1 and most of year 2 offer students fundamental knowledge courses in mathematics, natural sciences, and life sciences. In addition, students are trained in design thinking and introduced basic knowledge integration. At the end of year 2, students get a first taste of the three specialisations. In year 3, students can zoom deeper into one of the specialisations. They conclude the third year with the bachelor's project. Alternatively, students can use the third year to explore all three specialisations for a broader overview and/or as preparation for choosing their master's programme.

In accordance with university policy, the first term in year 3 may be replaced by a widening minor, either within the Faculty of Science or a university-wide minor programme. Participation in advanced courses and the concluding Bachelor's project will not be jeopardised by this.

The students the panel spoke to are positive about the programme. In the student chapter of the self-evaluation report, students wrote that the programme has a good structure and that the choice of the three specialisations is appreciated. Students also indicate that they would like to have more options outside the programme, as for example there is no engineering minor available.

Students feel that the Research Course provides an excellent introduction to how research is conducted, which serves as a fundamental skill prior to starting the undergraduate project. Also, students are positive about the interdisciplinary project course. This gives students practical experience working together to produce projects under the supervision of research groups or industry specialists.

Students state that the coherent design of courses throughout blocks guarantees a smooth transition between topics, enabling students to combine what they learn in one session with the fundamental ideas established in prior classes. An example of this is the integration project, as it is a project where students combine knowledge from three subjects.

Teaching methods

The study consists of lectures, tutorials (making assignments under the guidance of a lecturer), assignments (homework, literature study), practicals (practical assignments in a lab room) and self-study. There are medical facilities in the UMCG and engineering facilities to conduct practical work and gain experience with biomedical engineering products.

Students conduct the projects in groups. Students speak positively about the composition of the groups in the student chapter: 'Regarding multicultural integration, professors make every effort to put together diverse, balanced teams. This methodology ensures truly interdisciplinary teamwork, which increases the emphasis on various aspects of project progress.'

Admission requirements

Students are admitted if they have completed the subjects mathematics B, physics, and chemistry at a Dutch preparatory school (VWO). Biology is not compulsory but is strongly recommended. Students who have not completed VWO need a language proficiency certificate in English.

Students who cannot fulfil the VWO requirement due to a deficient profile or who wish to be admitted based on a successfully completed first year of HBO or colloquium doctum, should submit a supplementary admission request through the Admission Board Bachelor's programmes.

Staff

The programmes present a list of teaching staff from the Faculty of Science and Engineering (60%) and UMCG (40%). The student-to-staff ratio of the bachelor is 39.9. To ensure continued quality, newly appointed staff members are required to obtain basic teaching qualifications, namely in the form of the UTQ (University Teaching Qualification). During the UTQ programme fresh staff members train their skills regarding actual teaching; the (re)design of courses as well as testing and evaluation. Of the Biomedical Engineering course examiners, 94% possess the UTQ, or are in the process of getting it.

The Biomedical Engineering teaching staff is supported by teaching assistants during tutorials and practical sessions, under strict supervision of teaching staff. PhD students or students who meet the requirements set by the course coordinator can be assigned as teaching assistants for specific courses.

For the recent hires at Faculty of Science and Engineering in the field of Biomedical Engineering, the programme directors defined profiles to strengthen the areas of bioprinting and medical robotics. From the interviews, the panel concludes that, as a result of faculty cuts, there currently is no possibility of hiring fresh staff members. Current staff members will fill the open positions.

Considerations

The panel has established that the contents of the programme enable students to achieve the intended learning outcomes. The bachelor's programme has clearly translated the intended learning outcomes into the educational programme. Engineering and biomedical topics are mixed during the programme; the panel notes that the programme strikes a good balance between academic training and providing an environment that prepares students for real-world challenges through practical applications, collaborative projects and exposure to industry leaders.

In the eyes of the panel, the admission requirements of the bachelor's programme adequately match the contents and level of the programme. Biology is not a statutory entry requirement. The panel discussed with the management that it may seem peculiar that biology is not compulsory because the programme contains a lot of biology. However, experience shows that a backlog in biology is easier to make up than a backlog in mathematics, physics, or chemistry.

The panel notes that, according to the students, the programme has a good structure and integrates the various components well. However, according to the panel, the programme could do a bit more to highlight the rationale behind the structure in the curriculum. The learning lines can be made more explicit in this regard.

The panel appreciates the attention paid to the integration of monodisciplinary subjects, by offering integrated projects as a combination of three subjects in one period. In this regard, the panel believes that this integration could be given a more explicit place in the curriculum, where learning objectives are linked to the integration and this integration is part of the assessment in the earlier years. From the interviews, the panel concludes that the integration of different subject areas is still a challenge for the teachers themselves. Now, the curriculum is a mix of biomedical and engineering rather than an integrated organic unity. According to the panel, there is enough attention to strengthen this, so the panel is confident that the programme will see further integration in the coming years.

It became clear to the panel that since its start six years ago, the programme has actively monitored whether the content and format of the programme was appropriate and aligned with connecting master's programs. For example, the programme has increased the amount of mathematics in the programme when it became apparent that alumni lacked this for an adequate connection to their master programme. Because the panel sees that the amount of mathematics still seems more limited than in comparable bachelor's programmes, and partly of a different nature, the panel recommends that in the coming years the connection to the master's programmes, especially those of other Dutch and

international universities, be monitored and the programme be adjusted when necessary.

The programme states in the documentation and in the interviews that the specialisation Medical Imaging is quite vulnerable as this expertise is available only via a clinical department of the UMCG, with limited staff available for education. In addition, the panel notes that the programme pays limited attention to Clinical Imaging in the first years; the other specialisations are already covered. As mentioned earlier, the panel recommends reviewing the desired focus in the programme and determining whether Medical Imaging can and should be an equal component alongside the other two specialisations.

The panel notes that the UMCG provides a resource that is available to the students as it takes real clinical problems and offers them as projects to the students. This experience gives students a concrete link between their education and future opportunities by helping them to imagine career trajectories in both research and industry. Furthermore, lectures by guests from the UMCG and industry enhance the learning process even more. Physicians and Industry experts exchange perspectives, connecting theoretical understanding with real-world applications. The panel appreciates the contacts with the UMCG and believes that the programme could further expand the benefit of the connection with the UMCG, for example, by initiating more projects for both medical students and students in its own programme.

The teaching methods are in line with the learning outcomes and course contents. The panel believes that the programme chooses appropriate didactic teaching methods, where students of different nationalities interact and learn from each other. The panel notes, partly based on

meeting with students, that students receive appropriate guidance and support, including specific attention to students with functional disabilities.

The panel ascertained the programme-specific facilities to be adequate, but still on the limited side. Students can use facilities in the UMCG and engineering facilities have been added at a new location, but these cannot yet be used optimally due to technical problems. Although the students do not mention any problems regarding the facilities, the management itself also indicates that especially the engineering facilities are not up to par. The panel recommends closely monitoring whether achieving the intended learning outcomes is jeopardised by the limited facilities and looking outside the university for opportunities at companies for students to gain experience with various practical facilities.

The panel values the professional, scientific, and didactic qualities of the staff and the attention paid to their professionalisation. The panel notes that the staff have adequate proficiency in English. The human resources policy makes sufficient accommodation for teachers to teach in that language. The panel also concludes that the quantity of the staff is sufficient. It considered the student-staff ratio on the high side, but acceptable. The workload is high, teachers indicate, but they find it doable partly because of the good organisation of the programme and pleasant cooperation. The staff at the Faculty of Science and Engineering and at the UMCG involved in Biomedical Engineering are highly committed to making the degree programme a success. However, the panel did note that the programme is struggling to hire staff for all programme components. Due to university restrictions on hiring fresh staff and limited availability of lecturers with certain expertise, there is

limited availability for some topics such as AI and Robotics. The programme manages to resolve this by using current staff members, but it remains a problem. The panel understands the programme's concerns around this issue and recommends that when defining and sharpening the programme's profile, the programme should also consider the possibility of retaining the three different specialisations. As mentioned above, particularly around the Medical Imaging specialisation, the panel recommends evaluating whether the desired teaching offer is feasible.

Many of the staff participate in both the bachelor's and master's programme. The panel notes this ensures the development of clear lines of preparation via specialisations for one of the three specialisations in the master's programme.

The panel is pleased to note students' positive comments about the quality of the staff and especially their approachability. Although lecturers engage in multiple programmes, they are very enthusiastic about teaching in the bachelor's programme and willing to give students a lot of attention and support. However, from the student chapter, the panel concludes that students feel that the quality of teaching varies. Students think that improving training for teaching assistants and communication with lecturers could improve these problems.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Student assessment

Standard 3: The programme has an adequate system of student assessment in place.

Findings

The programme presents an overview of the forms of assessment per course. The intended learning outcomes to be assessed are indicated for each assessment. Assessment methods used in the programme are written exams, multiple-choice exams, oral exams, reports, interim tests, assignments, practical work, and presentations. A substantial part of the assessment entails group work.

The programme has started implementing more formative assessments in courses allowing students to practise laboratory skills, report writing and presentation skills. Students report in the student chapter that the connection between formative assessments and course content or summative assessment is not always optimal yet.

The exams are usually assessed by one examiner. The final work, the bachelor's project, is assessed by two examiners. The first examiner is typically the project supervisor, who can assess all four elements (practical work, management, oral presentation, and written report). The second examiner provides an independent assessment of the oral presentation and the written report. After the first supervisor has received the evaluation by the second examiner, they jointly decide on the final grade. After the two rounds of bachelor projects in the academic years 2022-2023 and 2023-2024, the programme intends to

modify the procedure of assigning the second examiner to improve their mutual independence and to reduce cultural differences in grading among the various research groups involved.

The faculty of Science and Engineering complies with the University of Groningen assessment policy. This assessment policy has recently been updated. The implementation started in 2023.

An assessment plan is annually drawn up by the programme director and programme coordinator, which describes the learning outcomes per course, the applicable modes of assessment, and the relationship between the courses and the intended learning outcomes.

The Board of Examiners was created in 2023 by a merger of two smaller boards of examiners that followed the university's new guidelines for creating broader boards of examiners with tightened procedures and more expertise. In addition to the bachelor's and master's programme Biomedical Engineering, The Board of Examiners is responsible for the Engineering bachelor's and master's programme Industrial Engineering and Management and the master's programme Mechanical Engineering. The assessment plan is a guideline for the Board of Examiners to perform quality checks and to ensure the quality of the examinations and the final as-

assessment. The Board of Examiners plans to evaluate the assessment of a set of courses and final research project reports each year to check if they adhere to the learning outcomes. The new Board has done a first check of a set of final reports of the bachelor's programme and is going to start checking the quality of assessment of courses.

Considerations

The panel judges that the programme has an adequate, solid assessment system and assessment procedures. The system is adequately based on the university wide policy, the panel notes. Multiple adequate assessment types are implemented in the programmes: from written exams to (individual and group) project assignments. The panel believes that the variety of assessment formats allows students to develop the necessary knowledge and skills.

The panel appreciates the programme's focus on shifting from 'assessment of learning' to 'assessment for learning', by increasing formative assessment. The panel challenges the programme to take further steps in this direction and ensure proper imbedding in education and summative assessment. Consideration could be given, for example, to expanding peer feedback by teachers but also by students to each other, including giving substantive feedback rather than just quantitative judgements. To carry this out properly, students (as well as teachers) should receive training on how to give effective feedback.

According to the panel, the procedures for assessing the final product of the programme (the thesis) are clear and the assessment itself is sound. The panel notes that the rubric used adequately assesses the practical work conducted

by the student, how this was managed and how the results were communicated in writing and orally. Also, the rubric addresses generic characteristics of any academic engineering programme, such as (self-)critical attitude, and ethical responsibilities. However, the panel notes that the feedback on assessment forms of theses is not always of the same level. In a few cases, for example, the feedback is limited or misses out, so that the grounds for the judgement are not completely in line with the outcome from the completed Rubric. The panel observes that the programme pays attention to the justification on the forms and recommends that the programmes continue this attention, for example in calibration sessions with each other to assess whether the justification for a judgement can also be followed by outsiders. In addition, the panel notes that the individual assessment by the second examiner is not always effectively an independent judgement. In the panel's view, the second examiner should give his or her own judgement, after which the two judgements are discussed jointly. It is important here that the second examiner is present at the presentation. This is not always the case, notes the panel based on the interviews. This finding by the panel is supported by the finding of the examination board, after the first round of final product checks. This audit highlighted the importance of improving the independence of second examiners.

According to the panel, quality assurance of assessment is ensured by the Board of Examiners. The new board, focusing on a group of programmes, shows a sufficient knowledge of the individual bachelor's programme and its assessment. The panel appreciates the attention that has already been given from the board to reviewing the quality of theses and their assessment. In addition, the panel advises the board to speed up the monitoring of the quality of

subject assessments, especially with the amount of group work and the changes the programme is implementing in the assessment system.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Achieved learning outcomes

Standard 4: The programme demonstrates that the intended learning outcomes are achieved.

Findings

The final bachelor project assesses if the intended learning outcomes are achieved. Students apply and integrate the knowledge during their bachelor project by performing a project that is either focused on research or on design in one of the research groups at the Faculty of Science and Engineering or at the UMCG. The project consists of four parts to be assessed: practical work (design, research, or development), management, oral presentation, and written report. It also focuses on generic characteristics such as a (self)critical attitude and ethical responsibilities.

Two cohorts of students have now graduated. In general, they continue their studies in a connecting master's programme. Most students choose the master's programme Biomedical Engineering at the University of Groningen, which is the best fit with the bachelor's programme. The programme has evaluated that the alignment with other master's programmes in Biomedical Engineering is not yet optimal, for example due to a lack of mathematical skills among alumni. Standard 2 discussed that the programme is aware of this and is taking measures to improve the connection.

Considerations

To form an opinion about the final level of the students, the panel read recent theses of a total of fifteen graduates of the programme and viewed the assessments of these works. The selection included theses with a variety of topics and a distribution between lower and higher grades. The panel found that all the theses attested to the bachelor's level. The quality of the works varies, with the grade given corresponding to the panel's assessment of quality. The panel notes the content of the theses matches the profiles of the programme. However, some theses are broad and more closely aligned with, say, pharmaceutical bachelor's content than biomedical engineering. In the interviews, management indicated that they are aware of this and monitor whether the projects are within the boundaries of biomedical engineering. However, it can sometimes happen that a subject falls slightly outside this. The programme continues to pay attention to this.

The panel noticed that the programme does not assess the final level of all intended learning outcomes in the thesis, but also does not designate specific other student products as final papers. The panel recommends that the programme develops a vision on this and more sharply defines the assessment of the final level.

In doing so, the panel recommends thinking about assessing the skills of conducting academic research and designing devices. Now, students may focus on one of the two in their thesis. The programme struggles with uniform assessment criteria for both types and the required way of reporting. The programme wants all students to become familiar with the way of reporting as it is done in a typical biomedical journal, but also recognises that drafts produced at bachelor's level do not always meet the requirements for that type of journal. The panel understands the struggle and advises the programme to make clear choices. These could include, for example, dividing the two skills between different final projects or, instead, leaving room for students to delve into one of the two. The panel notes that the programme aims to prepare for an academic or engineering career,

together with the subsequent master's programme in Biomedical Engineering. The panel observes that its own master's programme is a particularly good fit, partly because of the preparation for the three specialisations offered by the master's programme. The programme has evaluated that the alignment with other master's programmes in Biomedical Engineering is not yet optimal, for example due to a lack of mathematical skills among alumni. Standard 2 discussed that the programme is aware of this and is taking measures to improve the connection.

Taking these considerations into account, the panel assesses that the programme meets this standard.

Attachment 1: assessment panel

Jos Vander Sloten, chair

Professor Mechanical Engineering, Faculty of Engineering Science, KULeuven

Patricia Dankers, panel member

Professor in Biomedical Materials & Chemistry, TU/e

Peter Ketelaar, panel member

Managing Director at Life Cooperative, Groningen

Astrid Hornman, Student member

Student Biomedical Engineering, UTwente

The panel was supported by Linda van der Grijspaarde, certified secretary.

All panel members have completed and signed a statement of independence and impartiality, and these have been submitted to NVAO.

Attachment 2: site visit programme

Thursday 31 October 2024

ADL 1/UMCG North (Petrus Camper room (3211.0065))

Time	Meeting	Attendants
13:00 - 13:15	Arrival and welcome	Vice Dean Faculty of Science and Engineering Programme director Chair Programme Board Engineering cluster
13.15 - 14.30	Panel preparation and lunch	
14.30 - 15.30	Interview programme management	programme director programme coordinator academic advisor chair Programme committee
15:40 - 17:00	Interview with students and alumni	2 year 2 students 3 year 3 students 2 alumni

Friday 1 November 2024

Bernoulliborg, Zernike Campus

Time	Meeting	Attendants
08.45 - 09.00	Arrival	
09.00 - 9:45	Interview teaching staff	4 staff members UMCG 4 staff members University of Groningen
09:45 - 10:15	Interview Board of Examiners	chair member formal secretary
10.15 - 10.30	Short Break	
10:30 - 12:30	Thematic sessions	
	<i>Session 1: Curriculum Biomedical Engineering Bachelor year 3 (e.g. design vs research BSc project)</i>	lecturer (MDD) lecturer/chair PC (MI) lecturer (BSE) member Board of Examiners Programme Board student PC student programme director programme coordinator
	<i>Session 2: Group work</i>	member Center for Learning and Teaching, PIE team

		lecturer lecturer/PC member Programme Board student PC student alumnus programme director programme coordinator
12.30 - 13.30	Lunch break	
13.30 - 14:15	Internal panel session	
14.15 - 14.30	Final interview formal programme management	Vice Dean Programme director Chair Programme Board Engineering member Programme Board Engineering liaison UMCG-Faculty of Science and Engineering
14.30 - 15.30	Panel: Composing preliminary findings and oral report	
15.30 - 16.00	Oral report and conclusion	all audit participants

The open consultation was planned online prior to the visitation. No students and staff members signed in for this.

Attachment 3: Recommendations from previous assessment

The following overview of recommendations from the previous visitation and follow-up by the programme is taken verbatim from the critical reflection. The panel states that the programme has incorporated the recommendations well. Under the various standards, the panel addresses this.

Topic	Points of attention by panel	Progress and Improvement
Summary	However, it felt that his intended integration could be reflected more clearly in the programme's aims and learning outcomes to avoid a dichotomy between research and design within the programme.	Both the actual curriculum and the learning outcomes have been modified quite significantly in order to emphasise that Biomedical Engineering is an interdisciplinary programme where engineering and design are integrated and rest on a solid scientific foundation.
	It advises adjusting the [intended learning] outcomes in order to differentiate them from the master's programme and to better reflect the bachelor's programme.	After approval of the bachelor programme, the curriculum has been re-designed and the accompanying learning outcomes have been reformulated. In doing so, the distinction between the learning outcomes of the bachelor and the master programmes has been improved.
Teaching Learning environment	According to the panel, the content is sufficiently aligned with the programme-specific learning outcomes. However, it also remarked that the curriculum overview in the self-evaluation report only shows a rough outline of the relationship between the learning outcomes and the programme components.	For every year, the relationship between learning outcomes of the programme and the various courses is specified in detail in the annual Assessment plan in an overview table. In the table is per course is indicated which programme Learning outcome(s) are assessed
	It recommends clearly delineating the different learning paths in the programme, including research and design.	As the bachelor programme is gradually maturing, it has become clear that, in an ideal world, research and design are fully integrated in every aspect of any engineering programme. As the

		<p>Biomedical Engineering bachelor unrolled in the midst of the COVID turmoil it was not feasible to achieve this. However, starting in the academic year 2022-2023, courses with a heavy science flavour will also introduce 'design thinking' aspects. For example, a course on biomaterials will not only focus on the mechanisms from which these materials derive their properties, but will also address the question how to tune or improve those properties</p>
	<p>The panel advises exploring ways to make the teaching more active and increase student participation. The panel values the professional, scientific and didactic qualities of the staff and the attention.</p>	<p>This is a point of continued attention. Currently we are in the process of improving the course units, including their interconnectivity. During the coming years, in which we expect to see an expansion of the available teaching staff. We will closely monitor developments regarding active learning methods during the lecturer meeting thought the academic year.</p>
	<p>The panel also concludes that the quantity of the staff is sufficient.</p>	<p>This was correct for the expected influx of 60 students. The teaching staff obviously was not sufficient to deal with double this influx in the first two years (2020-2021, 2021-2022) of the bachelor, let alone an even higher influx. Fortunately, further growth is restricted by a Numerus Fixus (of 125). At the same time, the board of Faculty of Science and Engineering has agreed to initiate a dedicated section on Biomedical Engineering with several new positions within the Engineering institute ENTEG</p>

	<p>The panel appreciates the management's intention to closely monitor this balance and take further measures, if necessary.</p>	<p>We have done so, resulting in the expansion of staff within Faculty of Science and Engineering, as mentioned above.</p>
<p>Student assessment</p>	<p>The Board of Examiners still has to be formally established. There will be an overlap with the Board of Examiners of the master's programme Biomedical Engineering.</p>	<p>This has been changed as part of the new teaching organisation in Faculty of Science and Engineering. The board of examiners for Biomedical Engineering has been integrated in a Board of Examiners of the engineering cluster together with Industrial Engineering and Management and Mechanical Engineering.</p>
	<p>Panel advises elaborating measures to further strengthen the quality assurance of the thesis assessments, for example by promoting calibration sessions among the mentors.</p>	<p>The thesis evaluation procedure has been adapted to that used throughout all Faculty of Science and Engineering programmes: every bachelor project is evaluated by two independent examiners. The initial notion of a mentor in the bachelor project has been abolished.</p>
	<p>Panel recommends that these points be taken into account in the further development of the new assessment form.</p>	<p>The assessment form for bachelor projects is currently under development. It will be based on existing evaluation forms used in other engineering programmes and modified for the interdisciplinary nature of Biomedical Engineering.</p>

Attachment 4: reviewed documents

- Critical Reflection
- Student Chapter
- 15 theses with assessment forms
- Advies University of Groningen wo-ba Biomedische Technologie
- Midterm meeting report Biomedical Engineering 2022
- TER 2024-2025 BSc Biomedical Engineering
- Organisational chart Faculty of Science and Engineering cluster Engineering
- Composition committees and boards.pdf
- Annual Report Biomedical Engineering Programme Committee 2022-2023
- Board of Examiners Quality control information and guidelines
- Annual report Board of Examiners 2022-2023
- Domain-specific framework of reference
- Assessment plan Biomedical Engineering BSc 2024-2025
- Course and staff overview, including Mode of instruction and assessment
- Student Staff ratio
- Pictorial summary of SWOT
- Student performance
- University of Groningen assessment policy 2021-2026
- University of Groningen assessment policy presentation Project group
- Board of Examiners Rules and Regulations Faculty of Science and Engineering 2023-2024
- BSc project Assessment form and rubric
- Education monitor Biomedical Engineering 2023 to 2021
- Onderwijskaart Bachelor (incl. toelichting)
- National Student Survey 2023
- Generative AI at FSE
- Graduation work of 15 students, distributed among all study modes and sites

