Netherlands Quality Agency

NQA

Hanzehogeschool Groningen
University of Applied Sciences

Hanze University of Applied Sciences

Master Data Science for Life Sciences

Limited programme assessment

April 2024

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Summary

The Hbo-master programme Data Science for Life Sciences (MDSLS) from Hanze University of Applied Science was visited by an audit panel from NQA in February 2024. This programme is two years full-time, and taught in English on campus in Groningen. The audit panel assesses the quality of the programme as **positive.**

The assessment panel met with an enthusiastic and knowledgeable team of lecturers that are committed to their students, not only in terms of their study performance but also with regard to their concern about the personal lives of the (international) students. The programme is of a high level without any doubt, both in terms of educational content and student guidance. The staff is responsible for the content and quality of education. The programme operates in a high-quality research environment, but still ensures that a good practical research component is always available. A considerable number of students move on to PhD studies. At the same time, the programme ensures that a substantial element of applied research is one of the cornerstones of the programme.

Standard 1: Intended Learning Outcomes
The master's programme **meets** the generic quality requirements for standard 1.
The panel concludes that the programme has demonstrated that the intended learning outcomes convincingly match the content, level, and orientation requirements. The basic knowledge and skills have been updated based on changes in the professional field. The learning outcomes are regularly evaluated in accordance with the applicable NLQF level 7 for the master's programmes and the Dublin descriptors to maintain this level. The panel is positive about the positioning of the programme's being in line with the requirements of the professional field and how the programme connects with the most important issues for future employees. The panel encourages the programme to continue seeking input for developing its professional field orientation on both national and international levels.

Standard 2: Teaching-Learning Environment
The programme **meets** the generic quality requirements for standard 2.
The panel is convinced that students can achieve the learning objectives through the content and design of the programme. The facilities in the lab and the clear quality of the teaching team certainly contribute to this. Students are satisfied with their lecturers, not only because they are approachable and interested in the students' personal circumstances, but also because their comments about the programme or training can be addressed in an adequate and open manner. During the enrolment period all students are brought up to the common starting level of the programme by means of preparatory courses. Now that the extension of the course has been completed, the panel encourages the programme to evaluate the credit distribution across the various parts of the curriculum in relation to the study load and the prioritisations in the programme. Finally, the panel suggests exploring whether a part-time variant is possible in the long run.

Standard 3: Student Assessment
The programme **meets** the generic quality requirements for standard 3.
The programme has a reliable and transparent testing system. Communication with students about final objectives and testing is clear and understandable. It is also made clear which preparatory courses students must take before they can continue the rest of their programme.

The panel is of the opinion that both the quality of the assessment and the level of testing are sufficient. Nevertheless, it should be possible to provide a more detailed explanation and description of the steps to be taken to obtain a degree, also including the responsibilities and required procedures of the examination board.

Standard 4: Achieved Learning Outcomes

The programme **meets** the generic quality requirements for standard 4.

The panel concludes that the expected learning outcomes are achieved. The graduation projects are not only relevant but they are also appropriate to the intended level. The professional field is very satisfied with the results delivered by graduating students. Alumni indicate that they have learned a lot and that what they have learned is relevant and current. Students have also learned how to learn, which enables them to develop the skills needed to obtain more knowledge and skills at later stages in their careers.

Contents

Introduction

This is the report of the assessment of the Master's programme Data Science for Life Sciences offered by Hanze University of Applied Sciences, Groningen. The assessment was conducted by an audit panel compiled by Netherlands Quality Agency (NQA) commissioned by Hanze University of Applied Sciences. Prior to the assessment process the audit panel was approved by NVAO.

This report describes of the panel's findings, considerations, and conclusions. The assessment has been done in accordance with the *Assessment Framework for the Higher Education Accreditation System of the Netherlands* of NVAO (September 2018) and the *NQA Guideline 2019 for Limited Programme Assessment*.

The site visit took place on February 15th, 2024.
The audit panel consisted of:

Name	Role	Short job description
Dr. ir. K. A. Feenstra	chair	Programme Director of the Master Bioinformatics and Systems Biology, Assistant Professor Bioinformatics, IBIVU Centre for Integrative Bioinformatics, Department of Computer Science, Vrije Universiteit Amsterdam
Dr. B.H.G. Swennenhuis	member	Course Director of the Master's Programme Applied Nanotechnology and Researcher in the Professorship Applied Nanotechnology, Saxion University of Applied Sciences
Drs. ing. M. Demeyere	member	Vice-Rector for Education, Students and Internationalization, Howest University of Applied Sciences, Belgium
I.M.A. van Vugt	member	Master Student Bio Informatics, Wageningen University and Research

Drs. Y.E. Leegstra, NQA Auditor, acted as lead-auditor of the panel and was assisted by Drs. D.J. Oolbekkink LLB, NQA Auditor, who was responsible for writing the report.

The Master's programme Data Science for Life Sciences is not part of an audit cluster.

Method of working of the panel and process followed
For the assessment, the study programme offered a critical reflection with appendices. For the assessment of the achieved learning outcomes, the panel has studied fifteen final reports with products by graduates who recently finished their studies. These 15 final reports have been selected from the list of alumni of the last two academic years. In this selection, the variety in grading, modes of study and learning paths have been taken into account.

The site visit by the panel was the central in the assessments, the panel consisting of expert peers. To prepare the visit the panel held a preliminary meeting, where the panel members were instructed about NQA's method of working and about the *NVAO-Assessment Framework*. In this meeting the panel members also discussed their tentative findings. During both the preliminary

meeting and the site visit, the panel members shared their findings with each other continuously. During the site visit the panel spoke with various stakeholders of the study programme, such as first year and second year students, lecturers (examiners) and representatives of the professional field and it studied several documents, see Appendix 2. At the end of the site visit the panel incorporated all the information it had obtained into an overall picture and in a tentative, substantiated judgement. In the final oral feedback session, the panel chairperson communicated the conclusive assessment and the major findings of the panel.

Staff members and students of the study programme have had the opportunity to approach the panel (via email) in confidence to bring to the attention of the panel those matters they deem of importance to the assessment. However, nobody has made use of this opportunity.

After the site visit a draft report was formulated, which was presented to the panel. On the basis of the panel's input a second draft was made, which was presented to the study programme for a check on factual inaccuracies. The panel members have taken note of the reaction of the study programme and the report was adapted accordingly, wherever necessary. Subsequently, the report was made final. With all information provided (orally and in writing) the panel has been able to make a well-considered judgement.

The audit panel declares that the assessment of the study programme was carried out independently.

Utrecht, April 16, 2024

Panel chair	Panel secretary
Dr. ir. K. A. Feenstra	Drs. D.J. Oolbekkink LLB

Characteristic Features of the Study Programme

Hanze University of Applies Sciences in Groningen was founded in 1798 and offers 12 Associate degrees, 53 Bachelor degrees, 23 Master degrees, full-time as well as part-time, in the domains of technology, social studies, economics, health care and the arts. The Master's programme Data Science for Life Sciences is offered by the Institute for Life Science & Technology (ILTS). The Institute is one of the 16 schools at Hanze University of Applied Sciences, offers one master and four bachelor programmes and has around 1,100 students, still having a personal atmosphere and a fairly small student-lecturer distance. The students conduct an abundance of applied research in collaboration with small and medium-sized enterprises (SMEs) and larger companies, with the goal of developing concrete and new bio-based products, processes and activities that better fit the market demand (source: website Hanze.nl).

The Master's programme Data Science for Life Sciences (hereafter: the programme) started in February 2019 after a positive initial review by the NVAO. According to the Institute, the main reason for developing the programme was and is the growing demand for data-scientists. Computer science is becoming increasingly intertwined with the life sciences and is now an indispensable part of this research-intensive sector. The aim of the programme is to educate the data analyst of the future, who is aware of the developments in the field and knows exactly how and where the required information can be gathered and processed in order to come to a well-founded conclusion. It has a practical curriculum and a strong link with the professional field in the form of collaborations with companies and institutions in the region. Hanze UAS aims to train students to become thorough researchers and professionals specialised in data-driven methodologies that play an increasingly prominent role in the life sciences (source: Teaching and Examination Regulations).

Recently, approval has been granted to the programme to extend the study load to 120 credits. Students that started in September 2023 have been following the new programme. The content of the programme has not been substantially changed, but students now have more supervised hours and more time to grasp the considerable volume and variety of subjects.

Basic Data of the Study Programme

Name of study programme as in CROHO (Central Register of Study Programmes in Higher Education in the Netherlands)	M Data Science for Life Sciences
ISAT-code	New 49404, old 49300
Orientation and level study programme	Higher professional education (hbo)
Level study programme	Master
Degree	Master of Science
Number of study credits	120 credits, full time
Location	Groningen
Teaching language	English

The Previous Accreditation

In the previous audit (2022), no recommendations were made about the change in study load. In 2018 the initial audit panel made a number of recommendations:

The panel thinks that the programme could benefit from a more "external" view – outside of the region, or even international – for its future development. Subsequently, it advises the programme to take this into account when it comes to the composition of the Professional Board. A Professional Board has been established and is functioning. The current panel has made some remarks about this in the paragraph on Standard 1.

The panel advises the programme management to actively establish contacts with similar Master's programmes in the Netherlands. Such contacts would help in further clarifying the programme's own national profile. A partly similar part-time programme was started at Hogeschool van Arnhem en Nijmegen (HAN UAS), and the colleagues of both universities have discussed the curricula. The programme also participates in discussions regarding the master sector plan of the Vereniging Hogescholen (The Netherlands Association of Universities of Applied Sciences).

The panel recommends the programme management to further develop and clarify its vision on internationalization at a programme level. At this point, the programme is following Hanze UAS' internationalization strategy. The programme focuses on the individual development of students within an international context, collaborating with students and professionals from diverse cultural backgrounds, and conducting research within an international context in international learning communities.

The panel advises the programme management to closely monitor whether the translation of the ILO "Being entrepreneurial" in the curriculum is in line with the expectations of various stakeholders, particularly those of the professional field. The competence "Being entrepreneurial" has been somewhat reformulated in accordance with the NLQF level 7 and findings in the years past. This change will be implemented in the near future.

The panel recommends the programme management to make clear choices in terms of the supervision ratio and urges to do so before the programme starts. According to the panel, the programme has demonstrated that this recommendation has been incorporated into the curriculum.

The panel advises the programme management to closely monitor if the admission procedure will work out as planned once the programme has started. The admission procedure has been closely monitored and adjusted on several aspects (English level, motivation check). The panel is satisfied with the changes.

The panel suggests to expand the list of admissible bachelor's degrees with other programmes in the Netherlands and abroad. In the TER (Teaching and Examination Regulations), the programmes at Hanze UAS that grant admission to MDSLS have been described. Students with a different bachelor programme are also eligible if they can demonstrate the minimum level in programming skills, English language, statistics, and mathematical knowledge.

The panel suggests to refrain from using the word "exemption" in relation to the modules of the preparatory course, and instead address this scheme as an admission requirement. The TER states: "At the start of the programme, the Admission Committee will define the preparatory course programme for a student based on the student's level of data science, programming, and biology. Attendance of the lessons is not compulsory but passing the final exams is required for attendance of the main programme."

The panel recommends keeping an eye on the study load of the portfolio through the module evaluations and student mentoring. Surveys and conversations with students revealed that the workload of the programme was too high. Therefore, the programme has been extended to 120 credits.

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.

Conclusion

Based on the considerations mentioned below, the audit panel has assessed that the Master's programme Data Science for Life Sciences **meets** the generic quality requirements for standard 1. The panel finds that the programme has demonstrated that the intended learning outcomes all meet the requirements for content, level and orientation. The programme has recently updated the original body of knowledge and skills based on developments in the professional field. These developments are identified in discussions with the Werkveldadviescommissie (WAC, the Professional Board, i.e. with representatives from the professional field). In the opinion of the panel, the level of the programme is undeniably high. This level is maintained through periodic assessment of learning outcomes in light of the applicable NLQF level 7 for Master's programmes and the Dublin Descriptors. The panel praises the way in which the programme accounts for its position in relation to the professional field and uses the curriculum to connect with what is important to the future professional. The panel encourages the programme to continue to search broadly and both nationally and internationally for input on the professional field orientation. Although the panel received the impression from the documentation studied that the course is quite academic, the discussions held during the site visit showed that the practical orientation has been carefully woven into the curriculum. The panel encourages the programme to promote its applied science orientation more explicitly both towards future students and towards the professional field.

Substantiation

Professional orientation

The programme educates data scientists who, thanks to the practical and accurate curriculum of the course, can contribute to the ever-growing demand for data scientists specialised in life sciences. The education programme is aligned with the industry through collaborations with companies and institutions in the region such as BioBTX, Bioclear, Universitair Medisch Centrum Groningen (UMCG; Academic Medical Center Groningen) and the University of Groningen. The programme operates in an international context and contributes to research with a societal impact. With the help of the solid knowledge base, the student can work in both the academic research environment, including PhD programmes, and in commercial research centres as well as research and development departments in the industrial companies related to life sciences.

Final qualifications

To attain the necessary professional expertise, students are required to substantiate their mastery of six programme outcomes. The six programme outcomes are as follows:

CR Conduct critical and creative research
MM Model meaningful information
DO Deliver organised solutions
CE Communicate effectively
BR Being responsible
BE Being entrepreneurial

The last outcome, being entrepreneurial, is currently under construction and will be shifted towards ‘added value for stakeholders’. The precise wording of the outcome has to be decided upon. The programme started this outcome with a focus on business and/or future implementations inspired by an entrepreneurial spirit. Over time the focus has shifted towards empowering students to provide practical and effective solutions to validate research hypotheses in order to ensure its real-world usefulness. The panel finds that this is a valuable choice and supports the programme to finalise this shift accordingly. In a carefully formulated and extensive educational profile, the course explains how the learning outcomes relate to the HBO professional master standard, the NLQF level 7 and the Dublin Descriptors.

Cooperation with the professional field

Since the start of the Master's programme, UMCG was actively involved in providing education for the programme as the programme aligns perfectly with the needs of departments within UMCG. Although the academic world in which UMCG operates is still an important part of the students' future work field, during the site visit the programme clearly showed that there is also a demand for graduates in the business world. However, in the documentation that the panel studied prior to the visit, the image seemed to emerge of a programme that mainly prepares for an academic research career. Yet, in conversations with students, alumni, and the professional field it became clear that this is only part of the story. The practical orientation has been carefully woven into the curriculum. There is more about this in the text below.

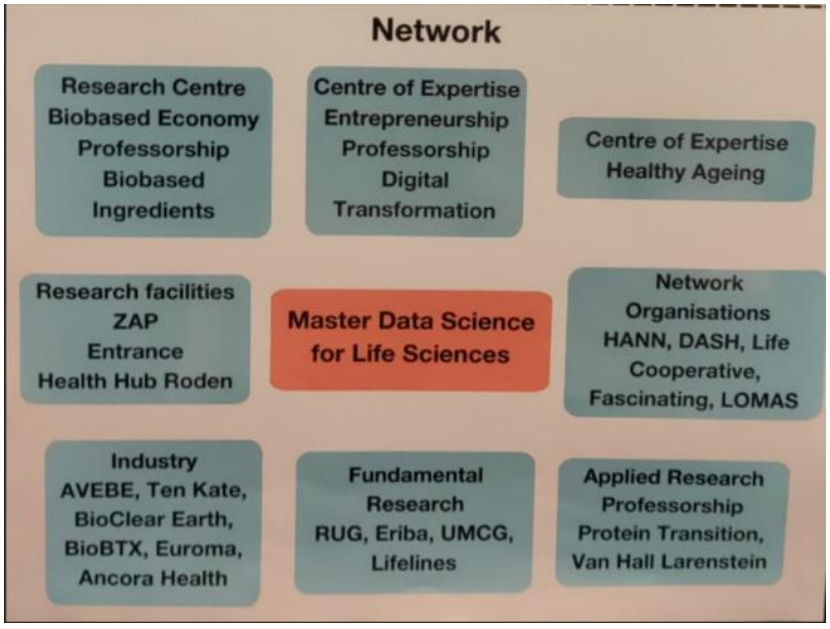

Figure 1 The network of MDSLS

During the site visit, a poster was shown with the text of figure 1. The poster depicts the vast network the programme maintains with the academic research-centres as well as applied research facilities and industrial parties. The panel encourages the programme to promote its applied science and practical orientation more explicitly both towards future students and towards the professional field.

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.

Conclusion

Based on the considerations mentioned below, the audit panel has assessed that the Master's programme Data Science for Life Sciences **meets** the generic quality requirements for standard 2. The panel believes that the content and design of the programme enables students to achieve the intended learning objectives. The evident quality of the teaching team and the available (lab) facilities contribute to this significantly. Students praise the lecturers. Not only because of their approachability and interest in students' personal situations, but also because comments from students about the programme or various courses are addressed quickly, adequately, and transparently.

Through the improved admission programme, all students are brought up to the common entry level of the programme through the preparatory courses. The panel understands the considerations behind this choice but has found that this can lead to students with a high level at the start having little to do in the first term. The panel appreciates that the programme wants to address this with the upcoming differentiation and choice options that will be introduced into the curriculum as of September 2024. Now that the extension of the programme has been realised, the panel encourages the programme, to evaluate the distribution of credits among the various curriculum components in relation to the size of the study load and the prioritization within the programme. Finally, the panel suggests that the programme consider whether a part-time variant of the programme could eventually be organised.

Substantiation

Content and structure of the curriculum

As of September 2023, new students will start in a programme worth 120 EC. Students who started earlier complete their studies within the original 90-EC programme. The appendix contains overviews of the initial programme (cohorts 2019-2022) and the updated programme (cohort 2023-2024). The consequence of the extended programme is that while new students master the same learning outcomes, they have more time during the various modules to practise what they have learned through exercises. As an example, the programme cites the way students learned how to programme during the first semester in courses Programming I and II. Because of the extended programme students had more opportunity to practise since programming is learned through lots of practice.

In general, the panel finds that the extension of the programme works out well. The structure of the programme is more balanced now. In addition, the panel recommends that the programme considers investigating whether the distribution of the number of credits over the various parts of the curriculum is still appropriate. For example, the students are of the opinion that the study load for mastering components of Bayesian statistics and numerical analyses is not in proportion to the reward provided.

The programme is offered as a full-time variant only. Although the programme is intensive enough to justify this, the panel sees reason to make a comment about it. During the site visit, the panel not only met a student who is studying part-time, but also someone who is interested in doing so. Part-time studying can appeal to students who are in principle already qualified to start as a professional. Students often have starting skills already at least at bachelor's level. Given their social position, some of them would like to be financially independent when they start their master. In view of these arguments given, the panel concludes in general that it may be useful to investigate in more depth the extent to which a part-time variant of this programme is viable.

Didactic concept

The programme identifies a number of design principles for education in its Educational Profile. Based on the fact that its students have already obtained a bachelor's degree, a certain degree of ownership and learning agency can be built on. Students are required to have a proactive mindset from which they can realize agency in their learning. Courses and projects are designed in such a way that students have the freedom to select topics of personal interest and thus craft their assignments. This is of course taking into account the learning outcomes and preconditions that have been set in advance. Students are therefore approached as partners in a learning environment in which they, together with faculty members, researchers, etc., create a cohesive community of learners for education, research and practical experience. In order to facilitate learning, the programme provides a diverse range of instructional methods within its learning environment, including (guest)lectures, tutorials, practical sessions, workshops and supplementary support sessions offered by student assistants. An all-encompassing learning-oriented way of assessment would tie in with this learning practice. More about this will be explained in standard 3.

Admission

The course has a detailed admission procedure and is accessible to students with bachelor degrees in chemistry, chemical engineering, engineering major sensor technology, biology and medical laboratory research, bioinformatics, medical imaging and radiation therapy and HBO-ICT. All applicants need to prove a minimum level in programming skills, English (IELTS score 6.0) and statistical and mathematical knowledge. They also have to hand in a motivational letter and curriculum vitae. Students who are not able to prove their competencies are allowed to do an additional test. After a student has successfully completed the admission procedure, he is admitted to the course as long as the admission committee is convinced that his motivation to participate in the course is adequate.

At the start of year one there are three preparatory courses: data science, programming and biology. Based on the level demonstrated by the student in the admission procedure, the admission committee determines which exams of these three courses the student should pass. Participation in the courses is not mandatory, but every student must successfully complete the associated exams in order to proceed to the rest of the educational programme. The panel finds this procedure commendable, especially given the fact that students register for the study with a very varied (international) background. On the one hand, it is not always the case that candidates already have sufficient knowledge and skills to cope with the requirements of the study programme. On the other hand, in conversation with the students the panel discovered that some students have little to do during those prep courses because they already have the required level. The panel encourages the programme to pay attention to this and, for example, look for

opportunities to involve these students in helping to supervise their peers, and having them give additional support in one or more of the three subjects mentioned.

Knowledge
In the Educational Profile the programme has explained how the learning outcomes have been included in the curriculum of the programme. There are four so-called learning lines (Programming, Data Science, Professional and Research Skills, Omics). Each of these learning lines is filled with multiple courses. Figure 2 provides an insight into how the learning lines are drawn through the curriculum. In the learning line Programming the focus is on automating data science by programming workflows in Python, followed by developing proficiency in data processing and interactive data visualization. The introduction of more advanced programming knowledge and skills improves the ability to strengthen students' expertise in data processing and analysis.
The learning line Data Science starts out with fundamental mathematical concepts such as calculus, statistics and numerical analysis. Students also receive instruction in linear algebra, graph theory and signal analysis in order to be able to work on multivariate analyses, machine learning and the analysis of biological networks.

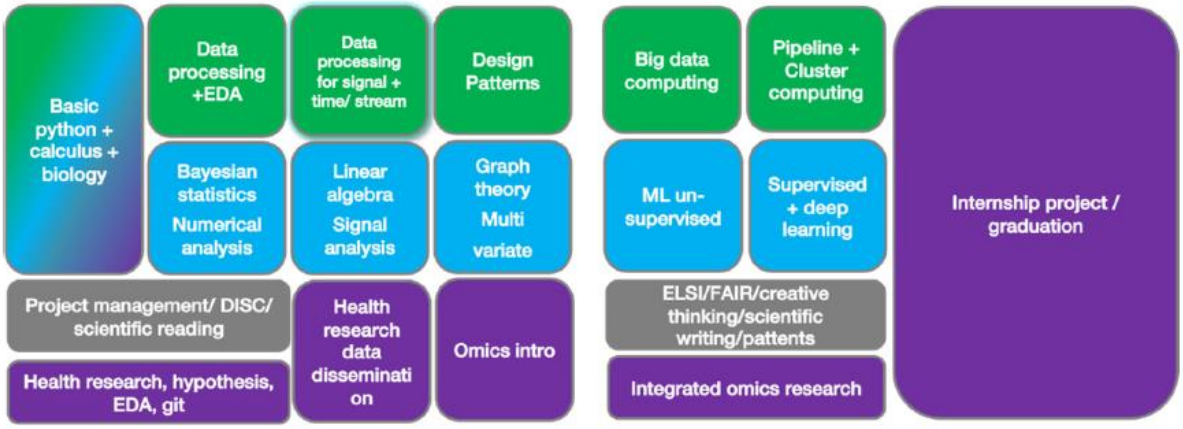

Figure 2 Curriculum overview with learning lines indicated. Green: programming; Blue: Data Science; Purple: Omics; Grey: Professional and Research Skills (source: SER).

In order to effectively work as a team and know how to collaborate with peers they take part in the learning line Professional and Research Skills. They learn about reading and writing scientific articles and also about project management and potential legal, societal and privacy issues related to research with datasets.
In the learning line Omics students get acquainted with a biology foundation. In the Omics research project students explore the design of experiments and research on a specific health topic, with links to, for example, genetics or cell biology and the acquisition of data. In the second part of the project students learn about laboratory techniques in various domains. They choose a research project with multiple datasets and formulate and test hypotheses using quantitative methods. In short, this aims to be a project in which students not only learn techniques but also learn how findings can be presented.

The panel is impressed by the level at which knowledge is provided during the training and also how the learning outcomes are linked to the four learning lines. Figure 3 provides an insight into how the learning outcomes are addressed in the curriculum.

	Data Science	Programming	Omics	Research and Professional Skills	Graduation
Conduct critical and creative research	x	x	x	x	x
Model meaningful information	x	x	x		x
Deliver organised solutions		x	x		x
Communicate effectively		x	x	x	x
Being responsible			x	x	x
Being entrepreneurial			x	x	x

Figure 3 The relation between the learning lines and the programme outcomes (source SER).

Skills

As indicated above, the further development of research and professional skills is an integral part of the training. At the start of the programme, it is carefully assessed whether the student has the competences in the basic knowledge and skills. The programme then ensures that all students arrive at an equal starting position through the prep courses. This certainly also applies to programming skills. In conversation with students, it became clear that a number of them are less satisfied with the fact that students who, for example, already have finished a well-connecting bachelor-programme still have to participate in the research skills courses. In the conversation with the lecturers, the panel noticed that they are well aware of the differences in level among students regarding research skills. They therefore try to challenge students to improve their own level and challenge themselves in this area. This applies to the entire course. If students wish to progress beyond the required master's level, the programme will support them in this aspiration to excel. Some lecturers also provide bonus exercises during the course for students in need of additional challenge.

Students can become proficient in professional skills of their choice via the so-called competence card, allowing for personal variation in focus on certain skills. On this card they indicate which development they want to go through and how exactly they are going to work on it. The course Research and Professional skills consists of several activities, including a personal assessment (DISC report) to identify preferred communication styles and develop effective communication and collaboration skills. Students demonstrate their development through a process of (peer) feedback and self-reflection. Competencies developed that also contribute to an educational learning objective are not only stated on the competence card, but they are also included in the portfolio for the relevant module. The completed competence card is conditional for graduation. For each competency developed, the student must obtain confirmation from the staff member involved who signs the competence card to confirm that the student has sufficiently developed in this area.

Teaching language and Internationalisation
Education is provided in English, including the all educational materials and the language used during projects. Given the nature of the international field in which graduates will be employed, this is a strategic choice that is not only justifiable but necessary as well. Although the programme, aligned with the ambition of Hanze UAS, also wants to strengthen liveability and sustainability in the Netherlands, the staff and scope of the activities in this programme are mostly internationally oriented, and therefore the main language is English. Most professional literature is in English and in most institutes and companies in the area staff and students have different nationalities. English is the language they have in common. However, there is also a second incentive: teaching in English creates the possibility to attract students from abroad. This is even necessary because the number of Dutch students is insufficient to fill the need for employees expected in this field, and even in the region of the north of the Netherlands. The panel finds these convincing arguments for the choice to provide education in English.
At Hanze, the language used is generally Dutch. The panel asked students whether that is problematic in any respect. The students make it very clear that this is not the case. First of all, everyone is willing to switch to English whenever desired. In addition, all relevant educational materials and also the more general announcements are available in English. Even the announcements via the public address system during evacuation exercises are given in Dutch and English.

Tutoring and student welfare
Students tell the panel that they are very satisfied with the supervision they receive from the teaching staff during their studies. During classes there is room for additional explanation, but also for additional challenges. In addition to this willing attitude of lecturers during lessons, the course offers a mentoring programme. Each student is assigned a mentor (staff member) who schedules regular mentoring meetings to monitor general well-being and discuss progress in their studies. The competence card mentioned above is also discussed in these mentor meetings. The mentor can help the student shape the personal development process and coaches the student during this process. A minimum of four mentor hours per half-semester is offered per student. Since 2022, the origin of incoming students is largely from outside the European Union. This requires appropriate student mentoring. After all, in coming to Hanze these students have undergone major changes in all areas of life. When asked, the international students reported that they were particularly well supported. Both lecturers and peers are aware of the culture shock that many international students go through. They are really helpful in any possible way.

Staff
Current teaching capacity is 1.96 FTE. This is allocated to twenty people who are associated with the programme as (guest) lecturer-researchers, education and research instructors or graduation coordinators. Many lecturers have appointments at other courses within ILTS, elsewhere in the Hanze University, or as PhD students at UMCG. They are seconded to this master programme for a number of hours. The vast majority of lecturers (fifteen out of twenty) have a PhD degree or is in the process of obtaining one. Almost everyone has the Basiskwalificatie Didactische Bekwaamheid (BDB; Basic Teaching Qualification) which includes the Basiskwalificatie Examinering (BKE; Basic Examination Qualification). The lecturers demonstrate a high degree of substantive knowledge of the research domain of data science for life sciences. The way they treat their students demonstrates a great commitment to their personal and professional

development. They also show ownership for the education that is provided. During the tour of the building, it was noticeable that the 'progress board' with the opportunities to improve has been hung on the walls in the classrooms. According to the panel, this shows that lecturers are made accountable for promises made for improvement. The panel finds the efforts made by the lecturers highly commendable.
With regard to the staff's English language skills, the panel notes that lecturers are sufficiently equipped to teach in English. Most of them have previously been working in a setting where English was the main language. If it nevertheless appears necessary to improve English language skills, it is possible to do this through the PL Academy (Hanze UAS' platform for professional courses for staff).
Although during the site visit the interviews with the lecturers were in Dutch, the response from students shows that they are satisfied with the way they are approached in English, both orally and in writing. During the tour, the panel also noticed that lecturers automatically switched to English when entering one of the classrooms. The panel is therefore of the opinion that the course meets the requirements with regard to English language proficiency.

Facilities
The programme has a number of well-equipped laboratories at its disposal where students can carry out tests to generate data they can use for further analyses. These facilities are modern and up-to-date and they are maintained by ILTS. The life science labs, including facilities for sequencing, microscopy, spectroscopy and cell-culturing are e.g. used in the Omics learning line. During the projects in this course students design tests and experiments. Because working in the laboratory is reserved for people who are authorised to do so, at least one of the group members has to be graduated from a course in which they have learned to work in a laboratory. ILST also provides various computer labs to students of this master programme with computers that run under open-source software. There is also a high-performance computer cluster that is under Hanze's own management. Apart from the facilities mentioned above, a variety of research facilities and labs can be used, such as ZAP-lab (Zernike Advanced Processing), Entrance (Energy Transition Centre, which is an initiative by Hanze University of Applied Sciences Groningen, the University of Groningen and the Energy Academy Europe) as well as the living labs Digital Society Hub and Healthy Ageing.

Standard 3 Student Assessment

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

Conclusion

Based on the considerations mentioned below, the audit panel has assessed that the Master's Programme Data Science for Life Sciences **meets** the generic quality requirements for standard 3. The programme has an adequate system of assessment that results in assessments being valid, reliable and transparent. The way in which final aims and objectives and methods of assessment are communicated to students is clear and traceable. It is also made clear at the beginning of the study which preparatory courses a student needs to complete in order to meet all requirements needed to complete the rest of the study programme. The panel is satisfied that both the level and the quality of assessment are up to standard. However, the assessment procedure for the graduation period could be more carefully explained and written down, including the role of the examination board here.

Substantiation

Assessment policy

The programme's assessment is based on the university's assessment policy and that of ILTS. These provide a framework for good assessment with minimal requirements and leave it to the individual programmes to determine their own specific implications. The ILTS assessment policy defines criteria for the quality of assessment and its assurance. Based on these two documents, the teaching team creates the content of the assessments, aligning them with the knowledge, skills, and competences (i.e. learning outcomes) formulated in the programme's assessment plan. A single-point rubric is used to determine whether a student meets the competence level that is required to pass the test. Students are informed about the way assessments are performed in the student manual on Blackboard.

Execution of assessment policy

When carrying out assessments, the lecturers are bound by the principles of the Hanze UAS' Assessment and Evaluation Workbook. It provides guidance for all stages of the assessment cycle. There is a variety of assessment types used in the programme in order to cover the range of competencies. It includes written and digital exams, individual and group assignments, professional products, presentations and interviews. Students receive feedback from lecturers, experts and peers while preparing exercises and portfolios.

As mentioned in standard 2, the programme facilitates prep courses in order to ensure that students have gained the knowledge required on time. Therefore, students have to pass their preparatory subjects either with an assessment or a granted exemption within the first half year. In order to check students' progress, missed opportunities for tests are marked in the progress list of the students so they can monitor their own progress better. Some stricter deadlines for assignments have also been implemented.

Quality assurance

During the site visit, the panel noticed that great value is attached to examiners' professionalism. The Examination Board emphasized that it is convinced that the examiners it appoints are capable of carrying out the task assigned to them well and thoroughly. The panel has found that all examiners have the BKE qualification and are therefore authorized to act as examiners. As far

as the panel is concerned, there is sufficient reason to state that they are indeed doing their work properly. However, the panel believes that the role of the Examination Board can be strengthened. At this time the board is responsible for checking whether procedures have been followed correctly and is not as such involved in the actual supervisory and validation task. In the panel's view, however, that is also a responsibility of the board. On this point, the panel draws a comparison with the way in which the Assessment Committee conducts its tasks. From the documentation studied (ILTS Assessment Policy) and from the conversation that took place during the site visit, the panel understands that the Assessment Committee checks the quality of written exams on the basis of random samples. A Test Scan Form is used for the so-called Large Scan procedure. The outcome of this scan is discussed with the examiners concerned and helps them to improve the quality of the assessments. The panel's advice is to describe the role of the Examination Board in the quality assurance of the graduation level in a similar way. Although chapter five of the ILTS Assessment Policy describes that the exit level is safeguarded by checking whether the programme carries out the Graduation Manual, the panel noticed that it is not sufficiently made clear what the Examination Board bases its confidence on that the learning outcomes have been met in terms of content.

During the site visit it was discussed that the graduation theses are assessed in constantly changing pairs of examiners. This assumes that continuous calibration takes place. The panel notes that the small circle of examiners might jeopardize the quality of the calibration in the long term. It is to be considered to organize calibration sessions with colleagues external from Hanze at appropriate intervals, as already happened during the calibration of September 2023 mentioned in the SER.

Standard 4 Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Conclusion
Based on the considerations mentioned below, the audit panel has assessed that the Master 's programme Data Science for Life Sciences **meets** the generic quality requirements for standard 4. The panel notes that the intended learning outcomes are realised. Graduation products are relevant and appropriate for the intended level. Not only is the professional field highly satisfied with the students that have finished the programme, but students and alumni report that they have learned a great deal and that what they have learned is relevant and that this concerns current knowledge and skills. Moreover, students have learned how to learn. In this way, they have capabilities to continue acquiring needed knowledge at later stages in life. With this upcoming differentiation in the Data Science module the programme is even better able to serve both the more academic work field and the business community in the field of data science. The panel encourages the programme in particular to continue to actively support international students during their preparations for graduation and finding suitable internships.

Substantiation
Graduation process
Prior to the graduation semester students start with the preparation phase in which they propose their project for approval before the graduation committee. Students also search for a suitable project and during the preparation phase receive specific guidance, such as job application training. In the expanded programme (120 EC) this preparation phase starts in quarter six. The actual graduation period starts immediately after the Christmas break. Students are pleased with this. After the project proposal has been approved students start working on their master thesis. When that has been finalised students undergo a criteria-based interview about their proof of competence in which they reflect on the competences they have achieved and developed during their studies. This proof is conditional before taking the final assessment and must be completed with a passing grade. The final assessment is based on the practical work and performance, the thesis and the oral presentation and defence (question and answer session). The process is completed in an exam session of approximately two hours in which the candidate, the first and second examiner and the company supervisor take part. This last-mentioned person advises on the student's performance within the company, institute, or professorship. In a grading session both examiners strive for consensus on the assessment. If they cannot reach an agreement, a third examiner will be involved. The final grade is then obtained by a weighted sum of the individual scores of the practical work (25%), the thesis (60%) and the defence (15%). All three scores need to be at least 5,5 out of 10.

The graduation process typically takes place externally at research institutions such as universities, (academic) hospitals, public research institutions and companies. Sometimes a student carries out a semi-external graduation project at a research centre of Hanze UAS. This is always an individual assignment. The process of graduation is monitored in Onstage, the digital monitoring and registration system of Hanze UAS. Rules and procedures regarding the graduation process are outlined in a Graduation Manual.

Level of intended learning outcomes in graduation products
The panel studied fifteen graduation files of less than two years old. The selected theses reflect a wide diversity of topics that match the nature and level of the programme. The assignments are up-to-date as well as relevant to the professional practice. These projects are real-life complex research projects with outcomes that are unknown beforehand. In a case where applicability was not evident, the assessment explicitly stated why the subject was nevertheless considered valid and the thesis was assessed. The panel was satisfied with their findings in this regard. Examples of subjects are:

- Feasibility study on defining beer types and quality by means of image processing and machine learning.
- Prediction of novel compounds for research into disease-nutrient interactions based on chemical similarity.
- Developing an integrated and interactive dashboard for predicting the effect of multiple anaesthetic drugs.

In the panel's opinion, the substantive assessment was carried out carefully.

Functioning of alumni in the work field
During the site visit the panel spoke to some of the members of the Professional Board from the work field (WAC). They spoke of the high-performance level of graduate-students they have been supervising, and likewise of those who started a PhD-track after their master's. Alumni also are full of praise for the programme. During the start of their working lives, they experienced that the MDSLS provided them with a sound knowledge base and applicable skills. They have learned how to learn, so that they can independently acquire missing or additional knowledge and skills during their professional careers.
According to the data provided by Hanze, most graduates find relevant employment within three months. After a year over 90% of the graduates have been employed. As much as fifteen percent of the alumni start a PhD after graduating. A reasonable share of the other graduates find jobs such as data scientist in life sciences (58%) or in a different sector (42%). There is evidently an increasing demand for data scientists for life sciences in the Netherlands. Most graduates (68%) find their first job in the Groningen region. Thirteen percent moved abroad.

Final Conclusion

Assessments of the Standards

The audit team comes to the following judgements regarding the standards:

	Master Data Science for Life Sciences
Standard 1 Intended Learning Outcomes	Meets the generic quality requirements.
Standard 2 Teaching-Learning Environment	Meets the generic quality requirements.
Standard 3 Student Assessment	Meets the generic quality requirements.
Standard 4 Achieved Learning Outcomes	Meets the generic quality requirements.

The judgements have been weighed in accordance with the NVAO assessment rules. Based on this, the audit panel assesses the quality of the existing **Master's programme Data Science for Life Sciences** of Hanzehogeschool of Applied Sciences Groningen as **positive.**

Recommendations

The audit panel has no recommendations for the programme.

Appendices

Appendix 1: Programme for the Site Visit

Time	Conversation partners/activity *EB = Examination Board;* *AC = Assessment Committee;* *PC = Programme Committee*
8.45-9.00	**Reception (Dutch/Nederlands)** Team Manager Master and Project Leader Visitation
9.00-9.15	Internal consultation panel
9.15-9.30	**Demonstration OnStage**
9.30-10.00	**Management team (Dutch/Nederlands)** Dean Institute for Life Science & Technology Team Manager Master Senior Lecturer
10.00-10.15	Break / internal consultation panel
10.15-10.45	**Guided tour facilities**
10.45-11.00	Break / internal consultation panel
11.00-12.00	**Students (English)** First year First year Second year Second year, part-time First year First year, student member PC
12.00-12.45	Lunch / internal consultation panel
12.45-13.45	Lecturers (Dutch/Nederlands) Senior Lecturer Lecturer Lecturer Lecturer Senior Lecturer / Chairperson PC
13.45-14.00	Break / internal consultation panel
14.00-14.45	Committees (EC, PC and AC) (Dutch/Nederlands) Chairperson EB Chairperson PC Chairperson AC Member EB
14.45-15.00	Break / internal consultation panel
15.00-15.45	Alumni / Field representation (English) UMCG University of Groningen Lector Hanze UAS BioBTX B.V. Alumnus Alumnus Alumnus
15.45-16.30	Assessment discussion by the panel
16.30-17.00	Pending issues Option for consultation management
17.00	Final impression with feedback panel

Appendix 2: Documents Examined

Self-Evaluation Report

Teaching and Examination Regulations Master Data Science for the Life Sciences, 2023-2024
Educational profile Master Data Science for the Life Sciences
Student Manual Master Data Science for the Life Sciences, 2023-2024
ILTS Quality assurance plan 2023
Master Data Science for Life Sciences Improvement Plan with appendices
Overview staff 2023-2024
Assessment policy Hanze UAS Dutch
Assessment policy ILTS
Graduation Manual Master Data Science for the Life Sciences 2018-2019
Graduation assessment form
Jaarverslag examencommissie ISLT 2022-2023 (Annual Report by the Exam Board; the panel read this in Dutch, but an English version is also available)
Minutes OC 3x (Education Committee, June – December 2023)
Minutes Professional Board, June 2023, with invitation
Presentation Professional Board, October 2023
Evaluation and minutes meeting UMCG

Fifteen graduation reports with assessment forms
Selection of students' work with assessment forms for the following exams: Final Portfolio, Bayesian and Frequentist Statistics, Graph Theory, Integrated Omics, Multivariate Analysis, Prep Omics, Programming 1, Signal Analysis.

Appendix 3 – Initial and updated master's programme

Initial master's programme (cohorts 2019-2022)

Semester 1			Semester 2		
Quantified Self			Integromics		
Course	**EC**	**AT**	**Course**	**EC**	**AT**
Prep course:					
Data science and/or	*2.5	W	Data Science II	5	C
Programming and/or	*2.5	C	Data Science III	5	C
Omics	*2.5	W	Programming II	5	C
Data Science I	5	C	Omics Project: Integromics	10	P
Programming 1	5	C	Research & Professional Skills	5	D
Data Science for Personal Health	10	P			
Research & Professional Skills	5	D			
Total	**30**		**Total**	**30**	

Semester 3		
Graduation		
Course	**EC**	**AT**
Graduation project	30	P/O
Total	**30**	

D = Digital Porfolio / Proof of Competence
W = Written Exam
C = Computer Exam
P = Professional Product
A = Assignment
O = Oral Exam
EC = European Credits
AT = Assessment Type
* = Choose 2

Updated master's programme (cohort 2023-2024)

Year 1	**Quarter 1**			**Quarter 2**		
	Data Science for Personal Health (1)			**Data Science for Personal Health (2)**		
	Course	**EC**	**AT**	**Course**	**EC**	**AT**
	Prep course:			Data Science II	5	
	Data Science I and/or	*5	W	Bayesian statistics	50%	C
	Programming I and/or	*5	A	Numerical analysis	50%	C
	Omics I	*5	W	Programming II	5	A
	Data Science for Personal Health	2.5		Data Science for Personal Health	2.5	
	Research & Professional Skills	2.5		Research & Professional Skills I	2.5	
	Total	**15**		**Total**	**15**	
	Quarter 3			**Quarter 4**		
	Data Science for Personal Health (3)			**Integromics (1)**		
	Course	**EC**	**AT**	**Course**	**EC**	**AT**
	Data Science III	5		Data Science IV	5	
	Linear Algebra	50%	W	Graph Theory	50%	C
	Signal Analysis	50%	C	Multivariate Analysis	50%	C
	Programming III	5	A	Programming IV	5	A
	Data Science for Personal Health	5	P	Omics Project: Integromics	5	A
	Total	**15**		**Total**	**15**	

Year 2	**Quarter 5**			**Quarter 6**		
	Integromics (2)			**Integromics (3)**		
	Course	**EC**	**AT**	**Course**	**EC**	**AT**
	Data Science V	5	A	Data Science VI	5	
	Programming V	5	A	Deep learning	50%	A
	Omics Project: Integromics	2.5		Unsupervised learning	50%	A
	Research & Professional Skills	2.5		Programming VI	5	A
				Omics Project: Integromics	2.5	P
				Research & Professional Skills	2.5	D
	Total	**15**		**Total**	**15**	
	Quarter 7			**Quarter 8**		
	Graduation					
	Course	**EC**	**AT**	**Course**	**EC**	**AT**
	Graduation	15	P/O	Graduation	15	P/O
	Total	**15**		**Total**	**15**	

D = Digital Portfolio / Proof of Competence
W = Written Exam
C = Computer Exam
P = Professional Product
A = Assignment
O = Oral Exam
EC = European Credits
AT = Assessment Type

* One shall be exempted
** BFVM23DSPH 3 quarters total = 10, assessed at end Q3
*** BFVM23RPS 4 quartes in total = 10, assessed at end Q6
**** BFVM23PRJOMICS 3 quarters total = 10, assessed at end Q6