Netherlands Quality Agency

NQA

Hanzehogeschool
Groningen
University of Applied Sciences

Netherlands Quality Agency B.V.

Hanze University of Applied Sciences

Master Data Science for Life Sciences

Assessment of request to expand the study load to 120 EC

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Contents

Introduction
This is the assessment report of the request to expand the study load of the Master programma Data Science for Life Science offered by Hanzehogeschool.

The assessment was conducted by an audit panel compiled by Netherlands Quality Agency (NQA) commissioned by Hanzehogeschool, Groningen, university of applied sciences. Prior to the assessment process the audit panel had been approved by NVAO.

In this report NQA gives account of its findings, considerations and conclusions. The assessment was undertaken according to the NVAO *Protocol Verlenging reguliere studielast (Protocol extension regular study load)*, maart 2022 and the *NQA Guideline 2019 for Limited Programme Assessment.*

The online visit took place on September 23, 2022. See appendix 1 for the audit schedule.
The audit panel consisted of:
dr. ir. K.A. Feenstra (Chair, domain expert)
dr. G.J. Kuipers (domain expert)
ing. M. Demeyere (domain expert)
L. van der Meer (student member)
and drs. Y.E. Leegstra, NQA auditor, acted as secretary of the panel.

Method of working of the panel and process
For the assessment, the study programme offered an information dossier with appendices (see appendix 2). Additionally, to establish their own opinion of the level of the graduation programme, the domain experts in the panel studied four graduation master theses of graduates who recently finished their studies.

Central in the assessment was the online visit by the panel, consisting of expert peers. To prepare the visit the panel held a preliminary meeting. In the preliminary meeting the panel members have been instructed about NQA's method of working and about the *NVAO-Protocol.* In this meeting the panel members also discussed their tentative findings. After this meeting, some additional information was shared by the progamme manager, see appendix 2. During both the preliminary meeting and during the online visit, the panel members shared their findings with each other continuously. During the online visit the panel spoke with various stakeholders of the study programme, such as students, lecturers (assessors), alumni and representatives of the work field. At the end of the online visit the panel incorporated all the information it had obtained in an overall picture and in a tentative substantiated assessment. In the final oral feedback session the panel chair communicated the conclusive assessment and the major findings of the panel.

After the online 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 where necessary, have adapted the report. Subsequently, the report was established as definitive. With all information provided (orally and in writing) the panel has been able to make a deliberate judgement.

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

Utrecht, *7th November 2022*

dr. ir. K.A. Feenstra   drs. Y.E . Leegstra
Chair   Secretary

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. 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. It aspires a personal atmosphere and a rather small student-lecturer distance. The students conduct a lot 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 The Life Sciences (hereafter: the programme) started in February 2019 after a positive initial review of 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 specialized in data-driven methodologies that play an increasingly prominent role in the life sciences (source: Teaching and Examination Regulations 21-22).

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	49300
Orientation and level study programme	Higher profession-oriented education (hbo)
Level study programme	master
For study programmes in higher profession-oriented education, the addition which is used for the degree.	Master of Science
Model of study	Full time
Number of study credits	To be raised to 120 EC, currently 90 EC.
Variant (s), including a possible 3-years track for VWO (pre-university education) in case of a study programme of higher profession-oriented education	N/a
Location(s)	Groningen
Teaching language	English

Substantiation of the request

In September 2022 the master's programme Data Science for Life Sciences (hereafter: the programme) was visited by an audit panel from NQA to assess the request of the programme to expand the study load to 120 EC. The programme currently has a one and a half year full-time curriculum and wants to extend the curriculum to a two year full-time programme. The audit panel advises that it is necessary to expand the study load of the programme from 90 EC to 120 EC. This higher study load is necessary for students to be able to reach the intended learning outcomes required by professional field, with an acceptable study pressure for students and within the time legally determined for the programme.

Learning outcomes and content of the programme

Through studying the supplied documentation (see appendix 2) and the conversations with representatives, the panel establishes that the level of the intended learning outcomes and the content of the programme are in line with the requirements of the professional field and the members of the panel. Furthermore, they are comparable with intended learning outcomes of other similar (120 EC) master's programmes, for example Bioinformatics and Systems biology of the Vrije Universiteit. The intended learning outcomes and content of the programme were developed in cooperation with the Professional board of the programme to ensure that the learning outcomes were in line with (international) professional expectations. The Professional Board consists, among others, of staff members from Universitair Medisch Centrum Groningen (UMCG), University of Groningen (RUG) and BioBTX (a start up at Groningen that produces BTX from biomass and plastics).

During the online site visit, representatives of the professional field told the panel that they were more than satisfied with the knowledge and professional attitude of the students they work with during the graduation projects and of the alumni they work with as employees. The representatives also mentioned that they would rather add some flexibility for students to the curriculum than eliminate any subjects. According to them, it is also not necessary to add any additional subjects or material. The panel concludes that the professional field is actively participating with the programme. The representatives are very enthusiastic about the students and the intended learning outcomes of the programme.

Work load

The reason for requesting an expansion of the study load to 120 EC is based on the very high work load and pressure of the preparation for exams in the three different areas of knowledge of the curriculum that students are experiencing. At the moment of the online site visit, four cohorts of students had started and followed the curriculum of the programme. Most students are not able to complete the curriculum within one and a half year.

As a first remedy, the programme managers, in consultation with the Professional Board, have introduced additional entry requirements from September 2020 onwards. In addition to holding a relevant Bachelor degree in the field of Chemistry/Biology research or informatics, prospective students have to provide proof of competence for the entry requirements of data science and programming. If this cannot be proven in a relevant portfolio, the student has to pass an entry exam in these subjects. This has resulted in a much lower drop-out rate: of the September 2019 cohort 11 of the 15 students deregistered before graduation versus 6 of 14 students of the 2020 cohort. Of the 2021 cohort only 2 students have dropped out so far.

However, many students still do not manage to pass the curriculum within the expected time span of 18 months: only four students out of the remaining 8 students of the 2020 cohort graduated within the designated time span. The students who did not finish the course or did not finish within 18 months, stated this was due to the excessive study load per week and the speed in which they had to master the complicated concepts for the exams. The students of the 2021 cohort and even the new students of the 2022 cohort also complained that they have to study for too many exams during the first year. Formal evaluations under the students show that 55% of the students spend more than the expected 40 hours a week on their study, with 12% even indicating that they study for 56 to 60 hours.

The panel has discussed the pressure the students face completing the curriculum with the students and alumni during the online site visit. They have told the panel that it is difficult to obtain a deep knowledge of topics offered within the given timeframe and that they only study (superficially) for the exams. Many students face resits, which only adds to the study pressure. Representatives of the professional field told the panel that students often have to take resits during the graduation project. The companies/university have to accommodate students in this, which negatively impacts the focus and time it takes to complete the projects students work on. The teaching staff confirmed to the panel that they struggle to teach the complicated concepts in the designated teaching hours and often organise extra help in their own time. The study load also negatively influences the mental health of all students: especially the international students, that have a limited 'social safety net' and have a budget that is restricted to exactly one-and-a-half year of studies, suffer mentally. The panel was impressed by the efforts the teaching staff take to accommodate and coach the students in every way they can, also outside the classroom. The pressure of the study load within the 18 months clearly takes a toll on all involved, the panel noticed.

The management attempts to increase the number of students enrolled. However, the somewhat critical attitude of the current students because of their sometimes negative experiences hampers the enrolment of prospective students from the preferred prior qualifications: the bachelor programmes of Bioinformatics and Biology & Medical Laboratory Research at Hanzehogeschool. The National Student Survey (NSE) results of the programme are currently below average, which may make the desired prospective students hesitant to start the master programme.

All representatives the panel spoke with, indicated that they do not recommend to remove part of the subjects covered in the curriculum or shorten projects/graduation. The curriculum is seen as well-balanced and covers all relevant aspects of knowledge in life sciences, data science and programming, which are seen as necessary for jobs and research positions in the work field. The panel concludes that the intended learning outcomes are as required by the professional field and recommends that these should not be changed. But the panel sees that a time span of 18 months (90 EC) is too short to get the expected deep understanding of all concepts the intended learning outcomes includes reach the level required at graduation in a timely and orderly manner.

Functioning of alumni in the work field
Aside from the stated learning outcomes, it has always been the intention of the programme founders and their professional partners that alumni of the programme would qualify for relevant PhD-positions. At the time of the online site visit, five alumni held PhD-positions within UMCG,

which leads the panel to the conclusion that the programme has reached its goal. Other positions the alumni hold, are also in the areas and at levels the panel would expect to see after a biomedical data science master's programme: data analyst at UMCG genetics, data architect at Johnson and Johnson and business intelligence consultant at Martiniziekenhuis for example.

A number of alumni is trying to secure PhD positions outside UMCG/RUG. The programme management learned that this is very difficult as national and international universities are expecting master programmes of 120 EC, especially from a University of Applied Sciences. An analysis of national and international comparable programmes found that all curricula encompass at least 120 EC (180 EC in the UK). A comparable programme of 90 EC could not be identified. The panel endorses the findings of the programme and includes the (inter)national requirement of 120 EC for a data science/life science programme, that qualifies as a start for a PhD position, as further substantiation for the recommendation to expand the study load.

Proposed changes to the teaching-learning environment
The new curriculum will not adopt new concepts. The curriculum board of the programme proposes to teach the same subjects, but to spread the introduction of the topics over a longer time. Some specific and more complex elements of the knowledge base (like Big data computing) will get more emphasis, but the subject and learning outcomes will remain the same. The introduction courses (course codes ending with 0, see Figure 1) of which students have to take two out of three, based on their prior qualifications, are also extended from 2,5 to 5 EC. The graduation process will not be changed. The students and representatives of the professional field the panel spoke with, support this approach, see Figure 1 for the proposed changes in the curriculum.

From (90 EC)	Q	Content (90 EC)	To (120 EC)	Q	Content (120 EC)	Motivation changes
			Data science courses			
BFVM19DATASC0	1	statistics, calculus, linear algebra (2.5 EC)	BFVM23DATASC1	1	statistics, calculus (5 EC)	concept of linear algebra is too complex to study in short time
BFVM19DATASC1	2	Bayesian statistics + signal analysis (5 EC)	BFVM23DATASC2	2	numerical analysis, Bayesian statistics (5 EC)	start with simple concepts, fit with stage of research
			BFVM23DATASC3	3	linear algebra + signal analysis (5 EC)	Makes more sense to combine, needed for research project in that phase
BFVM19DATASC2	3	graph theory, multivariate analysis, numerical analysis (5 EC)	BFVM23DATASC4	4	graph theory, multivariate analysis (5 EC)	2 topics instead of 3, more time to adapt to concepts
BFVM19DATASC3	4	machine learning (supervised, unsupervised), deep learning (5 EC)	BFVM23DATASC5	5	machine learning concepts and supervised (5 EC)	split in two topics, more time to adapt to concepts
			BFVM23DATASC6	6	deep learning and unsupervised (5 EC)	split in two topics, more time to adapt to concepts
			Omics courses			
BFVM19OMICS	1	biology (2.5 EC)	BFVM23OMICS1	1	biology (5 EC)	more time to adapt to concepts
BFVM20DSPH	1, 2	research project (10 EC)	BFVM23DSPH	1,2,3	research project (10 EC)	less concentrated, more time to conduct the research
BFVM19OMICSINT (first 3 weeks)	3	introduction omics (3 EC)	BFVM23OMICS2	4	Omics II (5 EC)	background introduction in the different research projects and technologies
BFVM19OMICSINT (second part)	3,4	integrated omics research project (7 EC)	BFVM23OMICSINT	4,5,6	integrated omics research project (5 EC)	less concentrated, more time to conduct the research
			Programming courses			
BFVM19PROGR0	1	python basics, intro OO (2.5 EC)	BFVM23PROGR1	1	python basics, Linux basics, intro OO (5 EC)	students missed the Linux part, so this is added
BFVM19PROGR1	2	data processing and exploration (5 EC)	BFVM23PROGR2	2	data processing and exploration categorical data, non-time related (5 EC)	split in two topics, more time to adapt to concepts
			BFVM23PROGR3	3	data processing for signal analysis / streaming data (5 EC)	
BFVM19PROGR2	3,4	OO, design patterns, big data computing (5 EC)	BFVM23PROGR4	4	OO, design patterns (5 EC)	split in three topics, more time to adapt to concepts
			BFVM23PROGR5	5	big data computing (5EC)	split in three topics, more time to adapt to concepts
			BFVM23PROGR6	6	pipeline, cluster computing (5 EC)	split in three topics, more time to adapt to concepts, topics were introduced in 2018 but discarded in 2020 due to time constraint

Figure 1: Changes in content modules 90 and 120 EC programme. (Q = quarter)

The programme management is convinced that allowing teachers and students more time to explore the concepts in data science and life sciences will ensure that students complete the programme within 120 EC, or two years. They will have a lower risk of having to do several resits, which interfere with the regular planning and the graduation project. The professional skills and the graduation tracks will remain unchanged.

The panel has studied the new curriculum in detail and supports the proposed implementation of the extension of the study load. As a non-binding advice, the panel suggests that the curriculum board might explore the possibility of giving the students more flexibility. This could be in the form of a longer graduation project or by taking an elective course from (another) university programme to deepen the knowledge in a specific field. This should of course not lead to extra workload for the teaching staff, nor for the students themselves.

Part of the changes in the curriculum is the switch from testing with computer based knowledge tests to testing with (ongoing) assignments. The teachers feel that students are better enabled take charge of their study load if they make their own planning within assignments, which are spread throughout the teaching periods. Working with the topics for a longer period instead of a short burst of study for an exam should lead to better understanding. The alumni and current students the panel spoke with, endorse this approach but warn the management to ensure that the assignments are made by the individual student and do not lead to procrastination and delay. The panel agrees with this point of view and advises the programme to monitor if students still gain the individual requested knowledge in a timely manner.

Conclusion
The panel is impressed with the curriculum, the teaching team, the alumni and the students they met. The professional field is actively involved and very satisfied with the level that students reach. Both the panel and the Professional Board of the programme are of the opinion that the intended learning outcomes should not change, as the demand in the professional field for people at this level is very high. Therefore, the panel recommends that the study load of the master programme Data Science for Life Sciences should be extended to 120 EC to enable a healthy study environment for students and their teachers.

Appendices

Appendix 1: Programme for the online visit

23/9/22

Time	Discussion partners
10.00-11.00 u	**Managementteam, lecturers and chairmen committees** - dean Instituut voor Life Science and Technology - opleidingsmanager DSLS - opleidingscoördinator en docent DSLS - voorzitter Opleidingscommissie, docent, afstudeerbegeleider DSLS - voorzitter examencommissie - docent en mentor DSLS
11.15-12.15	**Work field partners and students** -UMCG Genetica -RUG Computational Mass Spectrometry -Hoofd Bio-informatica Ancora Health -student cohort 2021, lid opleidingscommissie -alumnus cohort 2020, PhD UMCG Hematology/Radiation Oncology -alumnus cohort 2020, BI consultant Martini Ziekenhuis
12.45-13.00 u	Verdict panel

Appendix 2: Documents Examined

Information dossier for Accreditations Master Programme to 120 EC, 2022

Teaching and Examination Regulations Master Data Science for the Life Sciences, 2021-2022

Student Manual Master Data Science for the Life Sciences, 2021-2022

Graduation Manual Master Data Science for the Life Sciences 2018

Professional Board June 2020 curriculum analysis (document Professional Board)

Four examples of Graduation reports (Dated May 2020, June 2021, October 2021, May 2022)

Information on testing, the new curriculum and study success

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Appendix 3 International masterprogrammes identified by DSLS

Country			
Germany	**University**	**Master**	**EC**
	Georg-August-Universität Göttingen	Applied Data Science	120
	Georg-August-Universität Göttingen	Computational Biology and Bioinformatics	120
	Georg-August-Universität Göttingen	Microbiology, Biotechnology and Biochemistry	120
	Universität zu Lübeck	Biomedical engineering	120
	Internationale Hochschule	Data Science	120
	Ludwig Maximilians Universität München	Data Science	120
	Goethe Universität	Bioinformatics	120
	Freie Universität Berlin	Bioinformatics	120
United Kingdom	**University**	**Master**	**EC**
	Birkbeck University of London	Bioinformatics	180
	Swansea University (Wales)	Health Data Science	180
	The University of Edinburgh	Data Science	180
	University College London	Health Data Science	180
	University College London	Health Data Analytics	180
	University College London	Health Informatics	180
	University College London	Nanotechnology and Regenerative Medicine	180
Belgium	**University**	**Master**	**EC**
	University of Antwerp	Data Science and Artificial Intelligence	120
	De Vrije Universiteit Brussel	Computer Science	120
	Catholic University of Leuven	Bioinformatics	120
	Catholic University of Leuven	Nanotechnology and Nanoengineering	120
Luxembourg	**University**	**Master**	**EC**
	Université du Luxembourg	Data Science	120
	Université du Luxembourg	Integrated systems biology	120
	Université du Luxembourg	Information and computer science	120
Sweden	**University**	**Master**	**EC**
	Lund University	Bioinformatics	120
	Lund University	Nanoscience	120
Denmark	**University**	**Master**	**EC**
	University of Copenhagen	Bioinformatics	120
	University of Copenhagen	Nanoscience	120
	University of Copenhagen (in China)	Nanoscience and Technology	120
	Technical University of Denmark	Bioinformatics and systems biology	120
	Technical University of Denmark	Physics and Nanotechnology	120

	University	Master	EC
	Technical University of Denmark	Quantitative Biology and Disease Modelling	120
Finland	**University**	**Master**	**EC**
	University of Turku	Biosciences/ molecular systems	120
	University of Turku	Biology Biomedical Sciences/Molecular Biotechnology and Diagnostics	120
Austria	**University**	**Master**	**EC**
	FH Campus Wien	Bioinformatics	120
	Universität Wien	Bioinformatics	120
	Universität Wien	Data Science	120
Italy	**University**	**Master**	**EC**
	University of Bologna	Bioinformatics	120
Australia	**University**	**Master**	**EC**
	Edith Cowan University	Bioinformatics	120
New Zealand	**University**	**Master**	**EC**
	University of Auckland	Biotechnology	180
	University of Auckland	Data Science	180
Netherlands	**University**	**Master**	**EC**
	University of Groningen	Nanoscience	120
	University of Groningen	Artificial Intelligence	120
	Leiden University	Artificial Intelligence	120
	Leiden University	Advanced Computing and Systems	120
	Leiden University	Bioinformatics	120
	Leiden University	Statistics and Data Science	120
	VU Amsterdam & University of Amsterdam (joint degree)	Bioinformatics and Systems Biology	120
	VU Amsterdam	Artificial Intelligence	120
	Wageningen University & Research	Data Science for Food and Health	120
	Wageningen University & Research	Bioinformatics	120
	Utrecht University	Artificial Intelligence	120
	Utrecht University	Bioinformatics and Biocomplexity	120
	Radboud University	Artificial Intelligence	120
	Saxion University of Applied Sciences	Applied Nanotechnology	120

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