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Medical Informatics

University of Amsterdam

Bachelor's and master's programme

Report of the limited programme assessment

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Executive summary

Bachelor's programme Medical Informatics

The outcome of the external assessment of the bachelor's programme Medical Informatics (MI) of the University of Amsterdam by an NVAO approved panel is positive.

The three-year fulltime bachelor's programme aims to train medical informatics specialists who, from a scientific basis, can solve complex informatics problems at the interface of healthcare and Information and Communication Technology (ICT). The panel agrees that this exemplary programme responds to the high need in healthcare for specialised professionals with competencies at the interface of healthcare and ICT. Graduates of the MI bachelor's programme are qualified for junior positions in this professional field.

The programme translated its aims into a set of exit qualifications. These exit qualifications clearly reflect the level that may be expected of graduates of a bachelor's programme and are well aligned with the international requirements of the field. The panel appreciates the way the exit qualifications address soft skills. However, the panel advises rephrasing the content related exit qualifications in a more specific manner to better align with the actual content of the programme.

The panel is positive about the recent thorough revision of the curriculum. The new curriculum combines a strong focus on academic and professional skills with knowledge from different relevant disciplines. The curriculum discerns six learning pathways: 1) Health & Disease, 2) Organisation of Healthcare, 3) Informatics, 4) Interdisciplinarity, 5) Academic Competencies (AC), and 6) Professional Competencies (PC). In addition, the curriculum is organised around five themes: 1) the healthy human, 2) cardiovascular risk management, 3) mental health, 4) registrations (IC, obstetrics, renal), and 5) oncology and pulmonary diseases. The combination of learning pathways and themes offer a good structure to work on the medical informatics content in an interdisciplinary context.

The panel is pleased that students have the possibility to adapt the programme to their personal interest or ambitions by choosing 18 EC electives. However, it advises the programme expanding the number of possible electives and better informing students of the choices available to them.

The curriculum provides students ample opportunities to train their research skills and professional skills and to transcend disciplinary boundaries. The panel appreciates that students gain research experience during their bachelor's thesis at the Amsterdam UMC, or at an approved (international) institution or company.

The panel welcomes the highly interactive learning environment that stimulates interaction and cohesion amongst students and staff. The panel is convinced that the programme's approach of collaborative learning is supportive for the learning process of the students.

The panel thinks highly of the staff members, who are acknowledged scientists in their field and take supervision and tutoring of the bachelor's students very seriously. The recent recruitment of seven junior temporary staff lecturers relieves the workload of the teaching staff. The panel encourages the management to find a way to offer these junior staff members a permanent contract.

The programme has a clear framework for assessment and the panel applauds the strong alignment of the exit qualifications, the teaching methods, and assessment methods. The panel appreciates that the programme does not only use assessment to evaluate the performance of the student, but also uses assessment as a tool to guide students in their study behaviour. The revised curriculum added the use of the portfolio in which students collect the assignments of the Academic Competencies and

Professional Competencies (ACPC). The panel values the development of this portfolio system and encourages the management to expand this further, for example by including the development of the student in relation to the other learning pathways. The Examinations Board is well organised and safeguards the quality of the assessments in a proactive and structured manner.

The panel is pleased with the quality of the bachelor's theses it examined. The theses showed that graduates are capable of employing acquired knowledge and insights to solve informatics problems arising in the healthcare sector, and to justify the choices made and prepare a written or verbal report. Graduates are well prepared to continue to the job market in a junior position or to continue to a master's programme. Master students and alumni who did the MI bachelor's programme, confirmed that the bachelor's programme is preparing students adequately for a follow-up study at master level.

Master's programme Medical Informatics

The outcome of the external assessment of the master's programme Medical Informatics (MI) of the University of Amsterdam by an NVAO approved panel is positive.

The two-year fulltime master's programme aims to train medical informatics specialists who, from a scientific basis, can solve complex informatics problems at the interface of healthcare Information and Communication Technology (ICT). The panel agrees that this exemplary programme responds to the high need in healthcare for specialised professionals with competencies at the interface of healthcare and ICT. Graduates of the MI master's programme are qualified for key positions and research positions in this professional field.

The programme translated its aims into a set of eight exit qualifications. These exit qualifications clearly reflect the level that may be expected of graduates of a master's programme and are well aligned with the international requirements of the field. To do better justice to the interdisciplinary nature of the programme, the panel advises making more explicit references to interdisciplinary skills.

The master's programme is based on four learning pathways that reflect the main themes of the programme: the pathway 'Advanced Medical Data Analysis', the pathway 'Management of Healthcare Organisations', the pathway 'Sustainable eHealth', and the pathway 'Academic Skills'. Each pathway consists of a meaningful cluster of related courses.

The panel is positive about the well organised, coherent, and highly motivating curriculum. The first year of the curriculum consists of eight compulsory courses and two four-week internships. During these two short internships, students link the themes from the courses to research projects in the Amsterdam UMC. The second year starts with 18 EC electives, followed by the Scientific Research Project (SRP, 42 EC). The course assignments, the internships and extensive SRP provide students ample opportunities to train their research skills and professionals skills and to transcend disciplinary boundaries.

The panel appreciates the on-going revision of the programme. The panel is very positive about the introduction of the two elective tracks enabling students to specialise in a subdomain of medical informatics: 'Artificial Intelligence for Health' and 'Sustainable eHealth solutions'. The panel also welcomes the introduction of two separate compulsory courses on academic skills and management skills.

Each year, around 25 students enter the master's programme. Given the high need for highly educated professionals in the field of medical informatics, the panel encourages the programme to

make a sound strategy to stimulate the inflow of both national and international students in a more proactive way.

The panel welcomes the highly interactive learning environment that stimulates interaction and cohesion amongst students and staff. The panel is convinced that the programme's approach of collaborative learning is supportive for the learning process of the students.

The panel thinks highly of the staff members, who are acknowledged scientists in their field and take supervision and tutoring of the students very seriously. The recent recruitment of seven junior temporary staff lecturers relieves the workload of the teaching staff. The panel encourages the management to find a way to offer these junior staff members a permanent contract.

The programme has a clear framework for assessment and the panel applauds the strong alignment of the exit qualifications, the teaching methods and assessment methods. The panel appreciates that the programme does not only use assessment to evaluate the performance of the student, but also uses assessment as a tool to guide students in their study behaviour. The revised curriculum added the use of the portfolio in which students collect the assignments of the academic skills courses. The panel values the development of this portfolio system and encourages the management to expand this further. The Examinations Board is well organised and safeguards the quality of the assessments in a proactive and structured manner.

The panel is pleased with the quality of the master's theses it examined. The theses showed that the students are able to develop and implement interventions in medical informatics, as well as evaluating them through research. The panel established that graduates can arrive at new insights and possibilities for application and can integrate complex material into a broad or multidisciplinary context of the medical informatics field. The panel concludes that graduates are well prepared for a position as a researcher or medical informatics specialist.

The chair and the secretary of the panel hereby declare that all panel members have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 6 July 2022

1. Introduction

1.1 Administrative data

Name of the programme:	Medische Informatiekunde
CROHO number:	56573
Level of the programme:	Bachelor
Orientation of the programme:	Academic
Study load:	180 EC
Location:	Amsterdam
Variant:	Full-time
Submission deadline:	1 Nov 2022

Name of the programme:	Medical Informatics
CROHO number:	66573
Level of the programme:	Master
Orientation of the programme:	Academic
Study load:	120 EC
Location:	Amsterdam
Variant:	Full-time
Submission deadline:	1 Nov 2022

1.2 Introduction

This report focusses on the assessment of the bachelor's programme and master's programme Medical Informatics of the University of Amsterdam. The assessment is based on the standards and criteria described in the NVAO Assessment Framework for the Higher Education Accreditation System of the Netherlands 2018 (limited framework).

The panel that assessed the bachelor's programme and master's programme Medical Informatics consisted of the following members:

- Prof. dr. John Mantas, professor of Health Informatics and director of the Laboratory of Health Informatics, University of Athens, Greece (panel chair);
- Prof. dr. Alfred Winter, professor for Medical Informatics and vice-director Institute for Medical Informatics, Statistics and Epidemiology, Leipzig University, Germany;
- Dr. Lilian Minne, senior FHIR consultant at Furore;
- Dr. Harold Bok, associate professor, Department Population Health Sciences, Faculty of Veterinary Medicine, Utrecht University, The Netherlands;

- Laurens Engwegen BSc, master student Computer Science, Leiden University (student member).

The panel was supported by drs. Esther Poort, who acted as secretary.

All panel members and the secretary have signed a declaration of independence and confidentiality. In this declaration they affirm not to have had any business or personal ties with the programme in question for at least five years prior to the review.

The NVAO approved the composition of the panel on 29 November 2021.

1.3 Working method

Preparation

On 17 May 2022, the panel held an online kick off meeting. In this meeting, the panel received an introduction to the assessment framework and discussed the preliminary findings.

The programme management drew up a self-evaluation report describing the bachelor's and master's programme. This report included a chapter in which the students reflected on both programmes. The panel members prepared the assessment by analysing the self-evaluation report and the appendices provided by the programme management. The panel also studied a selection of fifteen theses of each programme and the accompanying assessment forms from the programme. The theses selection was made by the panel's secretary based on a provided list of graduates of most recent years. In the selection, consideration was given to a variation in assessments (grades) and topics.

The panel members individually formulated their preliminary findings and a number of questions they wanted to raise during the online visit. The secretary made an overview of these preliminary findings and questions and sent it to the panel members as a starting point for the preparation of the panel during the online visit.

Online Visit

The online visit took place on 24 May 2022 (see Appendix A for the schedule). During the preparatory meeting, the panel discussed the preliminary findings and decided which questions to raise in their meetings with the programme representatives. During the online visit, the panel spoke with representatives of the management, students and alumni, lecturers, and the Examinations Board. Everybody involved in the bachelor's or master's programme had the opportunity to inform the panel in confidence about matters they considered important to the assessment. No one made use of this opportunity. The panel used the last part of the online visit to evaluate the interviews and had a second meeting with the programme's management to receive answers to any remaining questions. At the end of the visit, the chair presented the panel's preliminary findings and impressions of the programme.

Report

The secretary drew up a draft report based on the panel's findings. This draft report was presented to the members of the panel and adjusted on the basis of their feedback. After adjustments, the draft report was sent to the institution for verification of factual inaccuracies. The secretary discussed the

programme's comments with the chair, after which the secretary drew up the final report and circulated it to the panel for a final round of comments.

The report follows the four standards of the NVAO's Assessment Framework 2018 (limited framework): 1) the intended learning outcomes, 2) the teaching-learning environment, 3) assessment, and 4) achieved learning outcomes. Regarding each of the standards, the assessment panel gave a substantiated judgement on a three-point scale: meets, does not meet, or partially meets the standard. The panel subsequently gave a substantiated final conclusion regarding the quality of the programme, also on a three-point scale: positive, conditionally positive, or negative.

Development dialogue

Although clearly separated from the process of the programme assessment, the assessment panel members and programme representatives will conduct a development dialogue with the objective of discussing future developments of both programmes in light of the outcomes of the assessment report.

2. Review bachelor's programme

2.1 Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings, analysis, and considerations

The bachelor's programme in Medical Informatics (MI) of the Faculty of Medicine at the University of Amsterdam (UvA) is based at the Amsterdam UMC. Medical Informatics is an interdisciplinary and scientific field that aims to increase knowledge about informatics and data science methods to prevent disease, solve problems in healthcare and promote solutions. This requires effective use of biomedical data, information and knowledge, and the domain is therefore closely linked to modern Information and Communication Technology (ICT). The general aim of the bachelor's programme is to train medical informatics specialists who, from a scientific basis, can solve complex informatics problems at the interface of healthcare and ICT. Graduates of the MI bachelor's programme are qualified for junior positions in the healthcare technology domain. The panel highly appreciates this exemplary programme in the Netherlands. The panel endorses that the programme meets the high need in healthcare for specialised professionals with competencies at the interface of healthcare and ICT.

The programme clearly leverages on its setting in which it is embedded in the clinical and research environment of Amsterdam UMC, particularly in the Department of Medical Informatics. This department is interconnected with the research of the Departments of Biostatistics, Epidemiology, Family Medicine, Social Medicine, Internal Medicine, Intensive Care, Oncology, Psychiatry, Obstetrics, Cardiology, Surgery, Geriatrics and the IT Department. Many of these departments maintain relationships with external institutions in primary, hospital and specialist care and with international research networks. This strong interdisciplinary environment enables students to transcend disciplinary boundaries in their assignments, internships and research projects.

The bachelor's programme focusses on acquiring knowledge, understanding concepts and principles, process and data analysis, analysis of theories and methods, and their application. Students learn to apply their knowledge and insights to solve informatics problems arising in the healthcare sector, and to justify the choices made. The programme translated its aims into a set of eight key exit qualifications and fourteen secondary exit qualifications, which are linked to the Dublin descriptors. The panel noted that the exit qualifications are a convincing reflection of the bachelor's level as indicated by the Dublin descriptors.

The panel established that the programme is well aligned with the recommendations on education in health and medical informatics of the International Medical Informatics Association (IMIA). The programme represented the relationship between its exit qualifications and the IMIA recommendations in a detailed and consistent manner. The panel appreciates that the programme is actively involved in the development and revision of the IMIA standard. This ensures that the programme is in line with the international requirements of the field.

The panel appreciates the way the exit qualifications address soft skills. This is important to enable students to constantly adapt to new technological developments and challenges in their professional

life. However, the panel finds that the exit qualifications related to the content of the programme are formulated in rather general terms and could be more tailored to the specific content of the programme. It encourages the programme rephrasing the content related exit qualifications in a more specific manner to better align with the actual content of the programme.

The panel noted that innovation is part of the programme's DNA. Lectures are internationally active researchers who are up to date on international developments in the field and able to translate these developments into the curricula. The programme management also consults an External Advisory Council that consists of scientific and societal representatives from the professional field. The panel appreciates the way the programme responds to the rapid changes in the field by focussing on the theoretical foundations underlying medical informatics rather than 'going with the flow' and adapting all new trends in the market.

Conclusion

The exit qualifications fulfil all requirements in terms of content, level, and orientation. The programme therefore meets standard 1.

2.2 Teaching-learning environment

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

Findings, analysis, and considerations

The programme is a fulltime bachelor's programme of 180 EC, divided over sixteen courses over a period of three years. It follows the UvA's 8-8-4 system in which two 12 EC courses (eight weeks) alternate with a 6 EC course (four weeks) in two semesters.

In 2019, the curriculum of the bachelor's programme was thoroughly revised. The panel is positive about the holistic and structured approach of this major revision. The programme established a curriculum committee that consisted of representatives from the programme management, education specialists, students, advisory bodies, and the support services. The three underlying principles for the revision were: 1) incorporating the rapid content-based, technological and political developments in healthcare, 2) innovating the didactics based on blended and hybrid teaching methods and interdisciplinary projects and cases; 3) improving study success rates. The revised bachelor's curriculum (also called MI-X) will have completed one full cycle by June 2022.

The curriculum discerns six learning pathways that reflect and align the cohesion, design, and continuity of the different disciplines. These pathways are: Health & Disease (GZ), Organisation of Healthcare (OZ), Informatics (IK), Interdisciplinarity (ID), Academic Competencies (AC), and Professional Competencies (PC). The first three basic learning pathways (GZ, OZ, and IK) come together in the ID pathway. This is then supplemented with 'soft skills' in the AC and PC learning pathways. The teaching and assessment of this academic and professional competencies is integrated in the content and assessment of the different courses. Students collect the assignments in the ACPC portfolio.

During the first five semesters, the content of the courses follows a semester theme, which are chosen in consultation with healthcare professionals to cover the major clinical areas. The following

themes are recognisable in the curriculum 1) the healthy human; 2) cardiovascular risk management; 3) mental health; 4) registrations (IC, obstetrics, renal); 5) oncology and pulmonary diseases.

Students start in the first year by getting acquainted with the field of medical informatics through several basic courses on informatics, healthcare organisation and medicine. In the second year, students build on this basic knowledge with more MI-specific topics like biostatistics, medical registration, and healthcare information standards. The third year covers the more advanced MI-topics like artificial intelligence and medical image processing. During the third year, students also follow electives (18 EC) and work on their graduation project in the bachelor's internship (24 EC).

Students can choose their electives from a list of approved electives, but they can also ask the Examinations Board to approve other courses. The panel is pleased that students have the possibility to adapt the programme to their personal interest or ambitions by choosing their own electives. The students also indicated to value the elective space, but they would have appreciated more options to choose from and better information about the choices available to them.

The panel appreciates that student gain research experience during their bachelor's internship. The bachelor's internships take place at the Amsterdam UMC, location AMC or location VUMC or at an approved (international) institution or company. During the internship, the student carries out medical informatics research under supervision, and reports on it in writing in accordance with scientific standards. The student can collect the data by means of an experiment, tests, questionnaires, or interviews.

The curriculum also offers an excellence programme. One of the students the panel met, spoke very enthusiastic about this programme. This is a non-selective programme with which students can earn extracurricular credits. Interested students can participate in an extra individual excellence assignment (2 or 4 EC). This assignment deepens or broadens the standard course content. The extracurricular credits earned are visible on the diploma supplement, and if 30 EC or more credits are earned, the designation 'excellent' is added.

The programme management puts a lot of effort into continuously improving the programme. The panel compliments the management for this proactive attitude and the well thought out design of the new curriculum. The combination of learning pathways and themes offer a good structure to work on the medical informatics content in an interdisciplinary context. The panel is positive about the actions taken by the management to ensure the coherence of the programme. The themes to be covered are constantly coordinated with the course coordinators in semester meetings so that they can keep an eye on their implementation in their courses. In addition, the pathways AC and PC offer a good structure to strengthen the coherence of the programme. The assignments, internships and bachelor research projects provide students ample opportunities to train their research skills and professional skills and to transcend disciplinary boundaries.

Students indicated both in the interview and the student chapter to appreciate the content and structure of the curriculum. They highly value the extensive attention paid to the development of their academic skills and professional skills. As point of attention, they mentioned that they would have liked more attention for international aspects, for example by inviting more international guest lecturers.

The self-evaluation report provides a clear explanation how the exit qualifications are accomplished in the programme. The programme is structured according to the principle of constructive alignment. This ensures an optimal alignment of exit qualifications, course objectives, assessment and learning activities. The panel highly appreciates act-E, the self-developed Curriculum Information System (CIS). Act-E collects and organises all curriculum information in a structured manner and makes this

information available to the programme teams, lecturers, students, and support services. The panel established that the entire programme covers all exit qualifications. Overall, the panel is of the opinion that the exit qualifications found a consistent and balanced translation into a rich, varied, and transparent curriculum. The panel finds that the programme succeeds in combining a strong focus on academic and professional skills with knowledge from different relevant disciplines.

Admission and student numbers

The programme is targeted at students with a pre-university secondary education (VWO). Students with a VWO diploma may enter the programme directly, if their exam subjects included mathematics A or B. Students without a Dutch VWO diploma who have followed a programme at a similar level can enter after successfully passing an admission assessment conducted by the Examinations Board. Students who have completed a prior programme in a foreign country may enter the bachelor's programme after demonstrating that they meet the language requirements.

The annual student intake fluctuates between 30 and 50 students (average of 40 per year). Most incoming students have a VWO diploma (89%)

Teaching concept and teaching format

The curriculum committee prepared a didactic blueprint based on educational science, the IMIA recommendations, and the requirements of the programme management, advisory bodies, and students. The panel highly appreciates this well thought out vision and the way these principles are implemented in the new curriculum.

The programme is characterised by small-scale education, attention for students, a strong community, and committed lecturers. The curriculum offers an integrated and multifaceted student-centred programme with room for both extra support and challenges. Students learn through assessment and feedback and personal feedback is provided as much as possible to enhance the learning experience of students. The teaching in the programme is interdisciplinary in nature and challenges students to come up with context-specific solutions to simulated or realistic situations from healthcare practice as much as possible. Collaboration in project teams plays a key role in this.

The panel appreciates the way the programme stimulates interaction, cooperation, and cohesion amongst students and staff. Students indicated both in the interview and the student chapter to highly value the small-scale education. The small-scale character of the programme entails that it is very easy to contact lecturers in an informal way. Furthermore, the students feel respected and taken seriously by the teachers. The panel is convinced that the programme's approach of collaborative learning is supportive for the learning process of the students.

Success rate, study load, study guidance

The panel established that the programme is feasible. The success rate within three years ranges between 72% and 92%. The panel finds it positive that the assessment policy is explicitly geared at high success rates (see also standard 3).

The panel established that the programme provides intensive tutoring through its mentoring system in which students receive support with their study progress and development of metacognitive skills. A mentoring group consists of six to eight students and is supervised by a mentor. The first year comprises four group sessions that match the themes from the ACPC learning pathway,

supplemented with four individual talks (and assessment of the portfolio). The second year comprises four journal clubs and in the third year, students organise three peer feedback groups.

The panel appreciates that the programme provides the opportunity to go into depth (for example by offering the excellence programme,) and the opportunity for remediation (e.g. mathematics, programming, or academic writing) or additional counselling through mentoring or study advisers.

Staff

The programme distinguishes between course coordinators, junior and senior lecturers, and guest lecturers. The teaching staff is highly qualified, both educationally, by having obtained a UTQ (University Teaching Qualification), and by possessing relevant expertise in their field of study.

The panel is very positive about the expertise and research track records of the senior lecturers in the programme. Full professors and associate professors are well represented in the teaching staff.

The panel was pleased to learn that most senior lectures (83%) possess their UTQ or are in the process of obtaining this. Almost half of the junior lecturers (43%) have their (UTQ) and 43% of the junior lectures are still in the process of UTQ certification. Several of the staff are also in possession of the Senior Teaching Qualification (STQ), have completed the didactic leadership course of the University of Amsterdam or have been appointed principal educators (PE) in the Amsterdam UMC.

Of the 46 lectures (junior and senior) in the programme, 89% have a PhD and 7% are still in the process of obtaining a PhD.

Lecturers are very engaged with the students and supervision and tutoring are taken seriously by all staff members. The students are very positive about the teaching skills of the teaching staff. In the conversation with the panel, the students especially praised the personal involvement and dedication of their teachers.

The Teaching and Learning Centre (TLC) of the Amsterdam UMC plays a prominent role in the professionalisation of the team of lecturers by offering a broad range of courses. The panel highly appreciates the broad range of courses on new teaching methods such as blended learning, preparing multiple choice assessments, using rubrics, providing feedback, etc. The panel encourages the programme management to stimulate and facilitate all staff members to attend several professionalisation courses per year.

The management indicated during the interview that they have recently hired seven junior staff members and that this has resulted in a significant reduction in the workload for the teaching staff. The panel understands the management's concerns that these junior lecturers may not be retained because they have temporary contracts. The panel encourages the management to find a way to offer these junior staff members a permanent contract.

Facilities

The facilities enable the programme to provide small-scale and intensive education. The panel is very positive about some recent innovations. First, the multifunctional active lecture room features highly innovative audio-visual equipment that supports the chosen teaching methods, including hybrid education. Second, the eHealth lab facilitates interdisciplinary educational projects with a simulation space where private companies and students can work together on healthcare IT innovations under the supervision of lecturers.

COVID-19

During the COVID-19 pandemic, the programme management and the lecturers made great efforts, in a very short timeframe, to transform what had been primarily physical education up to that point into online variants. Through alternative work practices, such as Zoom lectures, online breakout rooms and online contact between lecturers and students (e.g. during self-study), practically all the teaching could continue.

The panel asked students and teachers about their experience with online teaching. Whilst COVID-19 evidently had an impact on the interaction between student and teachers, both students and teachers were positive about the quick and efficient transition. The panel was pleased to learn that the programme also experienced that there are advantages to digital education and that the programme intends to continue providing digital education if such advantages can be retained.

Conclusion

The panel concludes that the programme fulfils all specific requirements for the teaching and learning environment of a bachelor's programme and therefore meets standard 2.

2.3 Student assessment

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

The panel noted that the programme has a solid set of documents and procedures in place which secure an adequate assessment system. The assessment policy describes the assessment vision, in line with the educational vision and ensures consistency at the various levels. It also describes how the programme ensures the validity, reliability, and transparency of tests and examinations. The assessment policy is translated in the assessment programme which is available in act-E. The basis of the assessment programme is formed by the course objectives, which guide the assessment activities. Act-E relates the exit qualifications to the various courses and examinations. The panel verified that the assessment programme covers and thoroughly assesses all exit qualifications.

The panel established that the assessment methods are sufficiently varied and suitable for the exit qualifications that are meant to assess. The programme uses written examinations, practical assignments, written assignments, presentations, and take-home examinations.

The panel appreciates that the programme does not only use assessment to evaluate the performance of the student, but also uses assessment as a tool to guide students in their study behaviour. To use this learning and development function optimally, assessment forms an integral part of the education. This is expressed by students receiving both qualitative and quantitative feedback. In addition, formative tests play an important role in student development and self-management. The bachelor's programme employs the principle of 'frequent assessments, few decision moments' and includes both formative and summative tests, both with written examinations and assignments. The assessment programme ensures that all key exit qualifications are covered by at least one high-stake summative assessment.

The programme uses the course catalogue and Canvas to inform students in advance about the assessment format, the criteria they must meet, the cut-off score and the weighting of the different components. The panel verified that students are well-informed about the type of assessment and grading criteria before the start of each course.

The graduation project of the bachelor's programme is the bachelor's thesis. The student is guided by a mentor (daily supervisor of the internship organisation) and a supervisor from the Department of Medical Informatics or another UMC department with the required expertise. The panel appreciates the use of assessment forms to evaluate the student's performance during the internships. The grade is set by the supervisor, the student's daily supervisor and the ACPC coordinator, who has acted as an independent assessor since 2019. The panel has reviewed a sample of 15 bachelor's theses, including the assessment forms. The panel noted that for one thesis, both supervisors had a clinical background. The panel understood that this was an exception because this student was also doing a bachelor's programme in medicine. However, the panel encourages the programme management to ensure the interdisciplinary nature of the thesis and to constantly strive for a professionally balanced review. The panel also established that the quality and quantity of written feedback varied. It encourages the programme to stimulate all assessors generating adequate written feedback.

The revised curriculum added the use of the portfolio in which students collect the assignments of the Academic Competencies and Professional Competencies (ACPC). The portfolio is evaluated in the last three courses of each academic year. The panel values the development of this portfolio system and encourages the management to expand this further, for example by including the development of the student in relation to the other learning pathways. In addition, the panel advises looking for a tool that provides more possibilities to organise and use the portfolio.

Examinations Board

The Examinations Board, which operates independently of the programme management, is responsible for the quality assurance of the assessment and examination. After every course, the examiners complete an assessment report providing extensive information on the design and implementation of the assessment plan of the course. The assessment quality committee of the Examinations Board reviews the results of the reports. When necessary, the examiner receives feedback or additional steps are taken (remediation, professionalisation). In addition, the Examinations Board aims to evaluate each course in detail once every three years (assessment plan, matrix, reports, and the examinations). Due to the high workload of the Examinations Board (also due to Covid), this activity has unfortunately not been executed regularly in recent years. The panel was pleased to hear that the Examinations Board intends to take this up again on a structural basis in the near future.

Each year, the Examinations Board performs a random selection of nine graduation projects. Starting in 2021-2022, when the first MI-X students will graduate, the portfolio will also be included in the final project assessment by the Examinations Board.

From the discussion with representatives of the Examinations Board, the panel gathered that the members possess the proper capacity, expertise, and attitude to perform all tasks in a proactive way. Overall, the panel is of the opinion that the Examinations Board is well organised and safeguards the quality of the assessments in a proactive and structured manner.

Conclusion

The panel concludes that the programme has a sound and thorough system of assessment in place and the Examinations Board takes its responsibilities seriously. The programme therefore meets standard 3.

2.4 Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

The panel reviewed fifteen bachelor's theses of the programme. It agreed that all theses reflected the required degree level and demonstrated that the graduates have achieved the programme's exit qualifications. The theses showed that graduates are capable of employing acquired knowledge and insights to solve informatics problems arising in the healthcare sector, and to justify the choices made and prepare a written or verbal report.

The panel considers the theses' quality to be in line with the grades given. The grading of the theses reflected the differences in the quality of the theses. Most theses deal with relevant topics and demonstrate that students make good use of the techniques acquired during the three-year programme. Most theses were well structured and well written. In some of the lower graded theses, the methods and results were somewhat mixed up.

According to the self-evaluation, most graduates (74%) continue their education with a master's degree programme. More than half of this group choose the master's programme Medical Informatics. Other popular master's programmes are Software Engineering, System and Network Engineering, Biomedical Science, Data Science, Artificial Intelligence, and Health Care Management. Master students and alumni who did the MI bachelor's programme, informed the panel that this programme is preparing students adequately for a follow-up study at master level.

The fact that about a quarter of the graduates did not continue to a master's programme, is primarily due to their relevant part-time job during their studies, which led them following an advanced programme within a company or starting their own business on the basis of their qualifications and experience. This testifies to the need for medical informatics specialists in the working field.

Conclusion

The panel concludes that the bachelor's theses demonstrate that graduates achieved the exit qualifications. Graduates are well prepared to continue to a master's programme or to entry the job market in a junior position. The programme therefore meets standard 4.

2.5 Strengths and recommendations

Strengths of the programme

The panel is impressed by the following features:
- Fulfils a clear need in the labour market – The exemplary programme responds to the need in healthcare for specialised professionals with competencies at the interface of healthcare and ICT;
- Well-balanced and transparent curriculum –The exit qualifications found a consistent and balanced translation into a rich, varied, and transparent curriculum. The combination of learning pathways and themes offer a good structure to work on the medical informatics content in an interdisciplinary context;
- Didactical concept – The programme is characterised by teaching in small classes and individual guidance with a great deal of attention for the students' individual needs, performance, and development. The active learning approach stimulates students to actively develop new knowledge and skills;
- Teaching team – The teaching staff is enthusiastic, well-qualified and knowledgeable in their respective areas. The staff members bring in a wide array of expertise from various disciplines;
- Assessment system – The programme has a sound and thorough system of assessment in place, characterised by a wide variety of assessment methods aligned to the aims of the programme. The programme uses a balanced mix of formative and summative assessment forms.

Recommendations

For further improvement of the programme, the panel makes the following recommendations:
- Exitl qualifications – Reformulate the content related exit qualifications in a more specific manner to better align with the actual content of the programme;
- Electives – expand the number of possible electives and better inform students of the choices available to them;
- International aspects –Pay more attention to international aspects, for example by inviting more international guest lecturers;
- Junior staff -Find a way to offer a permanent contract to the recently hired junior staff members;
- Assessment of the theses – Ensure the interdisciplinary nature off all theses by constantly striving for a professionally balanced review;
- Portfolio – Expand the use of the portfolio, for example by including the development of the student in relation to the other learning pathways.

2.6 Conclusion

The panel has found that the intended learning outcomes (standard 1), the teaching- learning environment (standard 2), the assessment system (standard 3) and the achieved learning outcomes (standard 4) meet the criteria.

The exit qualifications reflect the programme's aims and are in line with the discipline's and international requirements. The curriculum, the teaching methods, the quality of the teaching staff and the assessment system enable the incoming students to achieve the final qualifications.

Standard	Judgement
Standard 1	Meets the standard
Standard 2	Meets the standard
Standard 3	Meets the standard
Standard 4	Meets the standard
Final conclusion	**Positive**

3. Review master's programme

3.1 Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings, analysis, and considerations

The master's programme in Medical Informatics (MI) of the Faculty of Medicine at the University of Amsterdam (UvA) is based at the Amsterdam UMC. Medical Informatics is an interdisciplinary and scientific field that aims to increase knowledge about informatics and data science methods to prevent disease, solve problems in healthcare and promote solutions. This requires effective use of biomedical data, information and knowledge, and the domain is therefore closely linked to modern Information and Communication Technology (ICT). The general aim of the master's programme is to train medical informatics specialists who, from a scientific basis, can solve complex informatics problems at the interface of healthcare and ICT. Graduates of the MI master's programme are qualified for key positions and research positions in the domain of healthcare information technology. The panel highly appreciates this exemplary programme in the Netherlands. The panel endorses that the programme meets the high need in healthcare for specialised professionals with competencies at the interface of healthcare and ICT.

The programme clearly leverages on its setting in which it is embedded in the clinical and research environment of Amsterdam UMC, particularly in the Department of Medical Informatics. This department is interconnected with the research of the Departments of Biostatistics, Epidemiology, Family Medicine, Social Medicine, Internal Medicine, Intensive Care, Oncology, Psychiatry, Obstetrics, Cardiology, Surgery, Geriatrics and the IT Department. Many of these departments maintain relationships with external institutions in primary, hospital and specialist care and with international research networks. This strong interdisciplinary environment enables students to transcend disciplinary boundaries in their assignments, internships and research projects.

The master's programme focusses on the analysis, synthesis and evaluation of knowledge. Students learn to develop and implement interventions in medical informatics, as well as to evaluate them through research. They learn to connect theory to empirical data, write a research proposal, conduct research independently, make a creative and original contribution to their chosen research specialism, formulate a scientifically supported judgement about the results and conclusions, and write a scientific report. The programme translated its aims into a set of eight exit qualifications, which are linked to the Dublin descriptors. The panel noted that the exit qualifications are a convincing reflection of the master's level as indicated by the Dublin descriptors.

The panel established that the programme is well aligned with the recommendations on education in health and medical informatics of the International Medical Informatics Association (IMIA). The programme represented the relationship between its exit qualifications and the IMIA recommendations in a detailed and consistent manner. The panel appreciates that the programme is actively involved in the development and revision of the IMIA standard. This ensures that the programme is in line with the international requirements of the field.

Overall, the panel is of the opinion that the exit qualifications fulfil the requirements in terms of content, level, and orientation. However, the panel advises making more explicit references to interdisciplinary skills. This would do better justice to the interdisciplinary nature of the programme and the strong emphasis on training specialists that are able to work in interdisciplinary teams.

The panel noted that innovation is part of the programme's DNA. Lectures are internationally active researchers who are up to date on international developments in the field and able to translate these developments into the curricula. The programme management also consults an External Advisory Council that consists of scientific and societal representatives from the professional field. The panel appreciates the way the programme responds to the rapid changes in the field by focussing on the theoretical foundations underlying medical informatics rather than 'going with the flow' and adapting all new trends in the market.

Conclusion

The exit qualifications fulfil all requirements in terms of content, level, and orientation. The programme therefore meets standard 1.

3.2 Teaching-learning environment

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

Findings, analysis, and considerations

The programme is a fulltime master's programme of 120 EC. Divided over a period of two years, students must successfully complete thirteen compulsory courses (102 EC) plus 18 EC of electives. The first year consists of two semesters, each consisting of four compulsory courses lasting four weeks each and a four-week internship. During these two short internships, students link the themes from the courses to research projects in the Amsterdam UMC. The second year starts with the 18 EC electives, followed by the Scientific Research Project (SRP, 42 EC). For the electives, students have three options to choose from: 1) the Artificial Intelligence for Health elective track; 2) the Sustainable eHealth Solutions elective track, or 3) courses from other relevant master's programmes.

The master's programme is based on four learning pathways that reflect the main themes of the programme. Each pathway consists of a meaningful cluster of related courses. The pathway 'Advanced Medical Data Analysis' combines three compulsory courses on data analysis with the elective track 'AI for Health'. The pathway 'Management of Healthcare Organisations' consists of three compulsory courses focussing on processes, structures, and governance of organisations in the healthcare sector. The pathway 'Sustainable eHealth' combines evaluation of IT solutions with sustainable solutions and consists of one compulsory course in the first year and the elective track 'Sustainable eHealth Solutions'. The pathway 'Academic Skills' consists of one compulsory course on academic skills with a focus on scientific writing, and one compulsory course on management skills such as presenting and consultation. These courses are integrated with 'regular' courses so that the academic skills assignments do not stand alone but are embedded in the field of expertise. In addition, students train their academic skills during several other courses, the two internships in the first year and the SRP in the second year. The two separate compulsory courses on academic skills and management skills were introduced following the recommendations of the previous assessment

panel, along with the introduction of a portfolio for students to reflect on their progress in academic skills. The panel appreciates these efforts to enhance the skills training the programme. Compared to the previous accreditation, there is a more clearly defined learning trajectory focussing on both academic skills and professional skills.

The panel is very positive about the introduction of the two elective tracks enabling students to specialise in a subdomain of medical informatics: 'AI for Health', and 'Sustainable eHealth solutions'. The panel is pleased to see that the programme keeps pace with recent developments in the academic and professional setting of MI.

The 'AI for Health' elective track is provided in collaboration with the AI master's programmes of the Vrije Universiteit Amsterdam (VU) and the UvA. The track is embedded in the three master's programmes and each of the three master's programmes provides one course that is taken by students of the three programmes. In addition, Medical Informatics students take an extra AI course provided by the UvA (from June 2022), and AI students take an extra Medical Informatics course. The track focuses on AI in medical practice, covering imaging and processing, medical causal inference, natural language processing, machine learning and deep learning. Students carry out their SRP in one of those research domains.

The 'Sustainable eHealth Solutions' elective track is designed in collaboration with international partners within the International Medical Informatics Association (IMIA WG Human Factors Engineering in Health Informatics). In this working group there is a strong collaboration between universities and research groups focusing on methods and techniques to optimise the design and use of interactive healthcare technology. The aim is to design interactive healthcare technology in such a way that healthcare providers and patients are optimally supported in its use. The track focuses on social technological approaches to system design, prototyping, evaluation, optimisation and implementation, operations management (LEAN), and health technology assessment. Students carry out their SRP in one of these research domains.

The panel established that the two elective tracks offer students coherence in two specialisations of choice. Students were very positive about the two tracks. However, students indicated that it may be hard to find electives beyond these tracks. Another point of attention is that students who start the programme in February are not able to choose one of the tracks if they want to complete their master in two years. Although the panel understands that it is a challenge to offer the tracks during both semesters, the panel would like to encourage the management to look for ways to make this possible.

The panel values that students are given ample time for their SRP in the second year (42 EC). The overall aim of this research internship is to familiarise students with various aspects of scientific research by means of their own individual research project, which will typically be part of a larger, ongoing project. During their work on the thesis, the students are trained in undertaking critical assessment of scientific biomedical and biomedical informatics literature, formulating clear research questions, and independently resolving information problems in biomedicine and reporting their methods and findings. SRP positions are offered by departments of the Amsterdam UMC, in particular the department of Medical Informatics, or by other research or healthcare institutes and health IT businesses, both in the Netherlands and abroad. Students indicated to be satisfied with the positions offered by the programme.

The panel considers the curriculum to be well organised and to be coherent. The panel finds that the programme succeeds in combining a strong focus on academic, research and professional skills with knowledge from different relevant disciplines. The assignments, the internships and extensive SRP provide students ample opportunities to train their research skills and professionals skills and to transcend disciplinary boundaries. The panel appreciates the on-going revision of the programme.

Especially the introduction of the two elective tracks and the introduction of courses focussing on academic skills and professional skills are already yielding positive results. All in all, the panel concludes that the programme manages to offer a highly motivating curriculum. The panel encourages the management to continue developing the programme, for example by developing more elective tracks.

The self-evaluation report provides a clear explanation how the exit qualifications are accomplished in the programme. The programme is structured according to the principle of constructive alignment. This ensures an optimal alignment of exit qualifications, course objectives, assessment and learning activities. The panel highly appreciates act-E, the self-developed Curriculum Information System (CIS). Act-E collects and organises all curriculum information in a structured manner and makes this information available to the programme teams, lecturers, students, and support services. The panel established that the entire programme covers all exit qualifications. Overall, the panel is of the opinion that the exit qualifications found a consistent and balanced translation into a rich, varied, and transparent curriculum.

The programme has deliberately chosen an English programme name and English as the language of instruction. The programme management substantiates its choice by arguing that the current lingua franca of scientific research is English, students will function in an international work environment and the programme is open to international students. The panel supports this choice. Since the language of science is English, the programme requires each staff member to speak English fluently. The level of English is monitored through course evaluations and feedback from students. Most of the lecturers have extensive experience in international research and their English language skills are therefore at a high level. In the last ten years, only one point of concern was reported, after which the lecturer concerned received further training in English language skills.

Admission and student numbers

Students who have completed the bachelor's programme in Medical Informatics or the bachelor's programme in Natural and Social Sciences with the Medical Informatics major may enter without having to meet additional requirements. Students who completed a bachelor's programme in a specialist field that has aspects in common with medical informatics must first complete the pre-master's programme. The panel is positive about the possibility for these students to enrol, adding to the diverse set-up of the programme, and is positive about the pre-master that is in place to remedy their deficiencies. The panel also appreciates that the pre-master's programme is tailored to the student's background.

Each year, around 25 students enter the master's programme. There is a consistent student intake of around three foreign students per year. Recently, the proportion of students coming from the MI bachelor's programme is decreasing, while the proportion from other bachelor's programmes is increasing. The panel learnt that the reason for the relatively low numbers of MI bachelor students that enrol in the master's programme is that they decide to seek specialisation in a certain field (e.g. the field of healthcare, or the technical field).

Given the high need for highly educated professionals in the field of medical informatics, the panel encourages the programme to make a sound strategy to stimulate the inflow of both national and international students in a more proactive way. Especially the number of international students is still very limited. Alumni who are currently working in different positions inside and outside academia could be helpful in advertising the programme more broadly.

Teaching concept and teaching format

The master's programme is based on an elaborate vision on teaching and learning as described in the so called 'blueprint'. The programme is characterised by small-scale education, attention for students, a strong community, and committed lecturers. The curriculum offers an integrated and multifaceted student- centred programme with room for both extra support and challenges. Students learn through assessment and feedback and personal feedback is provided as much as possible to enhance the learning experience of students. Active and deeper learning by students is encouraged by using activating assignments (case studies, practical's), discussions and presentations in the courses. The programme encourages students to process the study material independently, actively and in depth. Students receive explicit instructions prior to assignments and self-study. Almost all courses last four weeks, with an assignment to be handed in almost every week on average.

The teaching in the programme is interdisciplinary in nature and challenges students to come up with context-specific solutions to simulated or realistic situations from healthcare practice as much as possible. Collaboration in project teams plays a key role in this.

The panel appreciates the way the programme stimulates interaction, cooperation, and cohesion amongst students and staff. Students indicated both in the interview and the student chapter to highly value the small-scale education. The small-scale character of the programme entails that it is very easy to contact lecturers in an informal way. Furthermore, the students feel respected and taken seriously by the teachers. The panel is convinced that the programme's approach of collaborative learning is supportive for the learning process of the students.

Success rate, study load, study guidance

The students and alumni the panel met, all agreed that the workload of the programme is feasible. However, the panel noted that the success rate within two years ranges between 46% and 62%. The panel understands that these low success rates are partly explained by the fact that many students already have a (side) job, causing them to take longer to complete their SRP. The management has taken measures to improve this, by being stricter in the time the student can start their SRP and setting a fixed end date. The panel is positive about these proactive measures taken by the programme management and encourages them to keep monitoring the study delay and take appropriate measures when necessary.

Academic student counselling is provided by two mentors who are junior lecturers. They serve as a source of information for transfer students in particular and can provide practical tips. If necessary, they can refer students to the study adviser, who is familiar with all the relevant legislation and regulations. In addition, the lecturers of the AS courses also fulfil a mentoring role for the students.

Staff

The programme distinguishes between course coordinators, junior and senior lecturers, and guest lecturers. The teaching staff is highly qualified, both educationally, by having obtained a UTQ (University Teaching Qualification), and by possessing relevant expertise in their field of study.

The panel is very positive about the expertise and research track records of the senior lecturers in the programme. Full professors and associate professors are well represented in the teaching staff.

The panel was pleased to learn that most senior lectures (83%) possess their UTQ or are in the process of obtaining this. Almost half of the junior lecturers (43%) have their (UTQ) and 43% of the

junior lectures are still in the process of UTQ certification. Several of the staff are also in possession of the Senior Teaching Qualification (STQ), have completed the didactic leadership course of the University of Amsterdam or have been appointed principal educators (PE) in the Amsterdam UMC.

Of the 46 lectures (junior and senior) in the programme, 89% have a PhD and 7% are still in the process of obtaining a PhD.

Lecturers are very engaged with the students and supervision and tutoring are taken seriously by all staff members. The students are very positive about the teaching skills of the teaching staff. In the conversation with the panel, the students especially praised the personal involvement and dedication of their teachers.

The Teaching and Learning Centre (TLC) of the Amsterdam UMC plays a prominent role in the professionalisation of the team of lecturers by offering a broad range of courses. The panel highly appreciates the broad range of courses on new teaching methods such as blended learning, preparing multiple choice assessments, using rubrics, providing feedback, etc. The panel encourages the programme management to stimulate and facilitate all staff members to attend several professionalisation courses per year.

The management indicated during the interview that they have recently hired seven junior staff members and that this has resulted in a significant reduction in the workload for the teaching staff. The panel understands the management's concerns that these junior lecturers may not be retained because they have temporary contracts. The panel encourages the management to find a way to offer these junior staff members a permanent contract.

Facilities

The facilities enable the programme to provide small-scale and intensive education. The panel is very positive about some recent innovations. First, the multifunctional active lecture room features highly innovative audio-visual equipment that supports the chosen teaching methods, including hybrid education. Second, the eHealth lab facilitates interdisciplinary educational projects with a simulation space where private companies and students can work together on healthcare IT innovations under the supervision of lecturers.

COVID-19

During the COVID-19 pandemic, the programme management and the lecturers made great efforts, in a very short timeframe, to transform what had been primarily physical education up to that point into online variants. Through alternative work practices, such as Zoom lectures, online breakout rooms and online contact between lecturers and students (e.g. during self-study), practically all the teaching could continue.

The panel asked students and teachers about their experience with online teaching. Whilst COVID-19 evidently had an impact on the interaction between student and teachers, both students and teachers were positive about the quick and efficient transition. The panel was pleased to learn that the programme also experienced that there are advantages to digital education and that the programme intends to continue providing digital education if such advantages can be retained.

Conclusion

The panel concludes that the programme fulfils all specific requirements for the teaching and learning environment of a master's programme and therefore meets standard 2.

3.3 Student assessment

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

The panel noted that the programme has a solid set of documents and procedures in place which secure an adequate assessment system. The assessment policy describes the assessment vision, in line with the educational vision and ensures consistency at the various levels. It also describes how the programme ensures the validity, reliability, and transparency of tests and examinations. The assessment policy is translated in the assessment programme which is available in act-E. The basis of the assessment programme is formed by the course objectives, which guide the assessment activities. Act-E relates the exit qualifications to the various courses and examinations. The panel verified in that the assessment programme covers and thoroughly assesses all exit qualifications.

The panel established that the assessment methods are sufficiently varied and suitable for the exit qualifications that they are meant to assess. The programme uses written and oral examinations, practical assignments, written assignments, and presentations.

The panel appreciates that the programme does not only use assessment to evaluate the performance of the student, but also uses assessment as a tool to guide students in their study behaviour. To use this learning and development function optimally, assessment forms an integral part of the education. Courses are typically organised around complex assignments with deadlines and students receive both qualitative and quantitative feedback.

The separate academic skills courses also comprise a portfolio for students to reflect on their progress in academic skills. Because each course runs for an entire semester, course objectives are assessed on multiple occasions so as to encourage and monitor students' improvements. The panel values this development to include the portfolio to monitor and evaluate the longitudinal development of students towards the exit qualifications. It encourages the programme to pursue this. In addition, the panel advises looking for a tool that provides more possibilities to organise and use the portfolio.

The programme uses the course catalogue and Canvas to inform students in advance about the assessment format, the criteria they must meet, the cut-off score and the weighting of the different components. The panel verified that students are well-informed about the type of assessment and grading criteria before the start of each course.

The grade for the SRP, the master's graduation project, is determined by the student's mentor (daily supervisor), the tutor (supervisor), and an independent expert, who only evaluates the thesis and presentation. The panel appreciates the use of assessment forms to evaluate the student's performance during the SRP. The grade for the scientific research project is based on the assessment of the research design (20%), the way the research was carried out (20%), the master's thesis (structure and contents, 40%), and the oral presentation (20%). Upon completion of the thesis, as part of the examination, the student gives a presentation to the SRP examination committee and other interested people. The presentation should be in English and takes 20 minutes. There are 10 minutes reserved for discussion. The SRP tutor chairs the session, with the session concluded by the chair of the examination committee. The panel has reviewed a sample of fifteen SRP's, including the assessment forms. It established that the scores on the different aspects are well substantiated, and students receive adequate written feedback.

Examinations Board

The Examinations Board, which operates independently of the programme management, is responsible for the quality assurance of the assessment and examination. After every course, the examiners complete an assessment report providing extensive information on the design and implementation of the assessment plan of the course. The assessment quality committee of the Examinations Board reviews the results of the reports. When necessary, the examiner receives feedback or additional steps are taken (remediation, professionalisation). In addition, the Examinations Board aims to evaluate each course in detail once every three years (assessment plan, matrix, reports, and the examinations). Due to the high workload of the Examinations Board (also due to Covid), this activity has unfortunately not been executed regularly in recent years. The panel was pleased to hear that the Examinations Board intends to take this up again on a structural basis in the near future.

Because the chair (or deputy chair) acts as the chair during the graduation session, the Examinations Board closely monitors the exit level of the graduates.

From the discussion with representatives of the Examinations Board, the panel gathered that these members possess the proper capacity, expertise, and attitude to perform all tasks in a proactive way. Overall, the panel is of the opinion that the Examinations Board is well organised and safeguards the quality of the assessments in a proactive and structured manner.

Conclusion

The panel concludes that the programme has a sound and thorough system of assessment in place and the Examinations Board takes its responsibilities seriously. The programme therefore meets standard 3.

3.4 Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

The panel reviewed fifteen master's theses of the SRP. It agreed that all theses reflected the required degree level and demonstrated that the graduates have achieved the programme's exit qualifications. The theses showed that the students are able to develop and implement interventions in medical informatics, as well as evaluating them through research. The panel is convinced graduates can arrive at new insights and possibilities for application, and can integrate complex material into a broad or multidisciplinary context of the medical informatics field.

The panel considers the theses' quality to be in line with the grades given. The grading of the theses was fair and reflected the differences in the quality of the theses. Most master's theses were based on relevant interesting and clearly formulated research questions, contained an adequate theoretical framework and were written in a structured and concise manner. For some of the lower graded theses, the research questions were not convincing. The questions should have been formulated in such a way that they are not only questions of the company commissioning the research, but also questions of a broader community.

The quality of the programme is clearly expressed by the achievements of the students, who are doing very well according to the self-evaluation report. During the online visit, the panel talked to alumni, who reported that they were very satisfied with their education and felt well-prepared for a

position as a researcher or medical informatics specialist. They expressed great confidence in their career opportunities. The panel noticed that the students were very communicative, well-organised as a group and fluent in English which indicates that they have been trained in their soft/communicative skills very well. The results of an alumni survey (among bachelor's and master's graduates) indicated that after graduation, the graduates easily find a job. Graduates can choose for a variety of jobs that combine IT and healthcare. Some jobs are focussed more on organisational aspects of healthcare (healthcare management), while other jobs have a more technical focus (software engineering, data science).

Conclusion

The panel concludes that the master's theses demonstrate that graduates achieved the exit qualifications. Graduates are well prepared for a position as a researcher or medical informatics specialist. The programme therefore meets standard 4.

3.5 Strengths and recommendations

Strengths of the programme

The panel is impressed by the following features:
- Fulfils a clear need in the labour market – The exemplary programme responds to the need in healthcare for specialised professionals with competencies at the interface of healthcare and ICT;
- Well-balanced and transparent curriculum –The exit qualifications found a consistent and balanced translation into a rich, varied, and transparent curriculum. The curriculum combines a strong focus on academic and professional skills with knowledge from different relevant disciplines;
- Elective tracks – The two elective tracks enable students to specialise in a subdomain of medical informatics;
- Didactical concept – The programme is characterised by teaching in small classes and individual guidance. The programme's approach of collaborative learning is supportive for the learning process of the students;
- Teaching team – The teaching staff is enthusiastic, well-qualified and knowledgeable in their respective areas. The staff members bring in a wide array of expertise from various disciplines;
- Assessment system – The programme has a sound and thorough system of assessment in place, characterised by a wide variety of assessment methods aligned to the aims of the programme;
- Alumni – Graduates of the programme have very good career chances. Alumni were very enthusiastic about the programme and expressed great confidence in their career opportunities.

Recommendations

For further improvement of the programme, the panel makes the following recommendations:
- Interdisciplinary skills – Make the focus on interdisciplinary skills more explicit in the exit qualifications;
- Attract more students – Make a sound strategy to increase the inflow of both national and international students in a more proactive way. Alumni could be helpful in advertising the programme more broadly;
- Elective tracks– Make it possible for students who enrol in February to choose one of the two elective tracks without facing study delay;
- Junior staff -Find a way to offer a permanent contract to the recently hired junior staff members;
- Portfolio – Pursue the use of the portfolio, for monitoring and evaluating the longitudinal development of students towards the exit qualifications.

3.6 Conclusion

The panel has found that the intended learning outcomes (standard 1), the teaching- learning environment (standard 2), the assessment system (standard 3) and the achieved learning outcomes (standard 4) meet the criteria.

The exitl qualifications reflect the programme's aims and are in line with the discipline's and international requirements. The curriculum, the teaching methods, the quality of the teaching staff and the assessment system enable the incoming students to achieve the final qualifications.

Standard	Judgement
Standard 1	Meets the standard
Standard 2	Meets the standard
Standard 3	Meets the standard
Standard 4	Meets the standard
Final conclusion	**Positive**

Appendix A – Schedule of the online visit

24 May 2022

Time		Session
08.30	10.00	Preparatory meeting panel
10.00	10.45	Interview with the programme management
10.45	11.00	Internal meeting panel/break
11.00	11.45	Interview with students (incl. PC student members)
11.45	12.00	Internal meeting panel / open office hours**
12.00	12.30	Lunch
12.30	13.30	Interview with lecturers (incl. PC lecturer members)
13.30	13.45	Internal meeting panel/break
13.45	14.15	Interview with alumni
14.15	14.30	Internal meeting panel/break
14.30	15.15	Interview with Board of Examiners
15.15	15.45	Internal meeting panel, preparing questions for second management meeting
15.45	16.15	Interview with programme management
16.15	17.45	Internal meeting panel
17.45	18.00	Presentation of preliminary findings

Appendix B – Documents studied

- Self-evaluation report with appendices:
    - Monitoring recommendations previous visitation
    - Faculty Strategic Policy Plan
    - Governance matrix MI-X
    - Curriculum evaluation MI-X
    - Examples course evaluation reports
    - Faculty annual plan
    - MI-X Blueprint
    - Blueprint Master
    - Teaching Quality Handbook
    - IMIA guidelines and Dublin descriptors
    - act-E
    - Design ACPC curriculum
    - List of approved electives
    - Excellence Program
    - Structure Major program
    - List of teachers and their qualifications
    - Annual report program committee
    - Examples of study guides
    - Quantitative student data
    - Information materials
    - Virtual tour of new lecture hall
    - Study guide
    - NSE reports
    - Assessment policy
    - High stakes assessment in MI-X
    - Examples of examination reports
    - Assessment forms
    - Thesis guide
    - Covid analysis UvA
    - Report on sample final papers
    - Annual Report Examinations Board
    - UvA Vision on blended education
    - Report of own alumni survey
    - Employer survey report + Minutes External Advisory Council
    - Report exit interviews
- Fifteen theses of the bachelor's programme with assessment forms
- Fifteen theses of the master's programme with assessment forms

Appendix C – Abbreviations

AC	Academic Competencies
ACPC	Academic Competencies and Professional Competencies
AMC	Amsterdam Medical Centre
AS	Academic Skills
BSc	Bachelor of Science
CIS	Curriculum Information System
EC	European Credit
ICT	Information and Communication Technology
MI	Medical Informatics
MSc	Master of Science
NVAO	*Nederlands-Vlaamse Accreditatieorganisatie*
PC	Professional Competencies (PC)
PE	Principal Educators
PhD	Philosophy Doctor
STQ	Senior Teaching Qualification
TLC	Teaching and Learning Centre
UTQ	University Teaching Qualification
UMC	*Universitair Medisch Centrum*
UvA	University of Amsterdam
VWO	pre-university secondary education