

# Educational Evaluation 2020/2021

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Reviewer report of the Master's  
Programme in Molecular Medicine at  
Uppsala University

## Introduction

The review is based on the self-evaluation of the Master programme in Molecular Medicine including the four freestanding courses 3MG049 *Innovation of molecular biosensors* (SensUs) 15 credits, 3MG018 *Immune, gene and cell therapy* 7,5 credits, 3MG009 *Basic medical genetics* 4,5 credits and 3PA013 *Molecular mechanisms of cancer*. Additional information was scrutinized, such as course evaluations, examinations and information about the Master theses. A site visit was performed in October 2021, where the programme coordinator and teachers provided additional information and answers to the review panel members' questions. Furthermore, students from the programme were interviewed. The review panel also performed several zoom meetings before and after the site visit. This review panel report summarises the conclusions and recommendations, where strengths, weaknesses and suggested improvements are described, within the 11 quality aspects defined by Uppsala University. The review was finalized December 15<sup>th</sup>, 2021.

The members of the review panel were:

- **Göran Andersson**, Professor, Swedish University of Agricultural Sciences (Chairman).
- **Nicholas Foulkes**, Professor, University of Heidelberg / Karlsruhe Institute of Technology, Germany.
- **Erik Fries**, Professor Emeritus, Uppsala University.
- **Margareta Krabbe**, Senior Lecturer, Biology Education Centre, Uppsala University.
- **Maria Lagerström-Fermér**, Associate Professor, Senior Director Clinical Innovation Early Clinical Development, Astra-Zeneca.
- **Anna Metreveli**, Stockholm University (Student representative).
- **Tejas Sawant**, Royal College of Surgeons, Dublin, Ireland (Student representative).

## Summary

The review panel concluded that the Master's programme in Molecular Medicine is a truly excellent Master's programme with high scientific level and of high international standard.

The courses included in the programme prepare the students for future careers in research both in academia and industry and has a highly dedicated programme director and an impressive list of excellent associated lecturers and teachers, providing expertise in a wide spectra of research and development. The curriculum is well structured with good administrative support and provides in depth knowledge within the targeted areas of molecular medicine to give excellent basis for students to achieve the expected learning outcomes. The examination process is also very flexible and ambitious with several different ways for examining the students. For e.g. research training and degree projects the student evaluations by supervisor are supported by rubrics and clearly defined criteria.

The teachers at both the programme-specific courses and the free-standing courses ensure that the course contents are regularly revised and updated to ensure that quality, intended learning outcomes and scientific-based teaching are maintained.

The following prioritized actions to improve quality are: Education in Biostatistics and Bioinformatics is lacking and the establishment of courses in these areas was identified as a prioritized action. Furthermore, the programme has a strong focus on cancer, which indicates that other diseases of high importance could be neglected. In addition, the response rate of course evaluations should be increased, to enable better coverage of the students experience and suggested improvements. The programme should be commended on the successful recruitment and support of international students, but the situation for incoming international students require more support in non-academic matters, such as health care costs/insurance, visa matters, obtaining Swedish civil registration number and more.

## The 11 aspects of quality

**1. That the study programmes shall comply with the provisions of the Swedish Higher Education Act (SFS 1992:1434) and the outcomes described in the Qualifications Ordinance, Annex 2 to the Swedish Higher Education Ordinance (SFS 1993:100), as well as programme-specific objectives, i.e., that actual learning outcomes correspond to expected learning outcomes.**

The review panel concluded that the Molecular Medicine Master's programme complies with the provisions and goals of the SFS 1992:1434 and the learning outcomes specified in the SFS 1993:100 act.

### **Strengths:**

The Molecular Medicine Master's programme is a very ambitious programme, where the students are educated broadly in transitional molecular medicine and trained thoroughly in a large number of different state-of-the-art molecular genetic and genomics technologies. The graduating students are therefore well prepared for future careers in either academia or the private sector.

### **Weaknesses:**

- The review panel raised concerns that the programme lacks sufficient training in the areas of Biostatistics and Bioinformatics. The field of Molecular Medicine is heavily dependent on analyses of clinical data, phenotype and genotype data obtained from large case-control study populations that require in depth knowledge in statistical methodologies. Furthermore, Next Generation Sequencing (NGS) technologies that produce huge amount of data are extensively used that require in depth knowledge in Bioinformatics and that also require competence in Biostatistics.
- For students preparing for an examination, the learning goals described in the syllabi are often too general.
- Not clearly specified which courses have manual plagiarism check-up.

- Some lecturers from industry appear not to be familiar with learning outcomes of the courses.

- No unified international grading system (see also below).

-It was difficult to perform an in depth evaluation of all the courses because specific schedules for all the different courses were not available. The courses were described in a rather general manner and thus difficult to assess. The review panel's impression is that there is strong focus on techniques and methodologies, which obviously also is positive, as indicated above. However, it was unclear whether or not the students are sufficiently exposed to the challenges, questions and issues that are present in today's healthcare. These challenges include e.g. preventing disease, setting correct diagnoses and providing appropriate treatment for the patients. Thus, a main question from the review panel is whether or not all these techniques and methodologies are put into a proper translational context?

- A concern was also stressed that a main focus in the programme is on different types of cancer and only limited efforts on education regarding other common diseases like for example immune-mediated and infectious diseases and cardiovascular diseases. The latter represents the leading cause of death globally and where many conditions such as heart failure are under-diagnosed and with a huge unmet need for both better diagnosis and treatments.

#### **Suggested Improvements:**

-The programme should provide a joint biostatistics and bioinformatics support system for the students when they are performing their research projects.

Providing external lecturers e.g. from industry with a list of the expected learning outcome specific courses and/or the programme ("goal attainment matrix") could help integrating topics more effectively into the programme.

-More detailed learning goals should, as proposed in the self-evaluation, be given in a study handbook. The study handbook could also list scientific or technical themes, such as biostatistics to highlight these and point to possibilities to bridge gaps or deepen knowledge in elective courses or reading materials. The study handbook could describe the expected progression of specific skills, such as communication skills or group work, and the training in programme courses. In addition, previous examination questions should be provided.

- Frame a goal attainment matrix, which specifies the learning outcomes. The medical faculty at Uppsala University in consultation with students can frame this goal attainment matrix.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.

The programme could provide a list of elective courses to guide the students to bridge gaps or expand their knowledge in certain areas.

## **2. That the content and teaching activities are founded on a scientific basis and proven experience.**

### **Strengths:**

- This is a well-established Master's education that has benefited from several years of implementation by experts in the relevant fields. Researchers who actually apply the various tools and approaches do the teaching. There are also many invited expert guest lecturers including engagement of local biotech companies.

- Inclusion of practical seminars into the course schedules creates a solid link to the scientific community. Overall, the programme coordinator, course leaders and teachers provide an impressive inclusion of career-promoting activities.

### **Weaknesses:**

- Existence of evening courses creates a barrier to students with children. The course that qualifies the students for participation in the SensUs competition is a 15 credits course that partly runs in parallel with the main programme.

- The programme would benefit from including a wider selection of lecturers from companies outside of the Uppsala region. The majority of "industry" lecturers come mainly from small, local companies. Thus, adding lecturers from larger global companies would add valuable additional perspectives.

### **Suggested Improvements:**

It might be beneficial for the students to invite representatives from key functions in bigger diagnostic companies, pharma and biotech. It would also serve as a starting point for students interested in doing their master theses in a company to get a contact person that would be able guide them into opportunities within their respective companies.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.

The list of freestanding/elective courses for students in the MM programme could be developed. The course 3MG009 Basic Medical Genetics appear to not add value to the programme as the content is on a very basic level as compared with mandatory courses in the programme. The course 3PA013 Molecular mechanism of cancer appears to overlap in content with the mandatory courses in the programme. The course 3MG018 consists of a seminar series, the contents of which partly overlap with other programme contents. The course 3MG049 Innovation of molecular biosensors (SensUS) is a valuable complement to the programme courses and the possibility for the Molecular Medicine students to join the cross-disciplinary group of students designing a biosensor should be facilitated, if possible.

### **3. That teaching focuses on the learning of students/doctoral students.**

#### **Strengths:**

- Highly selective admission strategy. There is significant flexibility in course offerings making the programme more versatile and accommodating the needs of students from a wide range of backgrounds.

A strategically important initial course brings the students from a range of backgrounds up to a common level.

- The Molecular Medicine Master's programme has an impressive 90-100% completion rate.

- Students benefit from presenting their findings and results to others. They also benefit from the many and recurrent possibilities they have to practice scientific writing.

#### **Weaknesses:**

- From the students' perspectives, there is apparently a lack of clarity in how „hybrid“ teaching approaches will be applied in the course as we move away from the periods of Covid-enforced lockdowns.

- Diversity in the levels of the students joining the course represents a challenge especially at the outset of the course.

#### **Suggested Improvements:**

- A clear plan for the use of hybrid learning has to be spelled out. Which lessons have we learned from the Covid pandemic in terms of which elements of the course could realistically be offered online, and also, which elements do not work in this format ?

- Biostatistics can be incorporated as a course in Semester 2 of Year 1 instead of a project. Furthermore, the lack of Biostatistics and Bioinformatics appear to be a general problem for several of the master programmes at the Medical faculty and a common strategy to solve the shortage should be investigated.

- The scope of the programme can be broadened to incorporate other areas apart from cancer.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.

The list of freestanding courses for students in the programme could be developed/expanded to cover areas of diversification of deepened knowledge in e.g. image analysis, bioinformatics, epidemiology, and infection biology.

### **4. That the intended learning outcomes are examined using appropriate methods and in a legally certain manner, and that progression is ensured.**

#### **Strengths:**

The Molecular Medicine Master's programme has taken the proper actions to ensure that the learning outcomes are met and that appropriate methodologies are used to evaluate this.

The established criteria for evaluating student's learning outcomes for e.g. internships, group work and the degree project are very well developed and provides good support for students as well as for supervisors/teachers.

**Weaknesses:**

- The Swedish grading system with the apparent lack of precision in the grading system for exams. „Pass“ or „Pass with distinction“ are the only pass options can be considered a negative aspect and risks degrading the usefulness of the courses especially for international students.
- During the second half of the first semester each student does a “short independent research project” in parallel with attending lectures and seminars covering “some 70 different techniques” forming the course Advanced Techniques in Molecular Medicine. Considering progression, independent research should appear at the end of the programme.
- The first course in the programme could allow for docking modules to bridge gaps in students knowledge and skills.
- The Professional training module adds value to the programme and contains training e.g. in communication as well as introductions to important topics such as sustainability. The contents and goals of the PT should be clearly described and examined so that students can continue building skills important for future careers. The communication training could be done in smaller groups to allow for more effective training of individuals and to identify gaps in student skills. This allows for students to develop the skills specifically. To ensure progression of soft (or other) skills, the students could be supported in building a “skills portfolio”, where training, self-evaluation and progress could be collected.

**Suggested Improvements:**

- A refined grading system to provide a more precise assessment of progress through the courses.
- Unify the grading scale, or provide the students with synchronized grading transcripts and/or overall GPA score.
- An explanation of the grading scale is provided as an appendix to the transcript. Students should be informed about this.
- The learning progression needs to be better defined, clarified and reflected in the programme. The learning outcomes need to be clearly specified and should portray the progression. A goal attainment matrix could be helpful to analyse and develop the progression of expected learning outcomes and building of skills.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses. The list of elective courses in the programme could be developed to allow for further progression of some of the programme themes and courses.

**5. That staff involved in the study programme possess relevant and up-to-date expertise in the subject matter, that they have pedagogical and/or subject didactic expertise, and that there is sufficient teaching capacity.**

**Strengths:**

This is a well-established programme that has benefited from several years of implementation by experts in the relevant fields. The teachers have high scientific knowledge and researchers who actually apply the various tools and approaches do the teaching. There are also many invited expert guest lecturers. There is a strong engagement of local companies.

The course “Advance techniques in molecular medicine” is a programme “flagship course”. The rotation of students in different laboratories is appreciated.

**Weaknesses:**

- Lack of proper Biostatistics and Bioinformatics training is as stated above clearly a weak point. Bioinformatics and biostatistics have to be at the core of the activities.
- It is difficult for external lecturers to grasp what the students have learned and what's has been covered in other lectures to give the lecturer at the right level and with the right content to be at the right level and avoid overlap with other lecturers.

**Suggested Improvements:**

- To resolve the lack of proper education in Biostatistics and Bioinformatics the students should be offered a strong core of bioinformatics skills (e.g. Python, R, Matlab programming) as they will need these basic skills but crucially they also have to be presented in the context of real world applications (e.g. sequence analysis, image analysis, statistical tests for experimental design, robotics, etc). The methods should be properly introduced early in the programme and topic-specific applications should be recurrent in many/all of the programme courses.
- Should there perhaps be a prerequisite for entry into the programme that students do have these basic statistics and computing skills? If this is not desired, then the programme has to commit to spending the time and effort to provide such courses „for beginners“.
- Who would be involved in teaching these extra courses? This may have to be resolved at an inter-faculty level. Uppsala University has strong research and educational resources when it comes to bioinformatics, computer science and statistics. This should be made available to students in this programme.
- The programme has to be made future-proof, sustainable. A line of succession for the organizers has to be in place. Commercial partners should play a key role in identifying future areas of technology development and thereby provide „beyond state-of-the-art“ training.
- Provide a short summary of what each lecture in the course is covering and also provide the external lecturers with the Syllabus of the master program and be clear what they are expected to cover.



- More work needs to be done on subject didactics i.e. keeping up with research on how to best teach a subject. The teachers in the programme could be offered an update to relevant subject didactics research in a yearly workshop. This could be done in collaboration with the department of Education at Uppsala University or by inspirational international researchers in didactics/pedagogy.

- It would be beneficial to provide some sort of guidelines to external teachers. While a full pedagogical training in this case would be neither expected nor justified, it would be helpful to provide some sort of basic guidelines.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.

The elective course 3MG049 “Innovation of molecular biosensors” offers a pedagogically valuable complement to the mandatory courses in the programme. This course is unfortunately not very accessible to the Molecular Medicine students since it partly runs evenings in parallel with mandatory programme courses. A new programme course which would be a Challenge-based group work or competition to solve a common problem, e.g. in molecular medicine, could be an attractive Summer school for these students, which would not interfere with regular courses during the semester.

## **6. That internationalisation, international perspectives and sustainability are promoted.**

### **Strengths:**

The international perspectives in the Molecular Medicine Master’s programme are impressive and the programme has a very strong international contribution.

The recruitment of international students, including non-EU students is effective and adds to the programme success.

### **Weaknesses:**

Some international students have repetitive issues with obtaining/renewing residence permits.

The topic of sustainability is only covered in one seminar in the professional training module semester 1. There are many more possibilities for the programme to raise and discuss sustainability issues, e.g. UN Sustainable development goal 3: “Good health and well-being”

### **Suggested Improvements:**

The programme should demand support from the Medical Faculty in helping international students in non-academic challenges such as to obtain visa, open bank accounts and more. The faculty could mobilize Uppsala University competence and support to solve or mitigate administrative hurdles for this important group of students. Constant communication should be established with Swedish Migration Agency and Swedish Tax Agency.

Contacting alumni to help guide students with bureaucratic matters, etc. Increased connection in general with alumni students from the programme.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses. The programme should be commended for the financial support to international fee-paying students studying during the summer (summer schools or internship/research training). For the sake of equity, these students should be allowed to study during the summer between the two master years without added costs to their yearly tuition fee.

## **7. That a gender equality perspective is integrated into the study programme.**

The Molecular Medicine Master's programme has ensured that equal opportunities are met and sufficient actions are in place to prevent discrimination. However, further work is needed to achieve an optimal gender balance.

### **Strengths:**

- The Professional training (PT) joint seminar series for all Master students at the medical faculty, includes ethics and the gender equality perspective. The programme shows awareness in gender equality perspective by identifying the lack of female scientists at certain courses in the programme and actively working to balancing the gender among the lecturers.
- The programme performs constant work to increase accessibility and equal opportunities.

### **Weaknesses:**

- The programme has not achieved an optimal gender balance among the students.

### **Suggested Improvements**

- It would be valuable to get a more even gender balance among students, and previous work and suggestions might be followed up.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses. Introducing computer science and technology courses to the list of elective courses might attract more students to the programme and would also allow for the students to interact with students from other programmes, possibly generating more gender balance, at least in those courses.

## **8. That the study programme meets individuals' and society's needs for learning and professional knowledge and prepares students for future careers.**

### **Strengths:**

Comprehensive range of courses covering a broad range of relevant state of the art technologies and approaches. There is a strong training element of presentation skills, designing projects and strong focus networking skills.

Students mentioned that they have good networking opportunities. They also have opportunities to undertake internships at companies.

Excellent training in communication, entrepreneurship, and business skills.

### **Weaknesses:**

The programme covers a very broad range of topics, however, it is very difficult to see „structure“ in the offerings.

The programme could benefit from providing clear course descriptions for the so-called ‘career tracks’, so that the students could see which courses would be advisable to take for a certain career path.

### **Suggested Improvements:**

It would be very valuable to present the course with an underlying structure and strategy. Otherwise, the course gives the impression of a stamp collecting exercise - with lots of current „hot topics“ and „buzzwords“. Grouping related training activities together under broader headings would help future course applicants better understand the scope of what training is on offer and then guide their subsequent choices

Students would like more statistics, mathematics and bioinformatics in the course. They would like a more hands-on approach in this regard – working on a project instead of just short activities, which can be performed mechanically without gaining much insight.

Provide a detailed list of courses that must be taken as mandatory for all career tracks, include a list of all conditionally elective and recommended courses for each career track.

The programme could support the start of a programme-specific alumni association. Such an alumni association could be an asset for the programme as well as for students.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses. In addition, the freestanding courses allow the students to specialize and prepare them for future scientific careers in academia or in the private sector. A longer, expanded list of elective courses could allow for preparation of more individualised career paths.

## **9. That students/doctoral students have influence on the planning, implementation and follow-up of the study programme.**

### **Strengths:**

Students mentioned that their feedback was taken seriously and improvements were implemented in the programme.

### **Weaknesses:**

None detected.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.

**10. That all students and doctoral students are provided with an accessible and fit-for-purpose study environment.**

The review panel concluded that the MolMed programme provides a supportive and good study environment that is allowing the students to obtain excellent education.

**Strengths:**

- The programme is using “Labster”, which is an innovative lab tool introduced during the COVID-19 pandemic to provide students with a virtual lab environment.

**Weaknesses:**

The programme does not have designated laboratories for students, which complicated scheduling and limits training in laboratory skills for programme students.

**Suggested Improvements:**

The program would benefit from having designated laboratories at the Rudbeck laboratory. This would allow for building a relevant instrumentation display and for more flexible scheduling of experimental training. This would also allow for research groups to access instrumentation in student laboratories and to supervise students outside of the research laboratories.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.

**11. That continuous follow-up and improvement of the study programme is carried out.****Strengths:**

- Feedback rounds to obtain opinions from the students for issues and amendments are carried out as regular efforts to improve the programme.

**Weaknesses:**

- This point is not specific to this particular Master’s programme but some students mentioned that the Swedish grading system, while holistic and comprehensive, can not be easily translated to grading systems in other countries e.g. a student who applied to LMU (Munich, Germany) for a PhD had some issues with this. Students who applied to US and British programmes did not.

**Suggested Improvements:**

- Further follow-up work is needed to ensure that adequate improvements are obtained.
- Benchmarking the programme to similar programmes elsewhere might allow for technology updates, pedagogic development, faculty exchange and more.
- Benchmarking might be developed to the establishment of programme networks, which could help sustainability of the programme.

- The programme organizers should convene a committee to look into this issue and develop a strategy that could also help other Masters programmes.
- This has to be taken very seriously and the necessary expertise has to be made available.

*Freestanding courses:* The same perspective applies for these courses as for the programme-specific courses.