



UPPSALA
UNIVERSITET

Dnr MEDFARM 2021/959

Självvärdering

Masterprogrammet i
läkemedelsmodellering och
läkemedelsutveckling vid Uppsala
universitet

Behandlad i Kommittén för utbildning på grundnivå och avancerad nivå vid
farmaceutiska fakulteten 2022-11-10

Innehållsförteckning

Overview of the Review Process	3
Assessment of the LMU and LMM Programmes	4
Background information on the Programmes	5
Masters Programme in Drug Discovery and Development (LMU)	5
Masters Programme in Pharmaceutical Modelling (LMM)	8
Examples from the LMU Programme	12
Examples from the LMM Programme	13
Student-Activating Teaching	14
Feedback	14

Overview of the Review Process

All education at the undergraduate, advanced level and postgraduate level are evaluated at least once every six years in an educational evaluation. An overall schedule has been established for the evaluation of programmes and courses, where the Masters Programmes in Drug Discovery and Development and Pharmaceutical Modelling are to be evaluated in 2022. The evaluations are based on Guidelines for Uppsala University's model for educational evaluation (UFV 2015/475). Forms and routines for quality assurance and quality development in the Disciplinary Domain have been prepared based on these and are described in the model for educational evaluation MEDFARM 2017/241 (MEDFARM 2017/1000, revised by the area committee for medicine and pharmacy 2020-03-18).

Each programme conducts an educational evaluation based on 11 aspects once every six years. This educational evaluation consists of a self-evaluation that is reviewed externally by at least two colleagues from one or more higher education institutions and by at least one colleague from another Faculty/Disciplinary Domain within Uppsala University according to accepted principles for peer review. To ensure professional relevance, it may be appropriate to include industry/non-academic representatives as reviewers of the programmes at the basic and advanced level. To ensure the student perspective is taken into account, it is recommended that student (s) from other programmes participate as reviewers (the same field of science is doing well). The reviewers' work results in a written assessor's statement, which is also published externally on Uppsala University's website.

Quality assurance and quality development takes place on all levels, from course and programme to faculty and disciplinary domain level. The Faculty of Pharmacy committee for undergraduate and advanced level education (GRUFF) is responsible for undergraduate and advanced level education (bachelor and masters level) within the Faculty of Pharmacy. The chair of GRUFF is a member of the Disciplinary Domain's working committee (AU) and Disciplinary Domain's Board (ON) – see appendix 1 for an organization overview. Action plans for quality work within educational programmes and independent courses are prepared within each committee, after which a written report with a proposal for a decision is submitted to ON. Prior to a 6-year evaluation, a plan for the evaluation work, including proposals for external and internal reviewers and student representatives (appointed by the student unions), is submitted to GRUFF. After preparation, the proposals are submitted for review and decision in ON. Preparation and decisions at several levels ensure that there are no problems regarding non-compliance.

After the 6-year evaluation, the assessor's statement, self-assessment reports and evaluation reports are submitted to GRUFF for review and approval prior to the decision in ON. In addition, GRUFF must enclose a brief description of the planned measures in a separate document that is published on Uppsala University's website together with the assessors' statement. GRUFF comments on the report and reviews the planned measures and provides views on the reasonableness of measures and

schedules. ON decides to approve evaluation reports after the completion of the 6-year evaluation and in cases where self-evaluation or assessment show deficiencies or raises the need for major measures, ON decides on necessary measures before the evaluation report is approved.

Assessment of the LMU and LMM Programmes

A working group to conduct the self-evaluation has been appointed by GRUFF and has consisted of programme coordinators Luke Odell (LMU) and Per Larsson (LMM) and student representatives (Maria Deligianni, Samia Mohamed, Viktorija Brundzaite, Jessica Mahajan). The self-evaluation has been developed in a process that has involved teachers responsible for the courses and in consultation with the members of GRUFF. Two teacher representatives and members of GRUFF have been appointed by GRUFF to read and comment on the self-evaluation. The self-assessment has subsequently been presented to GRUFF in writing and orally and the members have been given the opportunity to present their views, which as far as possible have been integrated into the self-assessment.

To further help in collecting background information for this self-assessment report, the working group put together a questionnaire that was circulated to students that had graduated in 2021 and before on both programmes (for LMU also including students from the previous incarnation of the programme). A document with questions reflecting the 11 assessment areas (see below) was also sent out to all teachers within the Faculty who are responsible for one or more courses within the programmes.

The 11 Assessment Areas

This reflective assessment is based on [Uppsala University's Model for Review of Study Programmes](#). Each review should cover, to some extent, the following aspects.

1. that the study programmes achieve the objectives of the Higher Education Act and Higher Education Ordinance (Qualifications Ordinance) and programme-specific objectives, i.e., that actual learning outcomes correspond to expected learning outcomes
2. that the content and teaching activities are founded on a scientific basis and proven experience
3. that teaching focuses on the learning of students/doctoral students
4. that the achievement of intended learning outcomes is assessed using appropriate methods, and complying to rule of law, and that progression is ensured

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
6. that internationalization, international perspectives and sustainability are promoted
7. that a gender equality perspective is integrated into the study programme
8. that the study programme meets individuals' and society's needs for learning and professional knowledge and prepares students for future careers
9. that students/doctoral students have influence on the planning, implementation and follow-up of the study programme
10. that an appropriate study environment is available to all students/doctoral students
11. that continuous follow-up and improvement of the study programme is carried out

Background information on the Programmes

Masters Programme in Drug Discovery and Development (LMU)

The international Masters Programme in Drug Discovery and Development was launched in autumn 2020 and was the second international programme at the Faculty of Pharmacy. The programme is based on an earlier Swedish programme that was given during 2011-2019. The main driving force for establishing the international LMU programme was to increase internationalization within the Faculty of Pharmacy while at the same time capitalizing on the Faculty's strong research and education expertise in the area. As of spring 2022, two cohorts of 30-40 students have entered the programme with the first intake expected to graduate in June 2022. At the time of writing there are 26 students in their second year of studies (14 non-EU, 3 EU and 9 Swedish) and 30 students in their first year (19 non-EU, 4 EU and 7 Swedish). The majority of international students have a background in pharmaceutical sciences while the Swedish students are either dispensing Pharmacists (Bachelor of Pharmacy) or have a degree in Biomedicine. The main difference in the international programme (aside from the language of instruction) is the implementation of a new study plan based on a fixed set of courses in the first year (60 credits) with elective courses (15/30 credits) and project work (30/45 credits) in the second year. The earlier programme contained one mandatory course (7.5 credits) followed by elective courses (82.5 credits) and project work (30 credits).

This self-assessment is primarily based on the revised international programme – see below for the study plan. However, as no students have graduated from the new

programme at the time of writing, the alumni questionnaire was sent out to students from the pre-2020 programme.

Current Study Plan for the LMU Programme

First semester (August–January)

Drug Discovery and Development (7.5 credits)
Biologics (7.5 credits)
Molecular Imaging – Focus on PET (7.5 credits)
Pharmacokinetics (7.5 credits)

Second semester (January–June)

Pharmaceutical Bioinformatics (7.5 credits)
Molecular Biopharmaceutics (7.5 credits)
Clinical Trial Methodology (7.5 credits)
Clinical Pharmacokinetics and Pharmacodynamics (7.5 credits)

Third semester (August–January)

Elective courses 15/30 credits
Begin Degree Project/Thesis (total 45 credits)

Fourth semester (January–June)

Degree Project/Thesis (30 or 45 credits)

During their first year, students are introduced to a wide range of topics covering aspects of the Drug Discovery and Developments (DDD) process ranging from hit identification to clinical trial design. While this course selection does not provide comprehensive coverage of all the various disciplines within DDD, the students are given the opportunity to engage with researchers/teachers from all three Departments within the Faculty as well as industrial representatives. In the programme's second year, the students are presented with a list of recommended tracks (see below) to aid their choice of elective courses. It is important to note that these are only recommendations and that students are, in fact, able to choose freely amongst any elective course both within and outside of Uppsala University. As some elective courses are also given within other Swedish speaking programmes, a number of courses are taught only in Swedish.

Medicinal Chemistry

Advanced Organic Chemistry and Drug Synthesis (15 credits)
Drug Discovery Based on Natural Products (7.5 credits)
Pharmacognosy B (15 credits)

DDD in Biological Systems

Preclinical Safety Assessment and Pharmacovigilance (7.5 credits)
Artificial Intelligence in Drug Discovery (7.5 credits)
Models for Biological Systems (7.5 credits)
Lab Automation in Bioscience (7.5 credits)
Applied Pharmaceutical Structural Bioinformatics (5 credits)
Drug Safety and Pharmacovigilance (7.5 credits)
Preclinical and Clinical Data Analysis in Predictive Drug Discovery/Development (7.5 credits)
Molecular Mechanisms for Enzymatic Activation (7.5 credits) – Swedish only
Toxicology (7.5 credits) – Swedish only
Drugs and Dependence (7.5 credits) – Swedish only
Neuropharmacology (7.5 credits) – Swedish only

Biologics

Proteomics for Drug Discovery (7.5 credits)
Pharmaceutical Protein Drug Development (7.5 credits)

Drug Formulation and Production

Advanced Drug Delivery (7.5 credits)
Molecular Physical Pharmacy (7.5 credits)
Introduction to Nanomedicine (7.5 credits)
Computational Pharmaceutics (7.5 credits)
Patient-Centered Drug Delivery (7.5 credits)
Extemporaneous Compounding of Drug Products (7.5 credits) – Swedish only
Regulatory Requirements and Quality Assurance (7.5 credits) – Swedish only
Drug Formulation (7.5 credits) – Swedish only

Molecular Imaging

Radiation Protection and Medical Effects (6 credits)
Nuclide Production and Radiochemistry (9 credits)

Misc Courses

Applied Pharmaceutical and Biomedical Analysis (7.5 credits)

All the courses listed above are available as electives in other programmes and, in the context of this evaluation, only courses taken by more the 25% of students were included. The only two courses that fulfilled this requirement are Patient-Centered Drug Delivery (7.5 credits) and Advanced Drug Delivery (7.5 credits).

Masters Programme in Pharmaceutical Modelling (LMM)

The international Master's Programme in Pharmaceutical Modeling was launched in 2016 and was the first international education programme within the Faculty of Pharmacy. One important factor that motivated the launch of the programme was the trend (which remains today) of more data-driven focus within both academic research as well as in the pharmaceutical industry. Different modeling and simulation approaches have gained ground over the years, and a number of research groups within the Faculty of Pharmacy were (and continues to be) strong in areas such as computational chemistry, bioinformatics, pharmacometrics and pharmacokinetics etc.

The first 2-3 cohorts that graduated from the programme were quite small (between 5-10 students), but since 2020 and onwards we have seen an increase in the number of students that start the programme, and as a consequence a greater number of students that graduate (around 20-25 in 2021 and 2022). At the time of writing there are 22 students in their second year of studies (14 non-EU, 3 EU and 5 Swedish) and 29 students in their first year (22 non-EU, 4 EU and 3 Swedish). The majority of international students have a background in pharmaceutical sciences while the Swedish students are either dispensing Pharmacists (Bachelor of Pharmacy).

The study plan for the programme has been relatively stable since it started. One course that was part of the programme initially (Health Economic Evaluations, 7.5 credits, 3FS140) was replaced in 2020 by the course Molecular Physical Pharmacy (7.5 credits, 3FC003). The reason for this was a change in teaching capacity within the Faculty.

Current Study Plan for the LMM Programme

First semester (August–January)

Drug Discovery and Development (7.5 credits)
Molecular Biopharmaceutics (7.5 credits)
Introduction to programming in Python and R for Biosciences (7.5 credits)
Preclinical and Clinical Data Analysis in Predictive Drug Discovery/Development (7.5 credits)

Second semester (January–June)

Pharmaceutical Bioinformatics (7.5 credits)
Computational Medicinal Chemistry (7.5 credits)
Advanced Molecular Modeling Applied to Drug Discovery (7.5 credits)
Clinical Pharmacokinetics and Pharmacodynamics (7.5 credits)

Third semester (August–January)

Molecular Physical Pharmacy (7.5 credits)
Models for Biological Systems (7.5 credits)

Elective courses (15 credits), or
Begin Degree Project/Thesis (total 45 credits)

Fourth semester (January–June)

Degree Project/Thesis (30 or 45 credits)

In the LMM programme, students are exposed to a wide array of different computational modeling, simulation and data analysis techniques, with a particular emphasis on how these are relevant in a pharmaceutical context. While this course selection does not provide comprehensive coverage of all the various disciplines within Pharmaceutical Modeling, the students are provided with a relevant course selection and are given the opportunity to engage with researchers/teachers from all three Departments within the Faculty as well as industrial representatives.

In terms of elective courses, the students have a maximum of 15 credits that can be used for courses outside the mandatory programme. Most students on the programme seem to prefer the option of a 45-credit thesis rather than a 30-credit thesis, and the combination of this means that a larger fraction of students do not take any elective courses. However, the option of the 30-credit thesis still exists, and some students do prefer this option. These students are then presented with the following list of courses

that are offered within the Faculty of Pharmacy and with English as the language of instruction.

Molecular Imaging with Focus on PET (7.5 credits)
Clinical Trial Methodology (7.5 credits)
Drug Safety and Pharmacovigilance (7.5 credits)
Applied Pharmaceutical Bioinformatics (7.5 credits)
Applied Pharmaceutical and Biomedical Analysis (7.5 credits)
Computational Pharmaceutics (7.5 credits)
Introduction to Nanomedicine (7.5 credits)
Pharmacokinetics (7.5 credits)
Students that understand Swedish to a high-enough level can in addition choose among these courses within the Faculty:
Läkemedel vid graviditet och amning (7.5 credits)
Fysiologi (9 credits)
Extemporettillverkning av läkemedel (7.5 credits)
Klinikorienterad farmaci (7.5 credits)
Läkemedel - kvalitetssäkring och regulatoriska krav (7.5 credits)
Läkemedelsmissbruk och beroendelära (7.5 credits)

In addition, students also have the option to look for courses outside of the Faculty of Pharmacy that they are eligible for and find interesting. Primarily those courses would be offered within the Medical Faculty or the Faculty of Science and Technology.

1. The Study Programmes Achieve the Objectives of the Higher Education Act and Higher Education Ordinance (Qualifications Ordinance) and Programme-Specific Objectives

In general, the teachers within the programmes are well acquainted with the overall programme objectives. In accordance with the overall guidelines for courses and programmes within the faculty, these objectives are heavily relied upon when planning and examining all teaching elements. The majority of courses throughout the programmes focus on the ability “to analyze, explain, discuss and critically evaluate aspects related to the subject area”.

The course objectives are clear to the students through the syllabus and the goal descriptions for each course. The goals are reviewed with the students during the course introduction and are referred to continuously during the courses. These documents are available to students via the course's learning platform and University syllabus database.

The majority of course objectives are examined at the end of the course through a written exam. The assessment of the exam is made either by scoring that reflects fulfillment of learning objectives or by questions directly corresponding to a course goal that are assessed as passed or not. In other instances, the goals are examined via mandatory seminars, project work, reports or oral presentations.

As stated above, the final 30-45 credit points of both programmes consists of an independent research project course. Here the students are integrated into a research group within the University or at an external site to carry out a small research project, based primarily on wet laboratory or in silicon experimental work. These projects are assessed by an examiner with expert knowledge on the broader subject area via a standardized set of grading criteria. The grading criteria have been developed to cover all of the course goals that are, in turn, reflective of the overall programme goals (see appendix 2 for a comparison of programme goals, course goals and grading criteria). To achieve a pass grade the students need to fulfill all the grading criteria and this process ensures that the students achieve the overall programme goals and the objectives of the higher education ordinance.

2. The content and teaching activities are founded on a scientific basis and proven experience

The forms of teaching are adapted to pedagogical needs of the courses. A variety of different teaching methods are used throughout the programmes such as lectures, seminars, laboratories, project tasks and essay work. Importantly, the subject area of the courses are well aligned with the research areas of the particular teacher and their research group. The courses are generally based on an initial more basic knowledge acquisition section followed by activities where knowledge is applied using various teaching methods. This can include problem-solving workshops, discussions, in-depth study of scientific issues and scientific writing. The various methods and concepts that are taught, such as laboratory methods in wet or in silico labs, are methods that the lecturers use in their own research and are thus highly relevant to the research environment.

The course material is built on a scientific basis regarding the choice of course material and the teachers' subject background. There is a clear connection to new research in the subject areas given that the course teachers are largely active in both teaching and research. Experienced teachers with solid higher education pedagogical education and teaching experience in the area mainly give the courses. The requirement for all permanent positions as a teacher (assistant professor, senior lecturer, professor) is ten weeks of higher education pedagogical training or equivalent experience (see appendix 3 for an overview of teacher competencies). In cases where junior staff participate in the teaching (PhD students, adjuncts), they do so in close connections with a senior teacher. Junior staff's teaching assignments are also based on their subject knowledge

and connection to research in the subject, and as part of their pedagogical development of the teacher role. In all Departments, the teachers work in teaching teams and are closely linked to the subject's director of studies, who in all cases, is an active teacher within the group.

The teaching staff are closely linked to a research environment and, in general, have University teaching positions. Most of the lecturers conduct research in subject areas that are relevant to the course and have long relevant experience in the field. Guest lecturers are either active researchers or active in professional fields, or a combination of these. The research connection is thus strong and is used in different ways in the courses. For example, teachers can provide insight into research through lectures, literature and in discussions with the students. The programmes culminate in a 30/45 credit point research project where students are directly involved in ongoing research within the Faculty or at an external partner. The vast majority of students conduct their thesis work within the University (only one student from the LMU programme is performing an external project this term) and increasing the proportion of external students is an ongoing goal for both programmes. In all project work, the teacher is directly involved in ongoing research and most likely publishes regularly on the subject.

In the courses with an online component, communication takes place with the student group and between the students in the student group, mostly via the learning platform Studium (Canvas). Examples of this are discussion forums where the course leaders activate the students by encouraging them to answer each other's questions while the course teachers can also make posts. On campus courses, much of the communication takes place in connection with teaching on campus and during breaks, which during the pandemic was partly replaced by contact via Zoom.

Ethical aspects also permeate the students' own work with the course through information about how the university works against plagiarism. Information regarding plagiarism is usually given in connection with assignments and all assessment tasks submitted through Studium are checked for plagiarism. Ethical aspects are also included in the lectures when animal and clinical studies are discussed.

Within the course Clinical Pharmacokinetics and Pharmacodynamics there is an introduction to Bloom's taxonomy pyramid, and a similar discussion takes place at the start of the Drug Discovery and Development course where students are challenged to move towards the higher levels in the SOLO taxonomy.

Examples from the LMU Programme

In the course "Biologics" the theoretical elements of the course are designed to help the students with the theoretical lab, which is run as an actual research project. The

aim of this lab is to allow in silico design breakthroughs in the design of biologics to tackle different diseases. This is a clear example of scientific and research based teaching.

In the course “Advanced Drug Delivery”, the teaching staff consists of one Professor, 2 Associate Professors, 3 Postdocs/PhD graduates and 2 PhD students.

In the course “Molecular Biopharmacy” the course literature is largely based on scientific articles. In this way the course content is continuously updated and in line with developments in the field as a whole. For example, there is an element during the course where students must present and critically review a scientific article in the subject area. The articles are both recently published and selected from relevant journals in the subject area, in order to give students insight into the current state-of-the-art in the field.

Examples from the LMM Programme

In both the programme courses focusing on computational medicinal chemistry (Computational Medicinal Chemistry and Advanced molecular modeling applied to drug discovery) within the Pharmaceutical Modeling programme, the practical computer exercises, which form an integral part of the courses, are based on scientific literature and sometimes allow students the opportunity to “recreate” actual scientific findings.

The course “Preclinical and clinical data analysis within discovery and development” is examined as a project work, where students get access to a dataset that represents e.g. a collection of solubility data, or data from a clinical trial. They then get the opportunity to put their knowledge about data analysis to the test in a more “realistic” way compared to a traditional written exam.

3. The teaching focuses on the learning of students/doctoral students

Student Rights and Responsibilities

The student groups are rather diverse and vary in their country of origin, country in which they received their education, time since they completed their bachelor studies, experience of university studies in different countries, etc. Given their heterogeneous background, extra focus is needed to clarify the student's own responsibility for their learning, and this is communicated to the students already at the start of their

education. Many of the participants have never studied at a Swedish university and for many; Swedish University studies also involve a different way of learning that requires new study techniques. The teachers therefore need to emphasize that the education is more focused on understanding and reasoning rather than memorization. At the start of the education, students are informed about their rights, such as the opportunity for re-examination and various support functions available at the Faculty and the University programme for teaching and learning. Many courses also reference the University's rules and guidelines in their information material, including the students' working conditions. This material can even be found on the programme homepage on Studium. Furthermore, the course goals and learning aspects are reinforced by the course coordinator and then by the respective teachers on the course.

Student-Activating Teaching

All courses incorporate elements of student-activating teaching within the lecture component (the most passive component of any course) of the course. This is achieved indirectly by relating lecture material to more activating teaching forms such as seminars, group work or labs and in this regard provides a link between theory and practice. Direct activating activities such as quizzes, polls and small-group discussions are also regularly employed to enhance student engagement. The teachers constantly monitor student engagement and active learning, with a large effort aimed at including students within the different teaching occasions as much as possible. Teacher-to-student, student-to-teacher and student-to-student interaction are all highly encouraged. For example, in the course Computational Medical Chemistry, a large proportion of teaching is based on student activation, with 59 hours divided into 10 computer exercises per student actively working at a computer. In the course Clinical Pharmacokinetics and Pharmacodynamics, teaching takes place mainly in workshop format. Here the students design, analyze, compile and discuss their results in groups, before presenting to other groups. In their final individual report, they compile their results and put them into perspective based on current existing literature.

Feedback

According to Uppsala University's guidelines (Pedagogical program for Uppsala University), students have the right to receive feedback on their grades. This is achieved in various ways depending upon the nature of the assessment task. In most cases, written feedback is given for written tasks and oral feedback for oral tasks. For larger written reports, the students are often provided with additional feedback after a second submission to monitor progress and development. During the degree project,

the students are encouraged to submit drafts of their report to their supervisor, at least once, for feedback prior to submission to the examiner. The examiner will also provide feedback to the student based mainly on the Faculty grading criteria (appendix 2). Feedback on written exams is often given as comments on paper or via the electronic examination system Inspira.

Students have the opportunity to practice giving constructive criticism or peer-feedback throughout the programmes. For example through participation in "study groups" where they jointly discuss and prepare for seminars, and via opposition to another students' oral presentation. The latter is a formal assessment requirement for completion of the research project courses with specific assessment criteria.

4. The Achievement of Intended Learning Outcomes (ILO) is Assessed using Appropriate Methods and that Progression is Ensured

Written exams are conducted in an examination hall in Uppsala according to "Guidelines for written exams including e-exams at Uppsala University". However, in response to the covid-19 situation many exams over the past two years have been given as home exams. In this case, teachers have used a number of methods to ensure correct examination (randomized questions, essay-type questions, plagiarism checks) however; there have been no tools available to check the identity of the student or to stop collusion. Due to these problems, all examinations were reverted to physical on-campus activities as soon as possible after covid-19 restrictions were lifted. All exams are written anonymously and decoded only after correction when the result is reported in the University student documentation system Ladok.

The courses use a variety of different examination forms to ensure examination of the intended learning outcomes. In the cases where group work is assessed, examination of each individual student is ensured through a final written exam. Exam questions and assignments are designed to cover all course objectives. Examinations are generally points-based, while assignments, reports and reports are usually assessed according to assessment criteria, reflecting each ILO. All submitted texts undergo automatic plagiarism review in the program Ouriginal (formerly Urkund) built into Studium / Canvas. The Faculty of Pharmacy has a strict follow-up process upon suspicion of misleading examination with well-developed routines for handling such cases.

The percentage of students entering and exiting the programmes is given in Table 1 below. These numbers do not take into account the drop off in student numbers (around 10 students per programme) generally associated with the first term of a new programme.

Table 1. Comparison of number of registered and graduated students per year and programme.

LMM			
Start year	Number of registered students	Number of graduated students	Throughput (%)
2016	16	12	62,5%
2017	20	8	40,0%
2018	20	12	50,0%
2019	25	18	52,0%
2020	33	0	0,0%
2021	40	0	0,0%
LMU			
Start year	Number of registered students	Number of graduated students	Throughput (%)
2016	1	1	100%
2017	3	1	33,3%
2018	12	9	75%
2019	4	1	25%
2020	38	2	8,7%
2021	38	0	0%

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

One or more Departments administer each course and within each Department, there is a management team that is responsible for resource planning of teaching assignments, both long-term and short-term. This team is usually made up of the Deputy Head of Department (responsible for undergraduate teaching) and the Director(s) of Studies for the specific subject area(s). Teaching assignments and working hours/percentage of full-time employment are formalized in a work plan agreement between the teacher and Department via the Head of Department.

The teachers involved in the courses have relevant higher education pedagogical education and/or work in teaching teams together with senior teachers with higher education pedagogical education (senior lecturers, professors) where more experienced colleagues support more junior teachers. At the Faculty level, there is a requirement for 10 weeks of higher education pedagogical training for both appointment of new teachers and in promotions. There are numerous opportunities for pedagogical education beyond these formal requirements at the University; however, this is largely done based on the individual interests of the teacher. In general, the Faculty's teachers have a large proportion of teaching in their positions and existing staff may lack sufficient time and or incentives for additional pedagogical training.

The Faculty of Pharmacy arranges undergraduate teaching workshops once every semester (three full days per year) where participation by all teaching staff is expected. These workshops include pedagogical education and collegial discussions on teaching issues as well as planning for upcoming developments (new programmes, courses etc.). At a higher level, the Faculty's Directors of Studies meet once a month to discuss various ongoing educational issues. External guests are often invited to these meetings to increase understanding of these issues. The guests usually participate during the first hour, when a specific topic is discussed. Students can be invited as guests, but do not participate otherwise. The forum enables in-depth discussion of various challenges in teaching. The Study Directors within each Department also meet about once a month, together with the Deputy Head of Department. Each Director of Studies also has regular meetings with their own group of teachers to discuss more local issues. All Directors of Studies are active teachers with a large proportion teaching in their work assignment. The local teacher group within a specific subject area is responsible for introducing new teachers to a particular course or teaching activity.

At the Disciplinary Domain (Medfarm), there is a Pedagogical Council (PRåM) whose role is to be a subject didactic node for pedagogical development and to promote high quality education, according to the University's goals and strategies. PRåM can provide support and advice undergraduate and postgraduate education committees as well as to individual teaching teachers. Furthermore, PRåM is responsible for disseminating information about teacher excellence, pedagogical means and activities in learning, for example via lunch seminars where teachers share and discuss examples of pedagogical development in the field of science.

6. That Internationalization, International Perspectives and Sustainability are Promoted

Given that both programmes are international and that more than 60% of LMU and 80% of LMM students are from outside Sweden, there is a strong intrinsic internationalization component. The programmes are an integral part of the Faculty's overall goal to increase and promote internationalization within undergraduate

education. There is, however, significant room for improvement in how international students are integrated into the faculty. The legal requirement for Swedish as the official language in many University forums, limits the ability of international students to act as representatives in various boards and committees. The Bachelor and Master of Pharmacy programmes culminate in a symposium where all students present their thesis work in the form of a poster or oral presentation. Unfortunately, this event is currently only held in Swedish and, as a consequence, the majority of international students do not participate. Nevertheless, the impression from the survey among graduated students is that for the most part they had a positive view on their study period (Fig. 1).

13. For international students: I felt comfortable in my studies as well as in Uppsala and Sweden in general? (*Antal obesvarade = 1*)

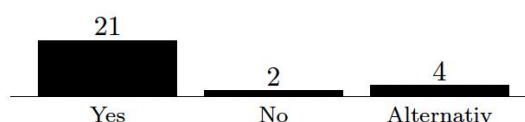


Figure 1. Overall impression of their study experience at Uppsala University and in Sweden among students with an international background.

In the majority of the courses, international research perspectives surrounding pre-clinical and clinical studies are emphasized. One example includes the regulatory requirements for drug approval from different international agencies (FDA and EMA) are also discussed, especially in the courses “Clinical Pharmacokinetics and Pharmacodynamics” and “Drug Discovery and Development”.

In the majority of courses containing group work, the students are assigned randomly to a particular group. This promotes the interaction between students of different backgrounds and facilitates the exchange of experiences between students from different backgrounds. This is even done in a more direct fashion in the course “Drug Discovery and Development” where students are divided into heterogeneous groups based on their background, previous education and current programme.

Sustainability perspectives are addressed to varying degrees in the courses, depending on what is dealt with in the course content, from the fact that it is not addressed at all in one course until the entire course is linked to sustainability perspectives, for example through the focus within a particular course on *in silico* research. However, it does not appear from the questionnaire for any of the courses that this is explicitly communicated to the students

7. That a Gender Equality Perspective is integrated into the Study Programme

Gender perspectives are treated to varying degrees in the course content itself and occur to a greater extent in courses that deal with drugs and substance abuse. In other courses, teachers and researchers of different genders and ethnicities are involved in course development work. Among the teachers that are responsible for courses on the programmes, there is overall a roughly a 50:50 split between male and female teachers. For the LMU program, however there are 6 female and 2 male teachers responsible for the eight mandatory courses in the first year. Specifically for LMM, there are 3 female and 7 male teachers similarly responsible for the 10 mandatory courses (with some teachers counted twice because of the overlap between the programmes for certain courses). The majority of the course responsible teachers are from within Sweden (but not necessarily from Uppsala University). There is more diversity however when taking into consideration the PhD-students and post-docs that are also involved in teaching. In particular for non-native Swedish speakers courses on the programmes are a very good opportunity to gain teaching experience.

All courses in the programmes report that detailed information about Uppsala University policies regarding equal opportunities/conditions is given with the first introductory lecture including, sometimes, links to the UU webpage and whom to contact. The message to students is that UU has no tolerance to any discrimination, any complaint will be taken seriously, and that they could turn to any person whom they will feel comfortable to discuss the case, even there are only suspicions. Courses that involve group-based work, such as for example the course Advanced Molecular Modelling Applied to Drug Discovery, report that they are regularly randomizing these during the course to that the everyone gets the opportunity to know students with different backgrounds. This is similar to what is described above for the course Drug Discovery and Development in an effort to also promote internationalization.

In the Faculty of Pharmacy's course template (for the learning platform Studium), there is a direct link to the department where information and contact information is available to the department's equal conditions representative and equal opportunities working group. In general, Uppsala University has decided that each department no longer needs to have its own action plan, as it goes under the university as a whole. However, the Department of Pharmaceutical Biosciences has already begun work on developing a plan for follow-up of equal issues, which will take effect until 2023, in order to clarify its own routines in this context. All three departments (Pharmacy, Pharmaceutical Biosciences and Medicinal Chemistry) hold equal opportunity seminars with invited lecturers for all teachers and researchers periodically to make employees aware of and observant of the problems. The seminars have a high attendance and are given special priority by professors and other senior teachers.

Finally, it is worth mentioning that, unfortunately, at least some of the communication from the student services department is only in Swedish which excludes non-Swedish speakers. The situation has improved over the years, but the "student symposium" which is organized at the end of each semester continues to be mostly in Swedish. The degree ceremony is another event where there is a Swedish ceremony organized student services in September each year. This is problematic not only for language reasons, but also since the typical visa period has expired then students are not able to take part. There is a ceremony organized by the Faculty of Medicine where international students from the Faculty of Pharmacy are invited however, but there seems to be room for improvement here.

8. That the Study Programme Meets Individuals' and Society's Needs for Learning and Professional Knowledge and Prepares Students for Future Careers

As can be seen from the response from students that have graduated from the programmes, most of them are able to find employment within the first 6 months following graduation (19 out of 28 total answers, Fig 2). One year after graduation, roughly 85% of the students had some kind of job, in either industry or academia. When talking to students that have just started their studies, a majority of them are more interested in a career within the pharmaceutical industry compared to pursuing PhD-studies. We did not ask the follow-up question whether they remain in Sweden or have found employment elsewhere.

6. After graduation, how long did take to get your first job?

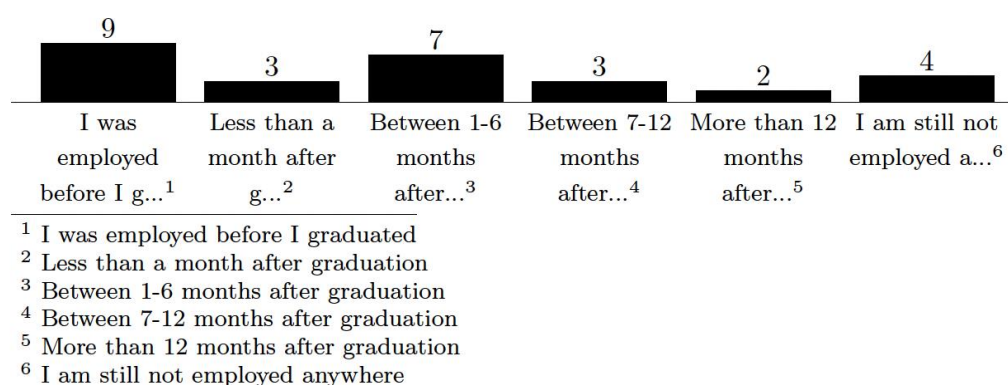


Figure 2. How long after graduation did students gain their first employment.

Making sure that the students get training in methods and gain knowledge that is relevant to society is also something that permeates the courses in the programmes. Almost all courses from the programmes report that some lectures are given by invited experts from the pharmaceutical industry or e.g. the university hospital and regulatory agencies. This ensures that teaching remains relevant. One comment from the student

survey was that “the courses are laid down exactly like the DDD pipeline. From basic DDD as the first course to pharmacovigilance and pharmacometrics as the final ones. This also gave the opportunity for students to choose which area of the DDD they were interested in and would like to further focus on and work in their future”. The answers from the programme survey indicates that the majority of the students feel they left the programmes well equipped for a future career (Fig. 3). Among the 6 students that felt that the program did not provide relevant training, one student was registered on the pre-2020 Drug discovery and Development programme, and seems to have dropped out before graduating. The student simply states that the program was “not relevant”. The remaining five students also unfortunately provide very sparse comments about why they answered the way they did. One of them indicated that the Pharmaceutical Modeling programme contained too much programming, which he/she felt was not relevant. The others in general seem to be please with their studies, and all of them have answered “yes” on the question about whether they would recommend the programme to prospective students. For the Pharmaceutical Modeling program then, we should try to make even more clear perhaps that the intention of the program is to educate students around modeling and simulation within pharmaceutical sciences and that if they are not inclined towards that it would be better to apply for Drug Discovery and Development instead.

8. If you are currently employed, in your view, did the program provide relevant training for your current position? (*Antal obesvarade* = 2)



Figure 3. Most graduated students felt that they were well equipped with skills for a future career within pharmaceutical sciences.

In the course Clinical Pharmacokinetics and Pharmacodynamics, which is common to both programmes, the students come into contact with students from other educational programmes from both pharmacy and engineering backgrounds. Importantly, the course is structured around a series of workshops where students take on different roles (preclinical specialist, statistician, physician, pharmacokinetics, regulatory specialist) and in that way learn how pharmacokinetics and pharmacodynamics are applied in each of these parts of the drug discovery pipeline. The students are also required to write project reports where for example the group that is responsible for pharmacokinetics should suggest appropriate study design (e.g. dosages and sampling times).

The courses in Molecular Biopharmacy (common to both programmes), Advanced Drug Delivery (LMU) and Patient Centered Drug Delivery (LMU) are also tightly linked to the SweDeliver Drug Delivery competence center. SweDeliver is a world-leading competence center within drug delivery which includes 16 industrial partners (both

SMEs and big pharma), and several research groups within the faculty are involved in the research activities. Discussion during the courses is also encouraged, and students are stimulated to learn from each other / take advantage of each other's experiences, regardless of whether it is about nationality, undergraduate education etc. The teaching staff also have different nationalities and educational backgrounds. In addition, there is a large number of international guest lecturers.

Technology and work methodology are continuously developed in the courses where applicable. For example, in the course Computational Medicinal Chemistry plans are in progress to include a component focusing on large-scale virtual screening assisted by appropriate machine learning filters.

9. That Students Have Influence on the Planning, Implementation and Follow Up of the Study Programme.

Courses at the Faculty of Pharmacy are evaluated through a joint routine that takes place in close collaboration with the Pharmaceutical Student Union. The course evaluations are based on faculty-wide questions with the possibility for each course coordinator to add their own questions. Administrators at the union review the answers and depersonalize the free text answers. A meeting between the course coordinator and course representatives takes place and a course report is written based on the answers received. The course report is then taken up by the department board and GRUFF.

Students are encouraged to complete the course evaluation at the end of the courses and this is emphasized especially if something special comes up during the course. In general unfortunately the fraction of students that respond to the evaluations is quite low, with numbers typically well below 50% of registered students. This is a problem that as such is not unique to the international master's programmes, but it is possible to speculate that having this opportunity to express opinions about a course is not something that students from outside e.g Sweden/EU are used to. Besides the formal course evaluations, there is also ongoing communication with the students during many courses, and most courses use discussion forums in the learning platform where students can express and share their opinions and have a continuous communication with the teachers. Students are also able to gain an insight into previous students' views and course changes as these are discussed during the course introduction on most courses. However, this can be improved so that it is regularly done on all courses (more about this below). Feedback is also given in other contexts during the course when discussions about the course structure arise. This can be improved with a routine that is currently being implemented where course reports are made more easily accessible in the learning platform. A challenge in the course evaluation work is to find course representatives who want to participate in the work with the course report. This is somewhat challenging in a group with many international students, since their knowledge and involvement in the student union has been rather low. Among the

teachers within the programmes, the students' opinions are generally highly valued and feedback is gratefully received by the teachers as it usually helps to improve the education.

12. In my view, the teachers on the program were interested in listening to opinions from the students ($Medel = 4,3$, $SD = 0,8$) ($1 = \text{Not at all}$, $5 = \text{Completely agree}$)



Figure 4. Response from previously graduate students about how they feel towards their opinions being listened to by teachers on the programmes.

It is encouraging to see from the responses in the survey sent out to graduate students that a majority of them feel that they had been listened to during their studies (Fig. 4)

10. That an Appropriate Study Environment is Available to all Students

The courses are taught in Uppsala University's premises in Uppsala (mainly at the Biomedical Center, BMC) via the learning platform Studium (Canvas). The premises are usually equipped with hearing loops and have good accessibility. Material is posted before lectures so it is available for people with dyslexia support. Writing support is offered according to Uppsala University's guidelines.

Most students on the courses, even those who are not previously used to the system, perceive the learning platform Studium / Canvas as easy to use. The Faculty of Pharmacy's course template (start page) used in Studium / Canvas, has direct links to "Rules and guidelines" with information about e.g. Equal treatment of students, Equal conditions, Re-examination of courses within the Faculty of Pharmacy, Pedagogical program, Rules and rights for all students at Uppsala University, Registration and re-registration of courses, Completion of written exams including e-exams, Students' working conditions, Misleading examination, Appeal referral as well as information about and links to the bodies that decide on rules and guidelines for students at Uppsala University and the Faculty of Pharmacy. According to guidelines, a detailed schedule for upcoming courses should be made available to students at least 5 weeks in advance, so that they have time to prepare for upcoming teaching activities. This is particularly important for students that live further from Uppsala and need time to plan accordingly. We do not have any reports from any particular course that they have failed to meet these requirements.

The course coordinator works actively to promote a good atmosphere and discussion climate during the courses. In several courses, there is an active follow-up of students who miss compulsory parts and assignments. The medical and pharmaceutical faculties' undergraduate education committees and the postgraduate education committee (GRUNK, GRUFF and KUF) to train staff and student representatives in detecting signs of mental illness have initiated a project on "mental health first aid".

Staff at the Faculty's student service, including study counselors, are important for helping students with extra needs and for informing course leaders about which students are in need of extra support. Information about the support available at Uppsala University, such as Student Health, is published on the learning platform and is available throughout the programme and University homepages. There is also a short contact route for course leaders and coordinators via the learning platform and email, which enables students to get in touch when they need to. In general, we have so far managed to solve the students' needs very quickly. Unfortunately however, we do not have information available about to what extent the students are taking advantage of the services that are offered for getting help with e.g mental health issues or study stress. The results from the survey among graduated students seem to indicate that in general the students are having a positive study experience.

The majority of the course leaders mention that one aspect of having a good learning environment is to have access to well-functioning lecture halls, computer rooms with modern equipment etc., but it is equally important to make sure that teachers on the individual courses are committed to the students, and that they are there because they want to teach and think that it is rewarding. A lot of experience from teachers on the programmes, but also from pedagogical research, tells that quite many students prefer to learn and study together, e.g in small rooms that are generally available throughout the Biomedical Center campus (or elsewhere). During the cover pandemic, this has been particularly challenging for a lot of students on the international master's programmes. Students that started, particularly in 2020, but also to some extent in 2021, in many cases found themselves in a new country and essentially barred from on-campus teaching, without any social network to facilitate such group-based learning. Throughout the period of online teaching we were quite happy to see that students seemed to cope quite well despite this, however. This was possibly due to many of them arriving from countries with much stricter "covid-rules" than in Sweden. Still however, when talking to students a number of them expressed feelings of isolation and boredom. In addition, in particular on courses that required access to e.g. high-performance computing resources, it was difficult at best to replace such resources with the (often low-end) laptops (often low-end) that students had brought with them.

11. That Continuous Follow-Up and Improvement of the Study Programme is Carried Out.

The quality of the courses and teaching on the programmes are continuously being monitored in a number of ways. On the level of individual courses, all teachers that have responded to the survey express that they organize meetings with the teaching staff after a course has finished, and then discuss what worked well, and what could and should be improved until the next time the course is given. Summative course evaluations form an integral part of this work, and the result is a report that summarizes the course from both the students' and teachers' points-of-view. The course evaluations are also being discussed both within the group of teachers in a particular teaching subject, where the director of studies is present. They are then further discussed within GRUFF as well at e.g. department board meetings and meetings with all directors of studies from within one department. No course on either programme currently uses formative course evaluations while the course is ongoing, but within the course "Drug Discovery and Development", which is the first course on both the programmes, there are plans to start a "mid-course" evaluation when the course is offered in autumn 2022. Generally, one can speculate that one possible reason for why this is not done more is that all courses are short 7.5 credit courses, meaning that there would not be a lot of time to adjust a particular aspect during that course.

Ideally, at least 1-2 students that have just completed the course should also be present at the course meetings, but unfortunately, such students are not always available for these programmes, something that might be due to the background of the students (some are simply not used to being asked about their opinion in this way). The next time the course is given, students are informed of the most important points from the evaluation from last time, as well as what measures have been taken because of that. The course report is also being made available to students in the Studium system. According to new guidelines within the faculty, this communication of the results from the previous course evaluation, and what potential measures that resulted in, is now mandatory and both current students and the programmes should be informed about the this.

Another mechanism for continuous improvement of the programmes is the yearly "action plan", which is being produced according to guidelines from the Disciplinary domain within Medicine and Pharmacy (appendix 5). The action plan highlights various parts of the education that are in need of reinforcement and improvement and prioritizes future measures in the short and long term. The action plan has been presented annually to GRUFF and the area committee.

LMM specific remarks

Examples of continuous improvement that come as initiatives from teachers on individual courses include plans to include large-scale virtual screening with input from machine learning based filtering on the course 3FK219 Computational Medicinal Chemistry.

On the course “Preclinical and clinical data analysis in drug discovery and development” the practical exercises for the preclinical part have been largely reworked during the last year, to include more up-to-date approaches around data analysis, and trying to get students acquainted with contemporary python/R analysis and modeling tools. A lot of effort has also gone into making better use of the knowledge about python and R that students are expected to gain on the course “Introduction to Programming in Python and R for Bioscience” that immediately precedes this course.

Concluding discussion points and remarks

Overall, the impression from the above self-evaluation survey is that the programmes are functioning well, but that there is also room for improvement in certain aspects. In the final part of the self-evaluation, we have tried to summarize aspects of the programmes that are not immediately captured by the 11 evaluation aspects, but where it would nevertheless be beneficial to think about potential changes moving forward.

Industrial relevance of our programmes

As mentioned above, the majority of the students are eager to launch into an industrial career once they are done with their studies. This begs the question then whether the programmes are doing everything possible to give them tools and equip them with the necessary knowledge to pursue an industrial career? Are there any clear flaws or areas that are missing? How should we think about balancing the needs of the industry with other areas, so that we are also catering to students that are more inclined towards an academic career path?

Thesis work - administration, finding a project, student symposium

Students on both programmes have the option of doing either a 30 credit (starting in semester 4) or a 45 credit (starting in the middle of semester 3) master thesis. Typically, these are performed within the university in close connection to one of the research groups that have been involved in the teaching on some course on the programme. A lot of the students however are interested in doing their thesis work in an industrial setting, and a number of students are able to find such an opportunity, either in Sweden or sometimes, for international students, in their home country. The process of finding a thesis project is sometimes perceived by students as somewhat vague, and the timing of the application process is commented on by the previously graduated students in the survey.

For students on the Drug Discovery and Development programme, the current process leaves students with a choice of a number of “topics”, essentially linked to how the faculty has organized teaching into a number of thematic units. There are currently a little more than 10 different such topics. Students on the Pharmaceutical Modeling programme have fewer thesis areas to choose from. These are limited to one of

“Bioinformatics”, “Computational Medicinal Chemistry”, “Pharmacometrics”, or “Pharmaceutics and Biopharmaceutics”.

The application process is handled by the student services organization, and roughly coincides with the Swedish national application periods to higher education in the first half of April (45 hp thesis) and October (30 hp thesis) each year. Something that the previous students that have responded to the programme survey feels can be improved is the timing of this selection. Again, most students are interested in the 45-credit thesis, but with an application window during the first half of April, this means that they have not completed all of the courses in the second semester of their programme. They therefore find it difficult to make an informed choice about their thesis, since they really cannot know that they would be very interested in a topic or area they have not been exposed to.

At the end of each semester, as described above, a “symposium” is organized by the student services organization. Here, students on the longer educational programmes within the faculty get the opportunity to present their thesis work with a poster, similar to a scientific conference. There are also a few students from each Department that are selected for oral presentations. Unfortunately, this event is in Swedish only, and while there is nothing that prevents non-Swedish speaking students from taking part in the symposium, the fact that all communication etc. around this event is in Swedish makes them feel less “welcome”. Here we see a clear potential for improvement, with very low-hanging fruit in the sense of making sure to include English as an alternative language in the symposium.

Marketing towards international students

The number of applicants in both programmes is relatively high (see table below) and compares favorably to other masters programmes at Uppsala University. In 2022, both programmes ranked among the top 20% across UU in terms of total number of applicants. Although this is a good base for recruitment, we would like to increase the number of high quality applicants. Currently, the programmes are marketed exclusively through the University websites (<https://www.uu.se/en/admissions/master/selma/program/?pKod=FLU2M>, <https://www.uu.se/en/admissions/master/selma/program/?pKod=FPM2M#>) and we would highly appreciate any feedback on how to improve their attractiveness towards primarily international students or any other insights into how to attract high-quality students.

Work is however underway to promote and present the programmes and the type of knowledge that graduated students have to presumptive employers both locally in the Uppsala/Stockholm area and elsewhere. At the moment this is done mainly in the form of dialogue with representatives of different organisations, but could perhaps be

expanded further. This will hopefully enable us to have a wider array of external contact points that students can contact when for example they are looking for degree project possibilities (remembering that students on both programmes are eager for their thesis to have an industrial connection). A document (in both Swedish and English) has also been put together with the intention that both students and external degree project partners get a better understanding about what it means to host a student working on a degree project, and to clarify the different roles and responsibilities for the student, the external partner and the faculty.