

Study Program Documentation

Master Biomedical Neuroscience (MSc-BmN)

TUM School of Medicine

Technical University of Munich

October 2017

Formal Indications

Name:	Biomedical Neuroscience (BmN)
Academic Department:	TUM School of Medicine
Degree:	Master of Science (M.Sc.)
Standard Study Period/ Credits:	4 Semesters 120 Credits
Form of Study:	Full time
Admission:	Standardized selection procedure based primarily on the academic excellence of the candidate.
Begin:	WS 2018/19
Language of instruction:	English
Person/s responsible for the Study program:	Prof. Dr. Pascal Berberat Prof. Dr. Arthur Konnerth Prof. Dr. Thomas Misgeld
Additional explanations for special program:	Elite Master with funding from the Elitenetzwerk Bayern (ENB)
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Under Article 3, Paragraph 2 of the German Constitution, women and men and their respective rights are considered equitable. Any and all masculine person references in the following charter apply equally to both men and women.

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1. Goals and Strategic Objectives of the Program

1.1. Goals of the Program

The topic of 'Biomedical Neuroscience' is highly timely and relevant. **Neuroscience is currently perceived as one of the 'frontier sciences'**, in which fundamental unresolved questions (e.g. regarding the biological correlate of higher cognitive functions) and societal needs (e.g. to treat age-related nervous system diseases or neuropsychiatric disorders) coexist with unprecedented technology progress (e.g. multi-scale optophysiology imaging and opto-genetic manipulation, connectomics, genome editing). Neurological and neuropsychiatric disorders are on a rise in developed societies, so further expansion of research and development in neurology-related health care and biomedicine is to be anticipated. Hence our graduates enter a growth market – so the career prospects of the graduates of the MSc-BmN program will be extremely good in academic research, clinical settings and in industry. The overall goal of MSc-BmN is to train excellent scientific professionals in the field of biomedical neuroscience, i.e. to train graduates who have a top-level understanding of neuroscience theory and practice, as well as a focus on neurological and neuropsychiatric disease from the get go, and who are equipped with all of the necessary key skills and competences to ensure a thorough professional personality. With this program we intend to fill the gaps between standard medical education, which often lacks in high-level scientific training, natural science curricula, which mostly do not provide deep insights into biomedicine, and a wide professional and personal development, which is often neglected in both fields.

The specific aims of MSc-BmN are as follows:

- To combine top-level understanding of neuroscience theory and practice with profound training in mechanisms and clinical aspects of neurological and neuro-psychiatric diseases.
- To deliver innovative, research-oriented education in basic neuroscience, from molecules to cells and systems, as a basis for a better understanding of the pathophysiological mechanisms underlying nervous system diseases.
- To broaden the horizon of our students, to foster critical thinking and to assure the development of a profound and comprehensive understanding of life and science, of consciousness and reality.
- To expose students to a broad range of research topics, professional environments and possible employers.
- Furthermore, to offer students an international experience by a close international cooperation with the Hebrew University. This interaction builds on the complementarity of expertise, with the TUM Medical School providing training in medical know-how and the Hebrew University providing special expertise in biomathematics.
- To establish a complete curriculum in English to be accessible for the best international students, to allow for the cooperation with the Hebrew University, to be open for visiting top international experts to contribute to the teaching program (e.g. Fellows of TUM Institute of Advanced Study), to facilitate students' access to freely accessible eLearning resources and to facilitate student research projects in the best laboratories abroad.
- To offer an individualized mentoring program for all students throughout the training period and adding an additional perspective to professional development and career planning.

1.2. Strategic importance of the study program

Within TUM School of Medicine, MSc-BmN will implement TUM's central teaching tenets of excellence, interdisciplinarity and internationalization at the Master level. The new program will complement the existing training portfolio in TUM School of Medicine and strategically link three core aspects of teaching in TUM School of Medicine's portfolio that have been successfully developed over the past decade: (1) Didactic professionalization of the standard medical curriculum with a renewed focus on scientific principles; (2) structured doctoral programs for medical students; and (3) structured PhD training for clinician-scientists and natural scientists.

AD (1) MSc-BmN will provide an essential complement to ongoing efforts to further professionalize and anchor training in scientific competences in the medical curriculum (as recommended by the German Scientific Council/Wissenschaftsrat in 2014 and the 'National Competence-Based Learning Objectives for Undergraduate Medical Education'). By providing a track for scientists to obtain biomedical competences and by attracting outstandingly qualified scientists into clinically-relevant research, MSc-BmN will provide a basic-science parallel to the well-developed clinician-scientist training within TUM School of Medicine.

AD (2) With regards to Graduate Training, in 2009, as a result of the Excellence Initiative, TUM founded the TUM Graduate School (TUM-GS) to promote structured graduate programs and assure quality. In the School of Medicine this resulted in establishment of the TUM Medical Graduate Center (MGC), which has realized TUM-GS's mandate of structured doctoral training for all thesis work (including medical theses). To accommodate this, a specific graduation program for research-interested medical students in 'Translational Medicine' was established. This program (which awards the degree of Dr. med. sci.) offers quality-controlled scientific projects, a systematic introduction to and training in scientific research. Since 2012, over 50 candidates have been enrolled in this program. MSc-BmN will closely collaborate with this program.

AD (3) Finally, a core reference point of MSc-BmN will be the highly successful international PhD program 'Medical Life Science and Technology' (PhD-MLST), which since 2006 trains doctoral candidates with a background in medicine, natural sciences or engineering (and is headed by one of the MSc-BmN speakers, Prof. Konnerth).

Hence, by being a beacon of basic and translational biomedical research education in the medical faculty, the MSc-BmN program complets the faculty's training portfolio in neuroscience and impacts the entire TUM School of Medicine's teaching program by providing a blue-print for the integration of MSc-level training in all Research Focus Areas of the faculty.

2. Qualification Profile

As new biomedical technologies will increase their impact in neurology and psychiatry (e.g. next-generation sequencing, proteomic tissue and bio-sample analysis, clinically applicable imaging modalities as diagnostics; cell replacement, genome editing, body-machine interfaces as potential next generation therapeutics), clinical implementation of such approaches will require close interactions between clinicians and scientists – for the latter. Our program provides a uniquely tailored preparation for this seminal interaction. In other words, our graduates are attractive to hire, as – from a medical department's point of view – they know their (scientific) matter as well as (clinically) matters.

The qualification profile of the graduates includes an in depth understanding of brain function and structure, from molecules and cells to large-scale circuits, behavior and brain diseases. Through their lab rotations and practical scientific work, the students are familiar with the most relevant, cutting-edge technologies for basic research (e.g. multi-scale optophysiology imaging and opto-

genetic manipulation, connectomics, genome editing). In the same time, the graduates have a detailed knowledge of disease related neuroscience. This includes both the theoretical background and the technical skills for commonly used clinical experimental approaches. Furthermore the graduates are able to define and plan scientific studies. They have also the soft skills to know how to competently summarize and present their scientific results, by taking into consideration possible ethical consequences. They have the competencies to do independent research and they are familiar with the ethical and social aspects of neuroscience. Due to that the graduates are prepared for a fast growing academic and industrial job market. With their interdisciplinary knowledge, the graduates have a wide neuro-biomedical competence, bridging the usual gap between standard medical education and natural science curricula.

3. Target Groups

The MSc-BmN is applicable to candidates who hold a Bachelor awarded from a German university in a subject of study from the field of natural science or engineering, including basic knowledge in Biology, Chemistry and Physics. Alternatively, students in Medicine, Veterinary Medicine or Dental Medicine or with an equivalent study at a foreign university can be accepted; formally this entry is based on final state examination ('Staatsexamen'), however, earlier inclusion is key. Hence, medical students will be able to enroll into MSc-BmN " in parallel to the clinical phase of their medical studies ('klinische Ausbildung') and obtain credits, allowing them to complete a substantial part of the curriculum and graduate with an MSc swiftly after medical school graduation. This will ensure – for a small subpopulation of exceptionally motivated and science-driven medical students – integration of the MSc-BmN into the existing framework of clinician-scientist training at TUM School of Medicine; introduce an important constituency into the student body and hence early contacts between medical and natural science graduates; and ensures that the PhD programs that accept MSc-BmN graduates will be offered well-trained graduates both with a science, as well as a medical background.

The target figure is 20 students per academic year and class. This is a substantial size for an intense Elite MSc program with a strong practical element and an intense didactic concept that also includes substantial teacher training. The target figure is set so as to assure that during all labs and lectures, the capacities of the facilities are not exceeded and the student teacher ratio does not hinder close interaction between the students and lecturers.

4. Demand Analysis

Neurological and neuropsychiatric disorders are on a rise in developed societies, so further expansion of research and development in neurology-related health care and biomedicine is to be anticipated. Hence our graduates will enter a growth market – so the career prospects of the graduates of the MSc-BmN program will be extremely good in academic research, clinical settings and in industry.

In addition to this positive outlook in general, both the characteristics of the proposed program and the local environment in Munich add further specific advantages: First, through the continuous MSc/PhD track at TUM (PhD-MLST) and the proximity of other outstanding graduate programs (e.g. Excellence graduate schools such as TUM's IGSSE and LMU's GSN; several International Max Planck Research Schools), access to outstanding post-graduate training is built into the program, and by virtue of Munich's standing as one of Europe's centers of neuroscience research and a major biomedical industry hub, the career outlook of graduates from such a program in Munich is very promising. Second, MSc-BmN graduates will have a distinctive characteristic by virtue of their 'dual training' in neuroscience and related medical questions. Dually trained researchers, i.e. either clinicians trained as scientists, and/or scientists specialized in clinically-relevant questions and technologies, will in the future be sought in growing numbers, not only in health industry, but also in academic medical departments. As true clinician-scientists are getting less available due to an increased density of clinical work and (monetarily) attractive job opportunities in pure clinical medicine, the medical departments in Germany are increasingly professionalizing their research staff. Thus in such a 'dual' system, where in medical departments pathomechanistic and clinical research will increasingly exist as parallel but intertwined 'worlds', specific training for scientists in the context of a School of Medicine's scientific and technology foci represents a unique opportunity.

The job outlook in the area of biomedical neuroscience is illustrated by the following (incomplete) list of subsequent employment opportunities:

Key academic programs: Ph.D. programs in neuroscience (locally – TUM, LMU, Munich-based International Max Planck Research Schools in Life Sciences and Translational Psychiatry; globally - similar programs exist at all major American, Asian, Australian and European universities); large-scale, long-duration (10+ years) international neuroscience initiatives such as the 'Human Brain Project' (EU), the 'BRAIN Initiative' (USA), 'Brain Mapping Initiative' (Australia); 'Brain Mapping by Integrated Neurotechnologies for Disease Studies' (Japan); multiple EU research calls in 'Horizon2020' in the Health Care and Information and Communication Technologies sectors.

Key private sector players: including 'Big Pharma', such as Merck, Bayer, Boehringer-Ingelheim, Novartis etc.; and smaller, often local biotech companies and start-ups, e.g. MorphoSys AG, Mikrogen GmbH and many more.

The pharmaceutical industry in Germany employs more than 15000 employees in the field of research and development. Besides the big pharmaceutical companies there are more than 600 biotech companies in Germany. Their number increases by 5-10 % every year. Most of them are specialized in the field of disease related innovative treatment strategies and are further potential employers for our graduates. It is assumed that there is much more demand on highly qualified neuroscientists than this study program can cover.

5. Competition

5.1. External Competitive Analysis

Training programs for natural science undergraduates in Munich: Another MSc with neuroscience focus (MSc 'Neuroscience'), which originated as an Elite MSc, exists at LMU. This program is closely tied to the GSN graduate school and hence – as MSc-BmN would be – to Munich's efforts in the context of the Excellence Initiative. Both GSN and MSc-BmN will thus be close educational partners of the SyNergy Clusters (with the coordinator of GSN and its MSc elements, Prof. Grothe, being a SyNergy member, and Prof. Misgeld one of the two SyNergy coordinators). Specific initiatives, such as joint Summer Schools to entice talented students to apply to our programs, are already planned.

Both Munich universities, the TUM and the LMU, strive to expand their training efforts at the MSc level, including a focus on biomedicine and bioengineering, as these are areas of special excellence in Munich, as well as fields of enormous growth and professional opportunity world-wide. As programs in these fields are being established (we are in close contact with those colleagues, who coordinate these efforts) points of cooperation and synergistic interaction are being proactively defined – such as credit point exchange agreements and opening of teaching events to broaden offers for our students; joint summer school and outreach activities to enhance national and international visibility of Munich-based elite training opportunities in biomedicine, bioengineering and neuroscience etc.. Such interactions are e.g. planned with the complementary Elite MSc 'Human Biology' (speakers Profs. Gudermann and Leonhardt) that is currently being initiated and will offer broader, less focused training targeted at a less technology-oriented student population. So, while MSc-BmN does not depend or overlap with any of these additional initiatives, our students would benefit from a broadening of training offers via cooperation with emerging programs.

Standard master neuroscience programs are part of the portfolio of the faculties of biology in several German universities (e.g. Univ. Freiburg, Univ. Heidelberg, HU Berlin, Univ. Göttingen, Univ. Frankfurt). Programs with a special focus on disease-related neuroscience exist (e.g. Translational Neuroscience, Univ. Würzburg and Univ. Düsseldorf, Molecular - Translational Neuroscience, Univ. Ulm, Experimental & Clinical Neuroscience, Univ. Regensburg) but are not very common. These biomedical programs cannot cover the increasing demand, especially that of the rapidly growing major research and clinical centers, such as Munich. Because of their limited training capacity, international master programs such as, for example, the "Research Master in Cognitive & Clinical Neuroscience" (Maastricht Univ.) or "Cognitive and Clinical Neuroscience" (Anglia Ruskin Univ., Cambridge), **are unable to cover** the increasing demand in biomedical neuroscientists.

5.2. Internal Competitive Analysis

Training programs for medical students: MSc-BmN, as the first Elite MSc in our faculty, will be closely coordinated with the ongoing teaching efforts for medical students. The MEC (with its director, Prof. Berberat, being a speaker of this initiative) will coordinate both aspects of student training and ensure their complementarity. As detailed above, we will make suitable parts of MSc-

BmN's curriculum accessible to research-focused medical students, who are enrolled in the 'Translational Medicine' graduate program (just as in converse, MSc-BmN students will attend suitable classes in the latter). We will provide credit transfer between programs thus adding high-quality content to both programs, and enable scientifically interested medical students to accrue substantial credits points towards completion of MSc-BmN after medical graduation. Importantly, we see a unique opportunity to anchor scientific competence training in our medical faculty to the mutual benefit of medical and natural science undergraduates.

Training programs for natural science undergraduates: At the TUM exists a related master program 'Neuroengineering'. This program is however, complementary and non-overlapping to this initiative, and hence offers attractive opportunities for collaboration. The Elite MSc program 'Neuroengineering' targets a different student population, namely graduates from engineering-related disciplines, in neuroscience basics aiming towards engineering implementation of neuro-inspired principles. As we intend to do the converse (educate biologically-trained students in quantitative neuroscience methodology), these two efforts complement – and we will cooperate to use synergistic opportunities (such as student-student tutoring in courses, where the initial expertise of the student population is essentially complementary; opening of lecture-format teaching and joint outreach to increase visibility). Coordination here is ensured via members of MSc-BmN (e.g. one of the speakers, Prof. Misgeld) also being faculty members in Neuroengineering. As additional MSc programs in related areas are being initiated at TUM, we will similarly expand our network of collaboration.

6. Structure of the program

The MSc-BmN is designed as 4 semesters full time (120 ECTS) Master-of-Science training, in which the 3 semesters full time training (90 ECTS) will be followed by an additional semester (30 ECTS) for the master thesis. Teaching and examination language is English.

The MSc-BmN curriculum will offer cutting-edge training in biomedical neuroscience conveyed by innovative didactical teaching methods. The teaching philosophy will be to focus as much on scientific reasoning skills as on specific knowledge content, and to engrain theoretical training by matched hands-on teaching units, such as lab visits and lab rotations during the initial three terms and a Master thesis in a state-of-the art lab environment in the fourth. The curriculum will be structured in longitudinal and interactive modules following a learning spiral – starting with built-up of specific knowledge, via classification of this knowledge in a more general context, to guided practical application.

The curriculum is modularly structured to convey three types of overarching competences:

- (1) Scientific Theory & Reasoning (6 modules)
- (2) Scientific Skills & Practice (7 modules incl. extensive lab time)
- (3) Transferable Skills & Professional Competence (3 modules incl. colloquium)

Ad (1): Together, the modules in scientific theory and reasoning cover the theoretical foundation of biomedical neuroscience. During the first semester, MSc-BmN students approach neuroscience starting with the nervous system at the molecular level (module: Molecular neuroscience) via the

cellular level (module: Cellular neuroscience) to the systems level (module: Neuroanatomy and Neuropathology). In the second semester, the training of the students continues with functional analysis of systems (module: Systems and behavior) followed by pathological settings (module: Pathophysiology of circuits and systems) and become familiar with the clinical presentation and treatment strategies for various disorders (module: Nervous system disorders and treatment). The third and fourth semester give the opportunity to apply the acquired theoretical knowledge in lab rotations and the Master's thesis project.

Ad (2): From the beginning MSc-BmN students use hands-on courses as learning opportunities for the theory-practice transfer - the modules of scientific skills and practices will dovetail with the theory modules to provide complementary practical skills and techniques for sustained understanding and competent application. In the first semester there will be two hands-on modules. One on 'Molecular biology and -omics approaches' will convey practical insights into modern technology for comprehensive molecular analysis of nervous system physiology and pathology. In the second module students will acquire advanced skills for structural analysis of neurons and glial cells under healthy and diseased conditions (module: 'Microscopy of nervous system structure'). During the second semester, students will participate in intense training in 'Computational analysis and modelling' to enable them to analyze and integrate data from neuroscientific studies. Here, we will benefit from our internationalization partner, Hebrew University's elite training program 'Brain Sciences: Computation and Information Processing'. The focus of this collaboration will be in the field of programming, data analysis and statistics, where our Israeli partners have unique expertise, while we will in return offer access to unique technical and disease-modelling infrastructure - this collaboration will be achieved via reciprocal exchange of students and faculty (for details on our internationalization concept, see Section 3.8). Furthermore, there will be hands on training in methods for the functional imaging of neuronal and glial cell activity (module: Neuroimaging and electrophysiology). With substantial compulsory elective elements of four lab visits (4x1 week) and two lab rotations (2x7 weeks) MSc-BmN students will get familiar with neuroscientific real-life research in their preferred specialization and also will get acquainted with the research programs of the faculty. The four lab visits during the intense and highly structured three first semesters will give the students a first opportunity to check out different areas of interest and will allow individual independent application of learned concepts. Building on this initial experience they will choose their two longer lab rotations and intensify their practice in specific fields - also with the prospect of identifying labs for future thesis work. All associated faculty and international partners agreed to offer suitable concise and tightly supervised research projects, thereby allowing students an exploration of their interests and an early specialization.

Ad (3): To complete the scientific training towards fully-grown scientific professionalism, as well as towards a mature personality, this program includes two explicit modules centered on transferable skills and professional competency. These modules run parallel to the neuroscientific content. Here students learn, on the one hand, all of the essential pragmatic skills of sound and successful scientific project management - this includes good scientific practice, data presentation, paper and grant writing etc. On the other hand, they will be asked to think beyond their immediate practical skill set and answer for themselves (and together with their peers and teachers) the question of what it means to be a (neuro-) scientist today. To achieve the latter, we designed a specific 'Life & Science' submodule that will encourage our students to reflect on the subjective and societal

implications of neuroscience and nervous system diseases, and also immerse themselves into the historic, epistemological and science-philosophical underpinnings of modern biomedicine and neuroscience. Here we will partner with the Munich School of Philosophy. Finally, in the third semester, all students have to present their upcoming master-project in front of their peers and teachers in a qualifying colloquium, where students use all aspects of their preceding transferable skills and professional competence training. We are confident that such elements – held in appropriate context – will also be an essential step towards establishing a ‘class spirit’ amongst students and to truly root important ethical principles and professional competences, rather than just loosely append them as ‘soft matter’ to the ‘hard facts’.

Course List

Courses in blue are hands on classes.

1. Semester (31 ECTS)

a) Molecular Neuroscience	5 ECTS
b) Cellular Neuroscience	5 ECTS
c) Neuroanatomy and Neuropathology	5 ECTS
d) Microscopy of nervous system structure	5 ECTS
e) Molecular biology and -omics approaches	5 ECTS
f) Scientific Practice	2 ECTS
g) Life & Science	3 ECTS
h) Lab visit - compulsory elective subject	1 ECTS

2. Semester (31 ECTS)

a) Systems and behavior	5 ECTS
b) Pathophysiology of circuits and systems	5 ECTS
c) Nervous system disorders and treatment	5 ECTS
d) Computational analysis and modelling	5 ECTS
e) Neuroimaging and electrophysiology	5 ECTS
f) Scientific Practice	2 ECTS
g) Life & Science	3 ECTS
h) Lab visit - compulsory elective subject	1 ECTS

3. Semester (28 ECTS)

a) Qualifying colloquium	2 ECTS
b) Lab visit - compulsory elective subject	2 ECTS
c) Lab rotation (I) - compulsory elective subject	12 ECTS
d) Lab rotation (II) - compulsory elective subject	12 ECTS

4. Semester (30 ECTS)

Master’s Thesis and colloquium	30 ECTS
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Total 120 ECTS

A key element of the training strategy within MSc-BmN will be ‘learning by research’ using four main approaches: (1) the students learn about current research findings from leading faculty through interactive seminars (‘research-led’); (2) the students learn about the research process with emphasis on how knowledge on a specific topic is constructed and what rules of good scientific practice need to be followed (‘research-oriented’); (3) the students learn as researchers around inquiry-based activities during lab visits, lab rotations and project work (‘research-based’); and finally (4) the students learn individually and in small teams to critically reflect and discuss their research findings and their role as researchers (‘research-tutored’).

Using validated methods of modern didactics, we aim to achieve deep and sustainable learning. For this, each topic in the ‘Scientific Theory & Reasoning’ modules will be taught in a three-step approach: (1) preparatory built-up of knowledge by eLearning, (2) content consolidation in face-to-face focus seminars, and (3) application of knowledge and problem-solving skills in application tutorials.

Step	eLearning	Focus seminar	Application tutorial
Objective	Get familiar with the basics	Consolidate contents	Apply knowledge in practice
Method	eLectures & Just-in-Time-Teaching	Expert talk	Assistant instruction

An exemplary week in the first term will comprise all these steps within the Scientific Theory & Reasoning’ module; this will be accompanied by hands-on courses of the ‘Scientific Skills & Practices’ modules and the longitudinal ‘Transferable Skills & Professional Competence’ content. As the students’ progress through the program, the proportion of theory decreases and hands-on experiences increase.

	Monday	Tuesday	Wednesday	Thursday	Friday
9 ^{am} - 12 ^{pm}	Topic 1 eLearning	Topic 1 Focus Seminar	Topic 1 Application Tutorial	Topic 2 Focus Seminar	Topic 2 Application Tutorial
1 ^{pm} - 4 ^{pm}	Hands-on	Hands-on	Topic 2 eLearning	Hands-on	Hands-on
5 ^{pm} - 7 ^{pm}			Transferable Skills & Professional Competence		

The focus seminars are mainly aimed to deepen understanding and evolve the ‘big picture’.

Application tutorials complete the didactic concept by providing an opportunity to apply and investigate the theoretical and conceptual knowledge learned before.

Study plan (courses in blue are hand-on classes):

1. Semester	2. Semester	3. Semester	4. Semester	
Molecular Neuroscience 5 ECTS	Systems and behavior 5 ECTS	Qualifying colloquium 2 ECTS	Master's thesis and colloquium 30 ECTS	
Cellular Neuroscience 5 ECTS	Pathophysiology of circuits and systems 5 ECTS	Lab rotation (I) 12 ECTS		
Neuroanatomy and Neuropathology 5 ECTS	Nervous system disorders and treatment 5 ECTS	Lab rotation (II) 12 ECTS		
Molecular biology and -omics approaches 5 ECTS	Computational analysis and modelling 5 ECTS			
Microscopy of nervous system structure 5 ECTS	Neuroimaging and electrophysiology 5 ECTS			
Scientific Practice 4 ECTS				
Life & Science 6 ECTS				
Lab visits 4 ECTS				
31 ECTS	31 ECTS	28 ECTS		30 ECTS

7. Organization and Responsibilities

The **key responsibility** will be held by the three speakers, which will by their distinct backgrounds ensure the implementation of the outlined intensive curriculum and the demanding teaching concepts. The day-to-day by interaction between the Chair of Medical Education and the Neuroscience Chairs will be ensured by the Curriculum Coordinators.

A **Curriculum Commission** (lead by the speakers and formed by representatives of the core faculty and two student representatives) of the program will supervise all regulatory requirements and aspects of continuous curricular development, as well as the tutoring and mentoring processes in regular meetings.

Students will be encouraged to actively participate in the implementation and development of the program. Student representatives will be elected by the program participants that lead regular discussions among the students. They are members of the Curriculum Commission and stay in close direct exchange with the speakers.

8. Resources

8.1. Human resources

Due to the unique position of TUM School of Medicine as one of few purely postgraduate medical schools in Germany, a substantial number of basic science chairs exist that can contribute teaching from their basic infrastructure. The participating professors and lecturers for the mandatory modules and elective modules are listed in the Resource Table as a separate document.

Hence several positions will exclusively serve to develop the dedicated scientific-didactic concept that we want to implement. These will serve, on the one hand, to provide in-depth tutoring at a very low student-to-teacher ratio; on the other hand, they will also enable substantial 'train-the-trainer' elements that are essential for realizing the envisaged intense and unique training experience. By a successful application to the ENB Elite Master Program the following positions (sum: ~6.5x E13) will be sponsored for at least five years starting October 2018:

- Administrative Contact (50% E13): For coordination and organization of the MSc-BmN program; for student counseling in administrative questions and contact and coordination point for TUM, the faculty's PhD programs and the SyNergy Excellence Cluster; to be located in the TUM Medical Education Center (TUM MEC).
- Curriculum Coordinators (2x 100% E14): Together, these Curriculum Coordinators will design and establish the specific curriculum content and didactic principles to be used across the MSc-BmN curriculum. While working closely together, one will be affiliated with the Chair of Medical Education (focus on didactics), and one at the Chair for Neuroscience (focus on curricular content); their collaboration will ensure smooth implementation of the scientific and didactic principles of the program across the curriculum, as well as constant quality control and readjustment as the program evolves. Moreover, the Curriculum Coordinators will act as primary

academic counselors of the trainees, and also coordinate the mentoring program with the faculty.

- Lecturer positions (8x 50% E13): The base-teaching of the MSc-BmN will be provided by the faculty from within their existing teaching pool, as mentioned above. The envisaged close teacher-trainee interaction and the special supervision ratio, however, that an Elite program requires, demands the addition of extra lecturer staff to the core faculty. These lecturers will take over specific teaching content and didactic concepts in coordination with the Curriculum Coordinators.

8.2. Equipment, facilities

- Students enrolled into the program enjoy the use of TUM's facilities and labs as. Basically students receive free access to:
 - Library Resources
 - Lab Access at participating chairs and professorships
 - Free WIFI / Internet Facilities