SETOF Soil Erosion and TOrrential Flood Prevention: Curriculum Development at the Universities of Western Balkan Countries

Co-funded by the Erasmus+ Programme of the European Union

WP1

Analysis of soil erosion state and torrential floods in Western Balkan Countries

Lead Organisations of WP1**: UNSCM; UB**

Participating Organisation: UNS; UNI; UBL; UNSA; INSZASUM; BOKU; UNIRC; FRI-BAS

Deliverable 1.4

Title: Report of analysis and elaboration of bachelor and master curricula in field of soil and torrent control in EU countries

Participating Organisation: BOKU, UNIRC

Project number: 598403-EPP-1-2018-1-RS-EPPKA2-CBHE-JP (2018 – 2579 / 001 – 001)
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PROJECT INFO

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1 Report on analysis and elaboration of bachelor and master curricula in field of soil and torrent control in EU countries – Austria

1.1 Introduction

Throughout Europe, the Master Program offered by the Institute of Mountain Risk Engineering at the University of Natural Resources and Life Sciences, Vienna, is quite unique in terms of hazard and risk assessment, and mitigation and adaptation planning including engineering construction. It is only the Bauhaus University of Weimar which offers a comparable technical Master degree, focusing mainly on engineering education and constructive design of hazard mitigation. Some Universities, however, included natural hazard management in parts (modules) of their Master Programs, such as the Universities of Salzburg, Innsbruck and Graz (all Austria) in Geography and Geography and Mountain Research, respectively. In Germany, the Universities of Bonn (Master Program in Geography) and Eichstätt (Master Program in Environmental Processes and Natural Hazards) focus mainly on the assessment of natural hazards, and in Switzerland, the Universities of Bern (Master Program in Geography), Lausanne (Master Programs in Geography and Environmental Sciences), Fribourg (Master Program in Geography), and Zurich (ETH, Master Program in Environmental Engineering, Master Program in Earth Sciences). Furthermore, in Switzerland, the University of Applied Sciences in Bern focuses on mountain forests and natural hazards in their Bachelor Program, and the University of Applied Sciences in Chur on natural hazard mitigation in their Bachelor Program on Constructive Engineering. The United Nations University (Bonn) offers in collaboration with the University of Bonn a joint Master Degree on Geography of Environmental Risks and Human Security, focusing mainly on DRR issues.

1.2 Analysis and elaboration of bachelor and master curricula in field of soil and torrent control in Austria

Teaching and research in the field of soil erosion and torrential control has a long history in Austria. Already beginning in the 18th century, Joseph Walcher (1719-1830), an Austrian Jesuit, physicist and mathematician, worked on the topic of hydraulic and glacier lakes. In his work ”Nachrichten von den Eisbergen in Tyrol” (Walcher, 1773), he investigated the Vernagt glacier, Gugler glacier and especially the Rofner glacier lake, which threatened the Ötz valley by repeated glacial lake outburst floods (Hübl and Nagl, 2019).Later, in the course of the industrial revolution in the 19th century, alpine watersheds were largely deforested. This non-sustainable usage of the natural resources led to dramatic soil erosion and to torrential disasters in the late 19 -hundreds. The severe floods in provinces of Tyrol and Carinthia in the year 1882 initiated a governmental controlled knowledge transfer from

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France to Austria in the year 1883. A delegation from Austria traveled to France to learn of the methods used and to implement them in Austria (Wang, 1901). Subsequently the emperor of Austrian-Hungarian monarchy, Franz-Joseph, passed the torrent control act in 1884, stating that torrent control works have to be executed on a national level, with public funding and with a systematic approach. The government implemented by that a legal basis for financing and organizing the torrent control service to ensure further development. Importantly, educational courses were established at the University of Natural Resources and Life Sciences, Vienna (BOKU) for students and the staff of the new established service (Hübl and Nagl, 2019).

Traditionally, erosion control and torrential hazard mitigation was established in the forest faculty the end of the 19th century. In the academic year 1967/68 the "InstitutfürWildbach- und Lawinenverbauung", led by Prof. Weber who was also the head of the Austrian forest service for torrent and avalanche control, was created. Until the academic year 1971/72 teaching on torrent control was included in the study program "Forestry". In 1971 the "Studienzweig" [specialization] "Wildbach- und Lawinenverbauung" as well as a "Lehrkanzel" [professorship] was created. From this time on, students were able to officially specialize on torrent control. This structure proceeded until the early 21st century.

In the course of the EU-wide Bologna process the classical Diploma studies transformed into Bachelor and Master programs. The first master program at the University of Natural Resources and Life Sciences, Vienna, (BOKU) was the English program "Mountain Risk Engineering". The intension for having an English master program at BOKU was to attract more international students. The program started in October 2004 and was terminated 2014 (with the last possibility to enroll in 2011). In 2011 this English master program was combined with the new, environmental engineering master program "Water Management and Environmental Engineering", which is still ongoing. Students that are specializing in mountain hazards (by enrolling the modules "Mountain Hazard Processes", "Mitigation Measures for Mountain Hazards" and "Risk Management", doing a constructive project and master thesis in the field of hazard processes) receive a diploma supplement "Mountain Risk Engineering".

Due to the increasing demand of educating engineers in the local language (German), a new master program was developed in 2009, called "Alpine Naturgefahren / Wildbach- und Lawinenverbauung" [*Alpine Natural Hazards / Torrent and Avalanche Control*]. This master program is the core of teaching torrent control at BOKU. The study program is ongoing with 60-70 active students (by summer term 2019).

1.2.1 Basic data

Academic Title of program (Master program)

"Alpine Naturgefahren / Wildbach- und Lawinenverbauung"

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Host Higher Education Institution (University/Faculty/ Department), offering the program *University of Natural Resources and Life Sciences, Vienna (BOKU)*

Risk Area

Mountain Risk Engineering, torrent and avalanche control

Number of years since the program has been operational

10 years in its current form, effectively > 100 years at BOKU

Number of students enrolled

67 (summer term 2019)

Duration of program in years and semesters

2 years (4 semester)

Tuition Fee

none

1.2.2 ProgramDescription, including objectives and target audience

In the master program the students acquire the necessary knowledge and skills for a responsible handling of the hazards in the alpine area. To achieve the educational goals, the training is based on the cycle of "Integral Risk Management" (Figure 1).

Here, the precaution, the prevention of natural hazards and their management form the basic pillars of the study program. In addition to scientific and technical events, questions of natural hazards law, spatial planning, civil protection and disaster management are an integral part of the program.

The emphasis of the training lies in the prevention of natural hazards. The individual hazard modules each contain the hazard analysis, the determination of protection deficits and the planning of active protective measures for the hazard types water (flood, debris flows), snow (avalanche) and solids (falls and slide). The technical training is reinforced by a civil engineering module. However, in order to be able to carry out the necessary measures in the entire catchment area of torrents and avalanches, the focus will be on forestry and ecology as well as practice-oriented knowledge.

Graduates recognize the potential dangers in the alpine region and are able to plan efficient protection strategies and measures for prevention. The combination of technical, forestry, engineering and spatial planning measures optimizes risk prevention. They are able to plan and manage projects, as well as to present them comprehensibly. Their knowledge of risk prevention, risk prevention and disaster management enable them to engage in integrated risk management. Social skills such as teamwork, leadership skills and self-employment are strengthened by the diverse training. The problem-solving competence is promoted by the networking of ecological, technical and socio-economic aspects.

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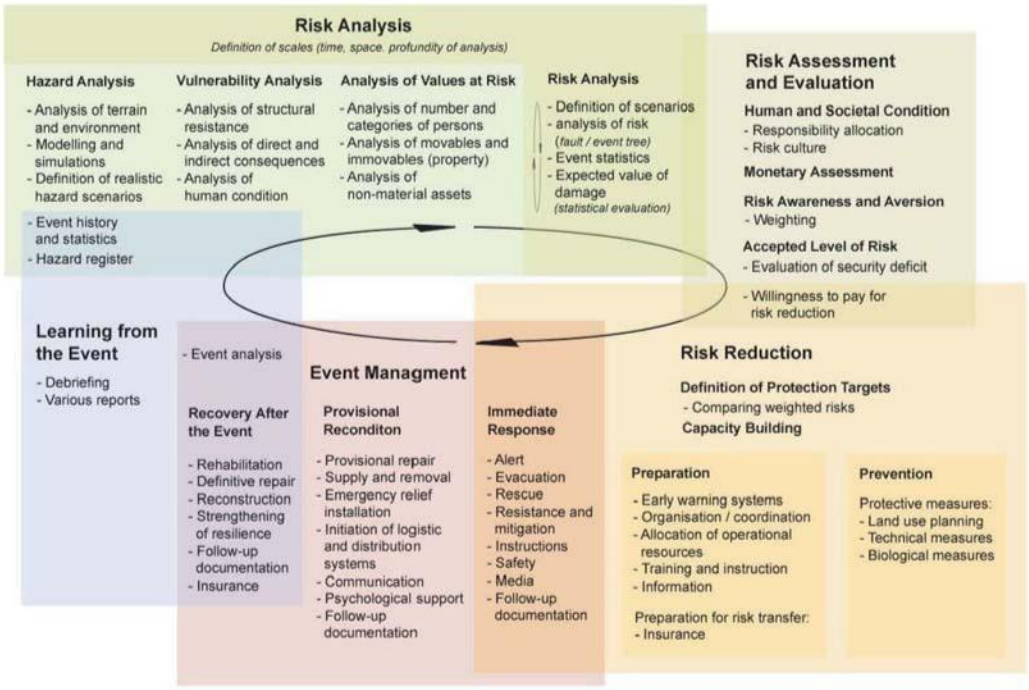

Figure 1: Risk management cycle (from Swiss Virtual Campus NAHRIS: www.nahris.ch)

The master program “Alpine Naturgefahren / Wildbach- und Lawinenverbauung” aims at the following fields of activity:

- Assessment and analysis of the hazards and mass displacement processes in the Alpine region
- Prevention of alpine natural hazards
- Integrated catchment management
- Risk provisioning
- Disaster management

For the graduates of the Master Program Alpine Natural Hazards / Torrent and Avalanche Control there are employment prospects especially in the following occupational fields, whereby the respective employment requirements have to be considered:

- Public sector Forest engineering service for torrent and avalanche control, state governments, ministries, infrastructure managers and public administration
- Services in engineering and planning offices, in consultancy, planning and project execution
- Self-employed, possibly as freelance engineering consultants, experts and project executives
- Research and development at universities and non-university research institutions and development departments of companies

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1.2.3 Admission requirements

The graduates of a bachelor's degree of the BOKU bachelor programs “Forstwirtschaft” and “Kulturtechnik und Wasserwirtschaft” or equivalent are admitted to the Master's degree program. It should be noted, however, that graduates of other Bachelor's degree programs seeking the master's program "Alpine Natural Hazards / Torrent and Avalanche Control" should have basic, equivalent knowledge of the subjects taught in the core subjects of the BOKU Bachelor's degree “Forstwirtschaft” and “Kulturtechnik und Wasserwirtschaft”.
For the admission of graduates of other academic studies, the following learning outcomes are required:

Basic scientific and technical knowledge

Mathematics, physics, geology / geomorphology, botany, ecology, surveying, strength theory, dendrology, meteorology, statistics, geo-information, mechanics, technical drawing with CAD, soil science / forest soil science, structural engineering, material and material science.

Knowledge in the core areas

Torrent and Avalanche Control, Forest Engineering, Hydraulics, Hydrology, Structural Hydraulic Engineering, Structural Engineering, Geotechnical Engineering, Silviculture, Forest Entomology, Wildlife Biology, Forest Ecology, Forestry Law, Forest Earnings.
If 30 ECTS credits can be proven from each of the two fields, they will be admitted directly to the university.

1.2.4 Content, including organization and curriculum

The study comprises a workload of 120 ECTS credits. This corresponds to a study duration of four semesters (a total of 3,000 hours of 60 minutes each). The study is divided into

Compulsory courses: 20 ECTS credits

Masters seminar: 2 ECTS points

Master Thesis: 30 ECTS points

Elective courses: 50 ECTS credits

Free elective courses: 18 ECTS credits

Of these, students have to complete foreign language courses worth 8 ECTS credits.
The 3-pillar principle is the central identification feature of both the Bachelor and Master studies at the University of Natural Resources and Life Sciences, Vienna. This is also the case for the study program “Alpine Naturgefahren / Wildbach- und Lawinenverbauung”. In the Master's program, the sum of the contents of the compulsory and elective courses consists of at least one each

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15% engineering and engineering

15% science as well

15% economics, social sciences and jurisprudence.

Excepted from the 3-pillar principle are the master's thesis and the free elective courses.

Compulsory courses

The compulsory courses amount to 20 ECTS credits and 2 ECTS credits for the Master Seminar:

Course	Type	ECTS
Wassergefahren [*water-relatedhazards*]		
Wassergefahren- Analyse und Bewertung [*water-relatedhazards, analysis and assessment*]	VS	3
Wassergefahren- Schutzmaßnahmen [*water-relatedhazards, mitigationmeasures*]	VX	3
Abflussentstehung in Wildbacheinzugsgebieten [*runoffassessment in torrentialcatchments*]	VS	2
Schnee- Lawinengefahren [*snow-related hazards*]		
Schnee und Lawinengefahren- Analyse und Bewertung [*snow-relatedhazards, analysis and assessment*]	VX	3
Schnee und Lawinengefahren- Schutzmaßnahmen [*water-relatedhazards, mitigationmeasures*]	VX	3
Gefahren durch Massenbewegung [*hazards due tomassmovements*]		
Gefahren durch Massenbewegungen- Rutschungen [*landslidehazard*]	VS	3
Gefahren durch Massenbewegungen- Steinschlag [*rockfallhazard*]	VX	3
Master Seminar	SE	2

VU…lecture and exercises, VS…lecture and seminar, VX…lecture and field trip, VO…lecture, SE…seminar

Elective courses

The specialization blocks have to amount to at least 50 ECTS points to be completed. In this case, at least one specialization block has to be completed from each of the three areas (basics, core and application).

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SpecializationBlock 1:

Course	Type	ECTS
Basics		
Forstliche Grundlagen des Naturgefahrenmanagements [*forestrybasicsofnaturalhazardmanagement*]		
Waldbau und Forstschutz für Naturgefahrenmanagement [*silviculture and forestprotectionfornaturalhazardsmanagement*]	VU	5
Bergwaldökosysteme [*mountainforestecosystems*]	VS	3
Technische Grundlagen des Naturgefahrenmanagements [*technicalbasicsofnaturalhazardsmanagement*]		
Bautechnische Bemessung von Schutzbauwerken [*structuraldimensioningofprotective structures*]	VU	4
Spezielle Geotechnik (Alpin-Geotechnik) [*alpine geotechnics*]	VU	4
Ökologische Grundlagen des Naturgefahrenmanagements [*ecologicalfoundationsofnatural hazard management*]		
Ökologische Aspekte im Schutzwasserbau [*ecologicalaspects in protectivehydraulicengineering*]	VX	3
Gewässerökologie und Morphologie [*riverecology and morphology*]	VO	3

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SpecializationBlock 2:

Course	Type	ECTS
Core		
Baumanagement und Bautechnik [construction management and construction engineering]		
Baubetrieb und Bauverfahren für Schutzbauwerke [*construction operation and construction process for protective structures*]	SX	2
Bauerhaltung und Monitoring [building maintenance and monitoring]	VU	2
Schutzkonstruktionen und Technischer Gebäudeschutz [*protectiveconstructions and technical building protection*]	VX	4
Schutzwaldbewirtschaftung und Ingenieurbiologie [*protectionforestmanagement and engineeringbiology*]		
Aufforstung und Forstschutz in den Hochlagen [*afforestation and forestprotection in thehighlands*]	VX	3
Ingenieurbiologie und Erosionsschutz [*engineeringbiology and erosion control*]	VO	2
Spezieller Waldbau für Schutzwälder [*specialsilvicultureforprotectiveforests*]	VX	3
Wildtierökologie im Schutz- und Dauerwald [*wildlifeecology in theprotection and permanent forest*]	VO	1,5
Sozioökonomie und Recht [*socio-economics and law*]		
Alpine Raumordnung [*alpine regional planning*]	VO	2
Naturgefahrenrecht [*naturalhazardlaw*]	VO	2
Vulnerabilität und Risikomanagement [*vulnerability and riskmanagement*]	VS	2,5
Grundlagen des Naturgefahrenmanagements [*basicsofnaturalhazardsmanagement*]	VO	1,5
Risikovorsorge [*riskprovisions*]		
Katastrophenschutz [*civilprotection*]	VX	1,5
Kommunikation, Information und Partizipation [*communication, information and participation*]	VO	3
Monitoring- und Warnsysteme	VO	1,5

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[*monitoring and warning systems*]		
Katastrophenbewältigung [*disastermanagement*]		
Ereignisdokumentation und Schadensanalyse [eventdocumentation and damageanalysis]	VO	1,5
Ereignismanagement und Einsatzorganisation [*eventmanagement and missionorganization*]	VX	1,5
Naturgefahrenpolitik inklusive Anpassungsstrategien [*naturalhazardspolicyincludingadaptationstrategies*]	VO	1,5
Schadensregulierung [*claimssettlement*]	VO	1,5

SpecializationBlock 3:

Course	Type	ECTS
Application		
Integrale Einzugsgebietsbewirtschaftung [Integral catchmentmanagement]		
Integrale Einzugsgebietsbewirtschaftung [*integral catchmentmanagement*]	PJ	6
Modelling and Simulation [modelling and simulation]		
Dynamics ofgeophysicalflows	VS	3
Scenario development and analysis	VU	2
Simulation models in natural hazards analysis	PR	3
Wald- und Baustellenerschließung [*forest and constructionsite development*]		
Erschließung [*constructionsitedevelopment*]	VS	5
Holzernte [*timber harvesting*]	VS	3

Free elective courses

Additional to the above described compulsory and elective courses, 18 ECTS credits must be completed in the form of free elective courses. These can be chosen from the entire range of courses offered by all recognized domestic and foreign universities. The free elective courses are designed to impart knowledge and skills from areas related to the subject as well as from areas of general interest.It is recommended to choose the free elective courses from the offer of elective courses.

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Master Thesis

A master's thesis is a work devoted to a scientific topic, to be written within the framework of a master's program. It includes 30 ECTS credits. With the Master's thesis, students demonstrate that they are capable of dealing with a scientific question independently and in terms of content and methodology.

The task of the Master thesis is to be chosen so that the processing is possible and reasonable within six months. The joint processing of a topic by several students is permissible if the achievements of the individual students remain separately assessable.

The master thesis is to be written in German or English. A different language is only possible after attestation of the supervisor. The Defensiois in any case to be conducted in German or English.

The master program is considered completed when all courses, the Master's thesis and the Defensio have been assessed positively.

Graduates of the master program “Alpine Naturgefahren / Wildbach- und Lawinenverbauung” will be awarded the academic title "Diplomingenieur" or "Diplomingenieurin", abbreviated "Dipl.-Ing." / "Dipl.Ing.in" or "DI" / "DIin ".

1.3 Teaching/Learning describing teaching methodology and assessment

The teaching format involves on-campus classesthat stimulate student’s participation as well as individual tutorials in order to make the relationship with teachers more personal. Students must carry out a personal piece of coursework, tutored by teaching staff.

The Master's course comprises the following educational activities:

- Taught sessions, run by the teacher responsible for that subject, in which the Program's central themes are presented and discussed.
- Practical and seminar sessions, in which the students' active participation is encouraged in order to develop their research, speaking, discussion and teamwork skills.
- Tutorials: individual activities whose aim is to supervise academic progress and development, future professional orientation and guidance as regards transversal skills.
- Teamwork: group activities carried out in small groups in the classroom for the acquisition of general skills and independent learning.
- Individual work: independent activities done by the student, such as the completion of exercises, writing of coursework and reports, and oral presentations.

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The required subjects have four or fivetimes 6 hours of teaching per week, one of them dedicated to discussing practical cases in small groups (of between 3 and 6 students). The subjects, combine teaching, practical and seminar sessions. Each subject has an appointed teacher who coordinates the team of lecturers giving the classes. This person sets the assessment method and coordinates the activities linked to the subject, including tutorials.
Following the ECTS criteria, the 3 or 4 -credit (required) subjectsinvolve around 75 or 100 hours of work for students, including personal work, group activities, seminars and teaching sessions. Elective, 2-credit classes involve around 50 hours work, and also combine practical and teaching sessions.Semesters are divided into 12 weeks of teaching, followed by around four weeks for completing coursework and exams.
Student assessment is continuous and will combine the systematic writing, during the course,of short essays about matters related to both the subjectstaught and the seminars; satisfactory participation in debates and practical sessions; and passing the exams.

The Department also organizes discussion seminars; where guest researchers and high-profile, experiencedprofessionals provide their points of view, opinions and experiences in order to stimulate students' analytical and reflective skills.
The department has established an exchange program with partner universities, which students can access the master from the second half to spend a semester of the Master in the foreign university chosen, picking a number of optional subjects there.
The academic coordinator of the Master Programs is responsible for attending to any doubts or queries students have about subject contents, as well as for resolving any problems of an academic nature that may arise during the course. He is also in charge of authorizing any changes to matriculation. The academic coordinator carries out tutorials that are personalized for each student and supervises students' progress during the program.

Student Peer Review (SPR) and blended learning concepts are used at the University of Natural Resources and Life Sciences Vienna (BOKU) in different types of courses with relatively small (n <10) and larger (several hundred) participants. In most cases, SPR is anonymized using the workshop module in Moodle. In other cases, (additionally) the presentation of short presentations with direct feedback takes place. It is important for the SPR to define concrete feedback criteria and to explain the benefits to the students for learning. Therefore, for all SPRs, corresponding assessment parameters are defined along point schemes, which must be provided with an additional comment in the course of the evaluation. Finally, a summary assessment of the work is also to be made.

For example, SPR is used as a didactic tool for feedback on term papers in various pedagogical courses with numbers of 9-35 students. The goalisto offer students the opportunity to work on an interesting, self-chosen topic within the framework of a given scheme, and then to allow the SPR a broader professional view beyond their own work. (critical reading and commenting) as peers and at the same time to acquire performance parts for the overall assessment of the course (LV).

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1.3.1 Evaluating Teaching: Students, Colleagues, and Self-Reflection

There are End -of-course rating forms and written comments. Generally, students are able to report on the extent to which a teacher appears prepared for class sessions, communicates clearly, stimulates interest, and demonstrates enthusiasm and respect for students; practice shows that student responses on these dimensions are moderate valid and reliable.
Student ratings are used for personnel decisions and teaching improvement, and include the following among others:

- Rating forms include open-ended questions so that students can write their own comments. Written comments for improving classroom performance.
- A knowledgeable colleague or teaching improvement consultant to discuss evaluation results with students and individuals in order to interpret scores, provide encouragement, and suggest teaching improvement strategies

1.3.2 Academic staff

Program councellor: Prof. Dr. Johannes Huebl

The University of Natural Resources and Life Sciences, Vienna strives to provide high qualification standards for young and senior scientists. This includes among others the qualifying examination habilitation for lecturing as assistant professor at a university. The classes provided in the Master Classes are lectured by the academic staff that complies the habilitation criterion or higher for lecturing.
The corresponding legal formulation is according to § 103 Abs. 2 und 3 des Universitätsgesetzes 2002, BGBl. I 2002/120, and reads:

„(2) Voraussetzung für die Erteilung der Lehrbefugnis ist der Nachweis einer hervorragenden wissenschaftlichen oder künstlerischen Qualifikation und der mehrmaligen Lehrtätigkeit an anerkannten postsekundären Bildungseinrichtungen zum Nachweis der didaktischen Fähigkeiten der Bewerberin oder des Bewerbers.
(3) Die vorgelegten schriftlichen Arbeiten müssen
1. methodisch einwandfrei durchgeführt sein,
2. neue wissenschaftliche Ergebnisse enthalten und
3. die wissenschaftliche Beherrschung des Habilitationsfaches und die Fähigkeit zu seiner Förderung beweisen. Die vorgelegten künstlerischen Arbeiten müssen die Fähigkeit zur Vertretung des künstlerischen Faches im Umfang der beantragten Lehrbefugnis beweisen.“

With respect to teaching related continuous education of the academic staff involved in the master programs, there is a specific BOKU’s Training Passport that provides a continuous education for academic staff and professors and has to be completed in accordance with the target agreements with the supervisor. For instance, fit for Teaching and Didactics comprises courses such as:

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- Basics in University Didactics and Academic Instruction: Teacher Training and Education
- Creating your own videos for teaching - Crash Course
- How to sucessfully prepare your teaching portfolio
- Multiple Choice Prüfungen
- "Prüfenmit BOKU learn"
- „Lehren, Lernen, Prüfen - Einführung in die hochschuldidaktische Reflexion und Gestaltung von Lehre und Studium"
- „Teaching in English"

See also https://boku.ac.at/lehrentwicklung/e-learning-und-didaktik

The academic staff follows the periodical evaluation criteria of the University of Natural Resources and Life Sciences, which are organized in the form of self-evaluation reports and planning measures. In these reports, teaching strategies, research strategies and research-driven teaching are to be analyzed, reflected and developed. Details about this rating and development elements of the staff can be found at:

https://boku.ac.at/universitaetsleitung/rektorat/stabsstellen/qm/themen/qualitaetsmanagement-lehre/qualitaetsgrundsaetze-und-aspekte-der-boku-lehre

Reference:

Hübl, J; Nagl, G (2019): From practical experience to national guidelines for debris-flow mitigation measures in Austria. In: 7th International Conference on Debris-Flow Hazards Mitigation (Eds.), 7th International Conference on Debris-Flow Hazards Mitigation.

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