

Rheinische Friedrich-Wilhelms-Universität Bonn

Mathematisch-Naturwissenschaftliche Fakultät

Urkunde

Herr Matthias Bärlein

geboren am 4. Mai 1996 in Ludwigsburg (Deutschland)

hat die Masterprüfung im Studiengang

Mathematics

am 14. August 2021 bestanden.

Aufgrund dieser Prüfung wird ihm der akademische Grad

Master of Science (M.Sc.)

verliehen.

Bonn, den 15. September 2021

Der Dekan der
Mathematisch-Naturwissenschaftlichen
Fakultät

Der Vorsitzende des
Prüfungsausschusses für gestufte
Studiengänge der Mathematik

Prof. Dr. Walter Witke



Prof. Dr. Jan Schröer

Rheinische Friedrich-Wilhelms-Universität Bonn

Mathematisch-Naturwissenschaftliche Fakultät

Prüfungszeugnis

Herr Matthias Bärin

geboren am 4. Mai 1996 in Ludwigsburg (Deutschland)

hat am 14. August 2021 die Masterprüfung im Studiengang

Mathematics

gemäß der Prüfungsordnung vom 27. August 2012
unter Berücksichtigung der Änderungen vom 17. Juli 2014

mit der Gesamtnote **ausgezeichnet (1,1)** bestanden.

Es wurden folgende Prüfungsleistungen erbracht:

Master's Thesis	Note	LP	Semester	Prüfer/in
Master's Thesis „Partial Regularity for Variational Problems“	sehr gut (1,0)	30	Sommer 2021	Dr. F. Gmeineder Prof. Dr. H. Koch
Master's Thesis Seminar	sehr gut (1,0)	6	Sommer 2021	Dr. F. Gmeineder
Module des Wahlpflichtbereichs	Note	LP	Semester	Prüfer/in
Foundations in Algebra: Algebra II (Istituzioni di Algebra) ^a	sehr gut (1,0)	9		
Foundations in Analysis: PDE and Functional Analysis ^b	sehr gut (1,0)	9		Prof. Dr. S. Müller
Foundations in Geometry and Topology: Geometry I	gut (2,0)	9	Winter 2018/19	Dr. C. Blohmann
Nonlinear PDE I	sehr gut (1,3)	9	Winter 2018/19	Prof. Dr. S. Müller
Nonlinear PDE II	sehr gut (1,0)	9	Sommer 2019	Prof. Dr. S. Müller
Advanced Topics in Analysis and Calculus of Variations - Regularity for Elliptic Variational Problems	sehr gut (1,0)	7	Sommer 2019	Dr. F. Gmeineder

Module des Wahlpflichtbereichs	Note	LP	Semester	Prüfer/in
Advanced Topics in Analysis (Istituzioni Fisica Matematica) ^a	gut (2,3)	7		
Selected Topics in Analysis and PDE - Function Spaces and Potential Theory	sehr gut (1,0)	5	Sommer 2020	Dr. F. Gmeineder
Advanced Geometry I - Geometry of Classical Field Theory	sehr gut (1,0)	9	Sommer 2019	Dr. C. Blohmann
Graduate Seminar on Analysis - The Ubiquity of Gaussian Measures	sehr gut (1,0)	6	Sommer 2019	Prof. Dr. M. Disertori
Additional Graduate Seminar on Analysis - Heat Flow on Metric Measure Spaces	sehr gut (1,0)	6	Winter 2020/21	Prof. Dr. K.-T. Sturm
Zusatzleistungen ^c	Note	LP	Semester	Prüfer/in
Recognised Module (Italiano per stranieri B2) ^a	unbenotet	4		
Italienisch A2	gut (1,7)	6	Winter 2018/19	I. Esposito

^a Anerkannte Prüfungsleistung der Università di Pisa

^b Modul bereits während des Bachelor-Studiengangs erbracht

^c Zusatzleistungen werden bei der Berechnung der Endnote nicht berücksichtigt.

Bonn, den 15. September 2021



Der Vorsitzende des
Prüfungsausschusses für gestufte
Studiengänge der Mathematik

Jan Schröer
Prof. Dr. Jan Schröer

Diploma Supplement

This Diploma Supplement model was developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international 'transparency' and fair academic and professional recognition of qualifications (diplomas, degrees, certificates, etc.). It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.



1. INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

1.1. Family name(s)

Bärlein

1.2. First name(s)

Matthias

1.3. Date of birth / Place, country of birth

04 May 1996 / Ludwigsburg, Germany

1.4. Student identification number

2869707

2. INFORMATION IDENTIFYING THE QUALIFICATION

2.1. Name of qualification and title conferred (in original language)

Master of Science

2.2. Main field(s) of study for the qualification

Mathematics

2.3. Name and status of awarding institution (in original language)

Rheinische Friedrich-Wilhelms-Universität Bonn (Founded 1818), Mathematisch-Naturwissenschaftliche Fakultät University/State Institution

2.4. Name and status of institution administering studies (in original language)

[same]

2.5. Language(s) of instruction/examination

English

3. INFORMATION ON THE LEVEL AND DURATION OF THE QUALIFICATION

3.1. Level of the qualification

Master, Second academic degree

3.2. Official duration of programme in credits and years

120 ECTS, 2 years (4 semesters)

3.3. Access requirement(s)

Bachelor's degree in Mathematics or equivalent with an overall grade of at least 2.5 (German grading scheme) and 120 ECTS credit points from mathematical modules, proof

of sufficient knowledge of the English language. Non-EU applicants may need to prove their ability in a qualifying test. There is an application and selection procedure. Passing this is necessary for entering the programme.

4. INFORMATION ON THE PROGRAMME COMPLETED AND THE RESULTS OBTAINED

4.1. Mode of study

Full-time

4.2. Programme learning outcomes

The Master's programme "Mathematics" offered by the University of Bonn is a four semester consecutive programme with a research orientation.

900 hours are set as an average workload per semester corresponding to 30 credit points. So, one credit point corresponds to an estimated workload of about 30 hours.

The programme contains compulsory modules of 36 credit points, and elective modules of 84 credit points. The compulsory modules are the Master's Thesis (30 credit points) and the accompanying Master's Thesis Seminar (6 credit points).

Some of the elective modules are assigned to one of the six mathematical areas A (Algebra, Number Theory and Logic), B (Analysis and Differential Equations), C (Discrete Mathematics), D (Geometry and Topology), E (Numerical Mathematics and Scientific Computing), and F (Probability and Stochastic Analysis). In the electives, at least 48 credit points have to be obtained in foundation and graduate courses of the areas A, B, C, D, E, F. In each of at least three out of these six areas a minimum of 9, 16 respectively 23 credit points must be acquired. At least 12 credit points must be obtained in graduate seminars. A secondary subject of at most 24 credit points is optional.

The Master's programme in Mathematics provides a research oriented scientific education and results in an advanced degree that qualifies the candidate for a professional career. Participants in this programme will expand their knowledge base and develop the skills to approach complex problems and solve them with sophisticated scientific methods. The Master's programme in Mathematics provides training in the required scientific knowledge, the

skills and methods utilized to succeed in independent scientific work, the capability to engage in critical classification and application of scientific findings, and the initiative to act as a professional in the corresponding fields of work. Successful candidates will graduate with a strong foundation in the field, the flexibility to apply this expertise in novel research situations, and the methodic and analytic competences that will enable them to continue to extend and apply their scientific knowledge in their future careers.

4.3. Programme details, individual credits gained and grades/marks obtained

See "Prüfungszeugnis" (Examination Certificate) for list of courses and grades, subjects offered in final examinations (written and oral) and topic of thesis, including evaluations.

4.4. Grading system and grade distribution table

General grading scheme cf. Sec. 8.6. Moreover, the overall grade "ausgezeichnet" (excellent) is awarded if the student has an overall grade of (1.1) or better and the Master's Thesis is graded with (1.0).

Degrees in M.Sc. Mathematics completed between
01 October 2018 and 30 September 2020

Total: 180 graduates

Grading level	Grades	Degrees (no.)	Degrees accum. (no.)	Quota (%)	Quota accum. (%)
ausgezeichnet*	1.0-1.1*	32	32	17.8	17.8
sehr gut	1.0-1.5	89	121	49.4	67.2
gut	1.6-2.5	57	178	31.7	98.9
befriedigend	2.6-3.5	2	180	1.1	100
ausreichend	3.6-4.0		180		100

4.5. Overall classification of the qualification (in original language)

ausgezeichnet (1.1)

4.6. Completion date of degree

14 August 2021

5. INFORMATION ON THE FUNCTION OF THE QUALIFICATION

5.1. Access to further study

Qualification to apply for admission to doctorate studies

5.2. Access to a regulated profession

This degree entitles its holder to the legally protected professional title of Master of Science (M.Sc.).

6. ADDITIONAL INFORMATION

6.1. Additional information

None

6.2. Further information sources

On the institution: www.uni-bonn.de

On the programme: www.mathematics.uni-bonn.de

For further national information sources cf. Sec. 8.8.

7. CERTIFICATION

This Diploma Supplement refers to the following original documents:

Document on the award of the academic degree (Urkunde) of 15 September 2021

Examination Certificate (Prüfungszeugnis) of 15 September 2021

8. NATIONAL HIGHER EDUCATION SYSTEM

The information on the national higher education system on the following pages provides a context for the qualification and the type of higher education that awarded it.

Certification Date:

15 September 2021

Official Stamp:

Bachelor-Master-Büro
Mathematik
Universität Bonn
Endenicher Allee 60
53115 Bonn


Prof. Dr. Jan Schröer
Chairman of the Examination Committee

8. INFORMATION ON THE GERMAN HIGHER EDUCATION SYSTEM¹

8.1. Types of Institutions and Institutional Status

Higher education (HE) studies in Germany are offered at three types of Higher Education Institutions (HEI).²

- *Universitäten* (Universities) including various specialized institutions, offer the whole range of academic disciplines. In the German tradition, universities focus in particular on basic research so that advanced stages of study have mainly theoretical orientation and research-oriented components.

- *Fachhochschulen (FH) / Hochschulen für Angewandte Wissenschaften (HAW)* (Universities of Applied Sciences, UAS) concentrate their study programmes in engineering and other technical disciplines, business-related studies, social work, and design areas. The common mission of applied research and development implies an application-oriented focus of studies, which includes integrated and supervised work assignments in industry, enterprises or other relevant institutions.

- *Kunst- und Musikhochschulen* (Universities of Art/Music) offer studies for artistic careers in fine arts, performing arts and music; in such fields as directing, production, writing in theatre, film, and other media; and in a variety of design areas, architecture, media and communication.

Higher Education Institutions are either state or state-recognized institutions. In their operations, including the organization of studies and the designation and award of degrees, they are both subject to higher education legislation.

8.2. Types of Programmes and Degrees Awarded

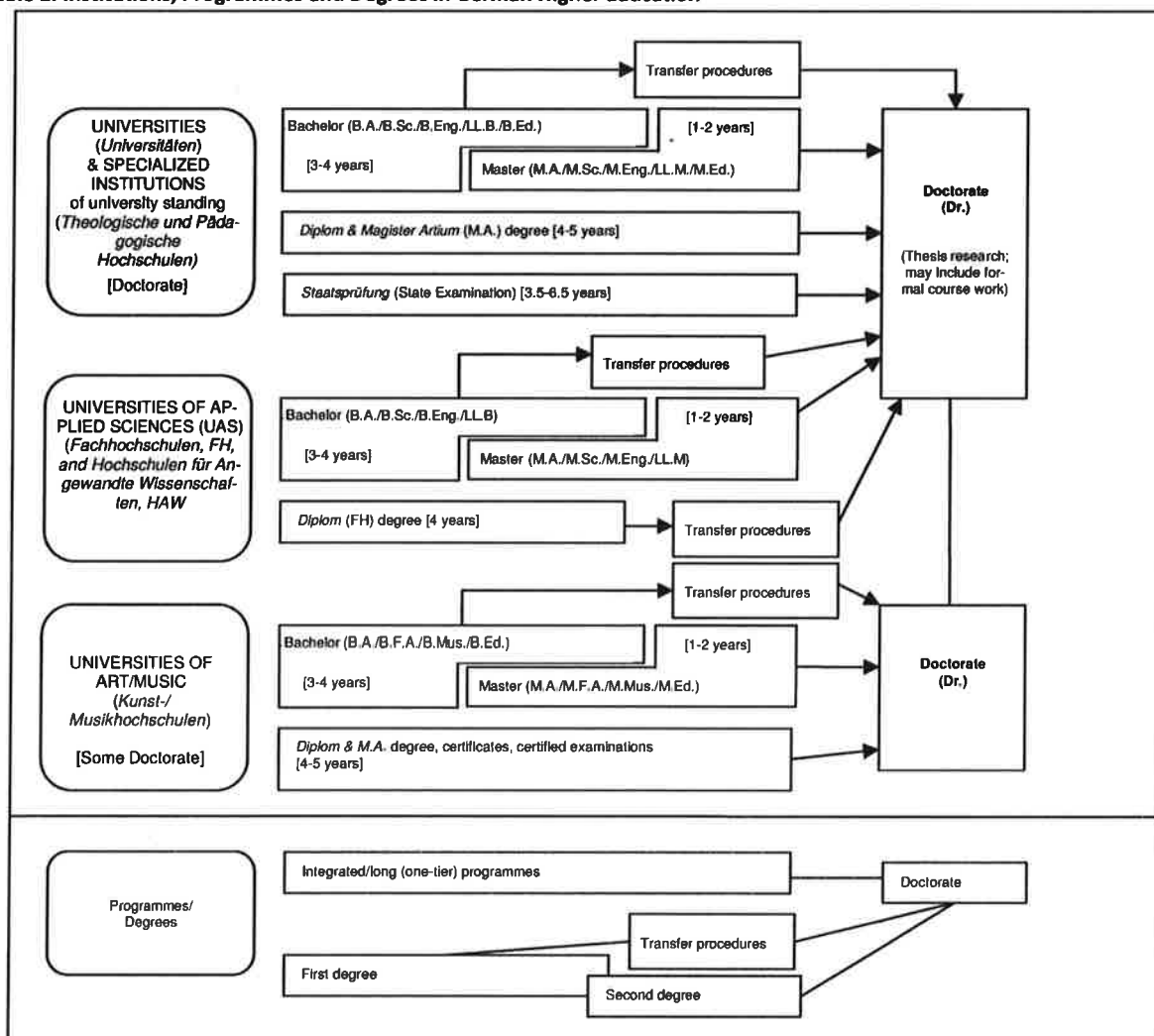
Studies in all three types of institutions have traditionally been offered in integrated "long" (one-tier) programmes leading to *Diplom-* or *Magister Artium* degrees or completed by a *Staatsprüfung* (State Examination).

Within the framework of the Bologna-Process one-tier study programmes are successively being replaced by a two-tier study system. Since 1998, two-tier degrees (Bachelor's and Master's) have been introduced in almost all study programmes. This change is designed to enlarge variety and flexibility to students in planning and pursuing educational objectives; it also enhances international compatibility of studies.

The German Qualifications Framework for Higher Education Qualifications (HQR)³ describes the qualification levels as well as the resulting qualifications and competences of the graduates. The three levels of the HQR correspond to the levels 6, 7 and 8 of the German Qualifications Framework for Lifelong Learning⁴ and the European Qualifications Framework for Lifelong Learning⁵.

For details cf. Sec. 8.4.1, 8.4.2, and 8.4.3 respectively. Table 1 provides a synoptic summary.

Table 1: Institutions, Programmes and Degrees in German Higher Education



8.3. Approval / Accreditation of Programmes and Degrees

To ensure quality and comparability of qualifications, the organisation of studies and general degree requirements have to conform to principles and regulations established by the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany (KMK).⁶ In 1999, a system of accreditation for Bachelor's and Master's programmes has become operational. All new programmes have to be accredited under this scheme; after a successful accreditation they receive the quality-label of the Accreditation Council.⁷

8.4. Organization and Structure of Studies

The following programmes apply to all three types of institutions. Bachelor's and Master's study programmes may be studied consecutively, at various higher education institutions, at different types of higher education institutions and with phases of professional work between the first and the second qualification. The organisation of the study programmes makes use of modular components and of the European Credit Transfer and Accumulation System (ECTS) with 30 credits corresponding to one semester.

8.4.1. Bachelor

Bachelor's degree programmes lay the academic foundations, provide methodological competences and include skills related to the professional field. The Bachelor's degree is awarded after 3 to 4 years.

The Bachelor's degree programme includes a thesis requirement. Study programmes leading to the Bachelor's degree must be accredited according to the Interstate study accreditation treaty.⁸

First degree programmes (Bachelor) lead to Bachelor of Arts (B.A.), Bachelor of Science (B.Sc.), Bachelor of Engineering (B.Eng.), Bachelor of Laws (LL.B.), Bachelor of Fine Arts (B.F.A.), Bachelor of Music (B.Mus.) or Bachelor of Education (B.Ed.).

The Bachelor's degree corresponds to level 6 of the German Qualifications Framework / European Qualifications Framework.

8.4.2. Master

Master is the second degree after another 1 to 2 years. Master's programmes may be differentiated by the profile types "practice-oriented" and "research-oriented". Higher Education Institutions define the profile.

The Master's degree programme includes a thesis requirement. Study programmes leading to the Master's degree must be accredited according to the Interstate study accreditation treaty.⁹

Second degree programmes (Master) lead to Master of Arts (M.A.), Master of Science (M.Sc.), Master of Engineering (M.Eng.), Master of Laws (LL.M.), Master of Fine Arts (M.F.A.), Master of Music (M.Mus.) or Master of Education (M.Ed.). Master's programmes which are designed for continuing education may carry other designations (e.g. MBA).

The Master's degree corresponds to level 7 of the German Qualifications Framework / European Qualifications Framework.

8.4.3. Integrated "Long" Programmes (One-Tier):

Diplom degrees, Magister Artium, Staatsprüfung

An integrated study programme is either mono-disciplinary (*Diplom* degrees, most programmes completed by a *Staatsprüfung*) or comprises a combination of either two major or one major and two minor fields (*Magister Artium*). The first stage (1.5 to 2 years) focuses on broad orientations and foundations of the field(s) of study. An Intermediate Examination (*Diplom-Vorprüfung* for *Diplom* degrees; *Zwischenprüfung* or credit requirements for the *Magister Artium*) is prerequisite to enter the second stage of advanced studies and specializations. Degree requirements include submission of a thesis (up to 6 months duration) and comprehensive final written and oral examinations. Similar regulations apply to studies leading to a *Staatsprüfung*. The level of qualification is equivalent to the Master's level.

- Integrated studies at *Universitäten (U)* last 4 to 5 years (*Diplom* degree, *Magister Artium*) or 3.5 to 6.5 years (*Staatsprüfung*). The *Diplom* degree is awarded in engineering disciplines, the natural sciences as well as economics and business. In the humanities, the corresponding degree is usually the *Magister Artium* (M.A.). In the social sciences, the practice varies as a matter of institutional traditions. Studies preparing for the legal, medical and pharmaceutical professions are completed by a *Staatsprüfung*. This applies also to studies preparing for teaching professions of some *Länder*. The three qualifications (*Diplom*, *Magister Artium* and *Staatsprüfung*) are academically equivalent and correspond to level 7 of the German Qualifications Framework / European Qualifications Framework.

They qualify to apply for admission to doctoral studies. Further prerequisites for admission may be defined by the Higher Education Institution, cf. Sec. 8.5.

- Integrated studies at *Fachhochschulen (FH) / Hochschulen für Angewandte Wissenschaften (HAW)* (Universities of Applied Sciences, UAS) last 4 years and lead to a *Diplom (FH)* degree which corresponds to level 6 of the German Qualifications Framework / European Qualifications Framework. Qualified graduates of FH/HAW/UAS may apply for admission to doctoral studies at doctorate-granting institutions, cf. Sec. 8.5.

- Studies at *Kunst- und Musikhochschulen* (Universities of Art-/Music etc.) are more diverse in their organisation, depending on the field and individual objectives. In addition to *Diplom/Magister* degrees, the integrated study programme awards include certificates and certified examinations for specialized areas and professional purposes.

8.5. Doctorate

Universities as well as specialized institutions of university standing, some of the FH/HAW/UAS and some Universities of Art/Music are doctorate-granting institutions. Formal prerequisite for admission to doctoral work is a qualified Master's degree (UAS and U), a *Magister* degree, a *Diplom*, a *Staatsprüfung*, or a foreign equivalent. Comparable degrees from universities of art and music can in exceptional cases (study programmes such as music theory, musicology, pedagogy of arts and music, media studies) also formally qualify for doctoral work. Particularly qualified holders of a Bachelor's degree or a *Diplom (FH)* degree may also be admitted to doctoral studies without acquisition of a further degree by means

of a procedure to determine their aptitude. The universities respectively the doctorate-granting institutions regulate entry to a doctorate as well as the structure of the procedure to determine aptitude. Admission further requires the acceptance of the Dissertation research project by a professor as a supervisor.

The doctoral degree corresponds to level 8 of the German Qualifications Framework / European Qualifications Framework.

8.6. Grading Scheme

The grading scheme in Germany usually comprises five levels (with numerical equivalents; intermediate grades may be given): "Sehr Gut" (1) = Very Good; "Gut" (2) = Good; "Befriedigend" (3) = Satisfactory; "Ausreichend" (4) = Sufficient; "Nicht ausreichend" (5) = Non-Sufficient/Fail. The minimum passing grade is "Ausreichend" (4). Verbal designations of grades may vary in some cases and for doctoral degrees. In addition, grade distribution tables as described in the ECTS Users' Guide are used to indicate the relative distribution of grades within a reference group.

8.7. Access to Higher Education

The General Higher Education Entrance Qualification (*Allgemeine Hochschulreife*, *Abitur*) after 12 to 13 years of schooling allows for admission to all higher educational studies. Specialized variants (*Fachgebundene Hochschulreife*) allow for admission at *Fachhochschulen* (FH) / *Hochschulen für Angewandte Wissenschaften* (HAW) (UAS), universities and equivalent higher education institutions, but only in particular disciplines. Access to study programmes at *Fachhochschulen* (FH) / *Hochschulen für Angewandte Wissenschaften* (HAW) (UAS) is also possible with a *Fachhochschulreife*, which can usually be acquired after 12 years of schooling. Admission to study programmes at Universities of Art/Music and comparable study programmes at other higher education institutions as well as admission to a study programme in sports may be based on other or additional evidence demonstrating individual aptitude.

Applicants with a qualification in vocational education and training but without a school-based higher education entrance qualification are entitled to a general higher education entrance qualification and thus to access to all study programmes, provided they have obtained advanced further training certificates in particular state-regulated vocational fields (e.g. *Meister /Meisterin im Handwerk*, *Industriemeister/In*, *Fachwirt/in* (IHK), *Betriebswirt/in* (IHK) und (HWK), *staatlich geprüfte/r Techniker/in*, *staatlich geprüfte/r Betriebswirt/in*, *staatlich geprüfte/r Gestalter/in*, *staatlich geprüfte/r Erzieher/in*). Vocationally qualified applicants can obtain a *Fachgebundene Hochschulreife* after completing a state-regulated vocational education of at least two years' duration plus professional practice of normally at least three years' duration, after having successfully passed an aptitude test at a higher education institution or other state institution; the aptitude test may be replaced by successfully completed trial studies of at least one year's duration.¹⁰ Higher Education Institutions may in certain cases apply additional admission procedures.

8.8. National Sources of Information

- Kultusministerkonferenz (KMK) [Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany]; Graurheindorfer Str. 157, D-53117 Bonn; Phone: +49 [0]228 501-0; www.kmk.org; E-Mail: hochschulen@kmk.org
- Central Office for Foreign Education (ZaB) as German NARIC; www.kmk.org; E-Mail: zab@kmk.org
- German information office of the Länder in the EURYDICE Network, providing the national dossier on the education system; www.kmk.org; E-Mail: eurydice@kmk.org
- Hochschulrektorenkonferenz (HRK) [German Rectors' Conference]; Leipziger Platz 11, D-10117 Berlin; Phone: +49 [0]30 206292-11; www.hrk.de; E-Mail: post@hrk.de
- "Higher Education Compass" of the German Rectors' Conference features comprehensive information on institutions, programmes of study, etc. www.higher-education-compass.de.

¹ The Information covers only aspects directly relevant to purposes of the Diploma Supplement.

² *Berufsakademien* are not considered as Higher Education Institutions, they only exist in some of the *Länder*. They offer educational programmes in close cooperation with private companies. Students receive a formal degree and carry out an apprenticeship at the company. Some *Berufsakademien* offer Bachelor courses which are recognized as an academic degree if they are accredited by the Accreditation Council.

³ German Qualifications Framework for Higher Education Degrees (Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany of 16 February 2017)

⁴ German Qualifications Framework for Lifelong Learning (DQR). Joint resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany, the German Federal Ministry of Education and Research, the German Conference of Economics Ministers and the German Federal Ministry of Economics and Technology (Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany of 15 November 2012). More information at www.dqr.de

⁵ Recommendation of the European Parliament and the European Council on the establishment of a European Qualifications Framework for Lifelong Learning of 23 April 2008 (2008/C 111/01 – European Qualifications Framework for Lifelong Learning – EQF).

⁶ Specimen decree pursuant to Article 4, paragraphs 1-4 of the interstate study accreditation treaty (Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany of 7 December 2017).

⁷ Interstate Treaty on the organization of a joint accreditation system to ensure the quality of teaching and learning at German higher education institutions (Interstate study accreditation treaty) (Decision of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany of 8 December 2016), Enacted on 1 January 2018.

⁸ See note No. 7.

⁹ See note No. 7.

¹⁰ Access to higher education for applicants with a vocational qualification, but without a school-based higher education entrance qualification (Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany of 6 March 2009).