Syllabus

Course Description

Course Title	Didactics of Mathematics and Natural Sciences 2 - In-depth Analysis of Selected Topics
Course Code	12422
Course Title Additional	
Scientific-Disciplinary Sector	NN
Language	German
Degree Course	5 year master degree in Primary Education - German section
Other Degree Courses (Loaned)	LM-85 bis Education Ladin section
Lecturers	Prof. Dr. Michael Gaidoschik, Michael.Gaidoschik@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/37288 Dr. rer. nat. Michael Frischmann, Michael.Frischmann@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/20255 Prof. Dr. Angelika Pahl, AnPahl@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/31985 Monika Lanthaler, Monika.Lanthaler@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/41237
Teaching Assistant	
Semester	First semester
Course Year/s	4.
CP	10
Teaching Hours	70
Lab Hours	50

Individual Study Hours	130
Planned Office Hours	30
Contents Summary	See the individual course modules.
Course Topics	See the individual course modules.
Keywords	Didactics of geometry, didactics of applied math problem-solving, didactics of fractions in elementary school, didactics of physics in elementary school, dealing with learning difficulties
Recommended Prerequisites	Successful completion of the courses in mathematics and physics didactics specified in the curriculum. Willingness to engage with the subject matter of mathematics and natural sciences relevant to early learning in kindergarten and elementary school, even if you feel uncertain about these subjects yourself and/or do not have fond memories of your own school lessons in these subjects. Interest in children's thought processes and enjoyment when children make intellectual discoveries.
Propaedeutic Courses	
Teaching Format	Lectures and laboratories (for details, see the descriptions of the individual modules)
Mandatory Attendance	In accordance with the regulation
Specific Educational Objectives and Learning Outcomes	Knowledge - the subject-specific and subject-didactic foundations, in particular the subject-immanent structures and cross-age developmental lines that must be observed in order to support children's learning processes in maths (in the content areas of fractions and decimals, space and shape or plane and space; quantities including time; factual arithmetic; data and predictions, taking into account the promotion of general, process-related mathematical competences as well as in physics from kindergarten to secondary school. - the role, significance and limits of scientific and mathematical approaches to solving factual problems - of application tasks that are suitable for thematising the content addressed in inclusive kindergartens and primary schools, combined with current didactic concepts for dealing with them in kindergarten and primary school Skills - to recognise and use the potential of games and everyday

	situations in kindergarten for mathematical and scientific learning in the content areas addressed in the module - to analyse, plan and design learning-promoting support for learning processes in kindergarten and school lessons in mathematics (in the content areas "Recognising temporal order and understanding and using time" and "Quantities", "Experiencing, understanding and using time") in a technically and didactically sound manner. "Quantities", "Experiencing, describing and measuring space and form" and "Plane and space", "Arithmetic", "Data and predictions" and "Fractions and decimals") and physics on the basis of the framework guidelines for kindergarten and primary school in South Tyrol with a view to the interdisciplinarity required in kindergarten and primary school - for the qualitative, process-orientated recording of learning levels and for dealing with heterogeneity in a way that promotes learning in the content areas covered in the module Expected learning outcomes and competences: Knowledge and understanding Basic specialist knowledge and fundamental insights into elementary mathematical and scientific structures and interrelationships in the content areas covered, with consistent consideration of the general mathematical skills of problem solving, communication, representation, argumentation and modelling/mathematics Knowing and understanding current development models for the acquisition of competences in the content areas covered Knowing and understanding the educational goals of the framework guidelines for kindergarten and primary school related to the content areas covered as well as basic didactic concepts that are suitable for achieving them Application of knowledge and understanding Expertise in solving tasks relevant to kindergarten, primary and secondary school in the content areas covered in different ways and in justifying the correctness of such different solutions Expertise in planning, implementing and evaluating qualitative, process-oriented learning assessments in the content areas covered

	Expertise in planning settings that promote learning in the content areas covered, taking into account heterogeneous learning requirements Judgement Competence in the technically and didactically sound assessment of the potential of everyday and play situations for maths and science education in kindergarten as well as of tasks, exercise forms and learning environments as well as methods and didactic materials for the further development of maths and science skills in primary school with reference to the content covered Communication The ability to present the mathematical and scientific content and interrelationships dealt with precisely and appropriately to the target audience in both specialised and everyday language Competence to present one's own thought processes and solution strategies in an intersubjectively comprehensible way Knowledge of the importance of linguistic competences for mathematical and scientific learning in the content areas covered and of suitable forms of promoting these in kindergarten and primary school Learning strategies Further development of cross-content and content-specific problem-solving strategies Further development of the ability to independently acquire and deepen subject-specific and didactic content
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The final written exam (3 hours) in two parts (didactics of mathematics, didactics of physics) covers the content covered in the four parts of the course. Within the exam, the tasks are explicitly assigned to either the lectures or the laboratories.
Evaluation Criteria	In order to successfully complete the course, all four sub-courses must be passed individually. If this condition is met, the performance in the four sub-courses

	will be taken into account in the overall assessment in proportion to the weighting of each sub-course in the overall course. The performance assessment of the written examination takes into account content and linguistic correctness, accuracy, and clarity, in particular the application of the content taught in the course when completing the examination tasks (transfer performance); correct use of technical language; reference to specialist literature; depth and comprehensibility of the required reflection and argumentation. For the performance assessment in the laboratory for mathematics didactics, a written term paper is also taken into account, the content of which is published in writing on the corresponding learning platform at the beginning of the semester. The term paper must be uploaded to the OLE learning platform within the specified deadline. The criteria for assessing the term paper are the same as those for the written exam. In the event of a negative assessment of the course, any positively assessed partial examinations will be credited the next time the course is taken. Please note, however, that even in this case, a negative assessment will count toward the number of examination attempts. According to the examination regulations, failing the course three times will result in a three-term ban from taking the examination.
Required Readings	See the references for required readings in the descriptions of the individual modules.
Supplementary Readings	See the references for further reading in the descriptions of the individual modules.
Further Information	
Sustainable Development Goals (SDGs)	Reduced inequalities, Quality education

Course Module

Course Constituent Title	Didactics of Mathematics: In-depth Analysis of Selected Topics

Course Code	12422A
Scientific-Disciplinary Sector	MATH-01/B
Language	German
Lecturers	Prof. Dr. Michael Gaidoschik, Michael.Gaidoschik@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/37288
Teaching Assistant	
Semester	First semester
CP	4
Responsible Lecturer	
Teaching Hours	40
Lab Hours	0
Individual Study Hours	60
Planned Office Hours	12
Contents Summary	The aim of the lecture is to impart the basic technical and didactic knowledge necessary to stimulate and support learning processes in the content areas of space and form (geometry), fractions and decimals, arithmetic and quantities as well as data and predictions from kindergarten to the end of primary school in inclusive settings in a child- and subject-appropriate manner and to promote the individual potential of the children.
Course Topics	- Development of spatial thinking and geometric concepts from kindergarten to secondary school - Basic concepts of elementary geometry - Current didactic concepts for dealing with geometric content in kindergarten and primary school in a way that promotes learning, taking into account the promotion of general (process-related) mathematical skills - Content-knowledge needed for teaching fractions and decimals in primary school - Current didactic concepts for the development and consolidation of sustainable basic concepts of fractions and decimals - Early childhood development of ways of thinking and ideas about measurement and standardised units - Current didactic concepts for the development and consolidation of sustainable concepts of measurement and model and base

	concepts of standardised units of measurement from kindergarten to the transition to middle school - Content-knowledge and didactic principles for teaching the conversion of units of measurement - Maths problem solving as integrated modelling and problem solving, teaching heuristic strategies in heterogeneous learning groups - Early childhood experiences with data, chance and probability - Importance of the content area "Data and predictions" for kindergarten and primary school - Content knowledge of the foundations of descriptive statistics and probability and knowledge of current didactic concepts needed for the propaedeutic treatment of the content area "data and predictions" in kindergarten and primary school - Specialised didactic approaches to the early, qualitative, support-oriented assessment of (even emerging) special learning difficulties in the area of early mathematics and to dealing with heterogeneity in mathematics lessons in general
Teaching Format	Lecture with media support, interspersed work phases (individual work to small groups), repeated invitation to written interim reflections and feedback on the course.
Required Readings	Franke, M., & Reinhold, S. (2016). Didaktik der Geometrie in der Grundschule, 3. Auflage. Springer Franke, M., & Ruwisch, S. (2010). Didaktik des Sachrechnens in der Grundschule. Spektrum. Gaidoschik, M. (2025). Lernschwierigkeiten in Mathematik. Warum wir nicht von Rechenschwäche und Dyskalkulie sprechen und was wir ab dem Kindergarten tun sollten. Persen. Padberg, F. & Wartha, S. (2015): Didaktik der Bruchrechnung. Heidelberg: Spektrum
Supplementary Readings	Benz, Ch., Peter-Koop, A., & Grüßing, M. (2015). Frühe mathematische Bildung. Mathematiklernen der Drei- bis Achtjährigen. Springer. Schipper, W., Dröge, A., & Ebeling, R. (2015-2018). Handbuch für den Mathematikunterricht, 1./2./3./4. Schuljahr. Bildungshaus Schulbuchverlage.

Course Module

Course Constituent Title	Didactics of Mathematics with an Emphasis on the Age Range 5-12 (Lab.)
Course Code	12422B
Scientific-Disciplinary Sector	MATH-01/B
Language	German
Lecturers	Prof. Dr. Michael Gaidoschik, Michael.Gaidoschik@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/37288 Monika Lanthaler, Monika.Lanthaler@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/41237
Teaching Assistant	
Semester	First semester
CP	2
Responsible Lecturer	
Teaching Hours	0
Lab Hours	30 Gruppe 1: Prof. Dr. Michael Gaidoschik Gruppe 2, 3, 4 und 5: Monika Lanthaler
Individual Study Hours	20
Planned Office Hours	6
Contents Summary	The aim of the laboratory is, on the one hand, to support students in acquiring the content of the lecture "Didactics of Mathematics: In-depth content" through practical exercises in small groups. On the other hand, it is about the practical testing of substantial tasks, materials, media... for early mathematical education in kindergarten as well as for its continuation in primary school (focus), as well as the reflection of the experiences made and their reference back to the theory dealt with in the lecture.
Course Topics	- Games and everyday situations in kindergarten as well as substantial tasks and learning environments that stimulate and promote the (further) development of skills in the areas of

	"geometry", "fractions and decimals", "quantities and maths problem solving" and "data and predictions" - Age-appropriate examples of modelling and math-problem-solving tasks, heuristic strategies - Practical exercises with the aim of fostering the own understanding of the mathematical content as well as of analysing and testing current didactic concepts and related methods and didactic materials for the content areas "Geometry", "Fractions and decimals", "Quantities and math problem solving" and "Data and predictions"
Teaching Format	Laboratory with theoretical input; individual, partner and group work, discussions; written assignments.
Required Readings	See the notes for the corresponding lecture.
Supplementary Readings	See the notes for the corresponding lecture.

Course Module

Course Constituent Title	Didactics of Physics: In-depth Analysis of Selected Topics
Course Code	12422C
Scientific-Disciplinary Sector	PHYS-06/B
Language	German
Lecturers	Prof. Dr. Angelika Pahl, AnPahl@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/31985
Teaching Assistant	
Semester	First semester
CP	2
Responsible Lecturer	
Teaching Hours	30
Lab Hours	0
Individual Study Hours	20
Planned Office Hours	6
Contents Summary	The aim of the lecture is to impart the basic technical and didactic

	knowledge necessary to stimulate and support learning processes in the field of science education, especially in the field of physics, from kindergarten to the end of primary school in a child- and subject-appropriate manner and to promote the individual potential of the children.
Course Topics	- Differentiation between experiential and modelling values and their significance for the understanding of physical natural phenomena - In-depth insight into typical ways of thinking and working or methods of the natural sciences that are used in the world of experience and modelling - Typical pupil perceptions and in-depth knowledge of the subject-specific fundamentals of physics, which are necessary for the implementation of learning programmes in kindergarten and primary school - Technical and didactic fundamentals of the basic concepts of matter, systems, interactions and energy and thinking about their significance for people in terms of education for sustainable development (ESD) - Basic knowledge of the principles, structures, processes and procedures of physics, with particular reference to the areas mentioned in the framework guidelines for lower secondary schools in South Tyrol, especially electricity, heat, light and shadow, space - Exemplary demonstration of suitable experiments to illustrate technical concepts of physics - Methods of assessing learning levels in order to recognise and promote scientific potential and interests in pupils, especially in the field of physics - Lesson examples and structures for various physics content areas, which are intended to facilitate the continuous development of skills in kindergarten and primary school
Teaching Format	Lecture with media support (including videos) and interspersed work phases (individual work to small groups)
Required Readings	• Kahlert, J., Demuth, R. (2010). *Wir experimentieren in der Grundschule: Einfache Versuche zum Verständnis physikalischer und chemischer Zusammenhänge. Teil 1*. Aulis Verlag. Kapitel 3. • Kahlert, J., Demuth, R. (2010). *Wir experimentieren in der Grundschule: Einfache Versuche zum Verständnis*

	physikalischer und chemischer Zusammenhänge. Teil 2. Aulis Verlag. Kapitel 1, 2, 3. • Labudde, P. & Metzger, S. (2019). *Fachdidaktik Naturwissenschaften (3. akt. u. erw. Aufl.).* Haupt. Kapitel 6, 12. • DK (2022). *Visuelles Wissen Physik*. Dorling Kindersley Verlag. (die thematisch passenden Seiten)
Supplementary Readings	• Van Saan, A. (2008) *365 spannende Experimente für Kinder.* Moses. • Wagenschein, M. (2003). *Kinder auf dem Wege zur Physik*. Beltz.

Course Module

Course Constituent Title	Didactics of Physics with an Emphasis on the Age Range 5-12 (Lab.)
Course Code	12422D
Scientific-Disciplinary Sector	PHYS-06/B
Language	German
Lecturers	Dr. rer. nat. Michael Frischmann, Michael.Frischmann@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/20255 Prof. Dr. Angelika Pahl, AnPahl@unibz.it https://www.unibz.it/en/faculties/education/academic-staff/person/31985
Teaching Assistant	
Semester	First semester
CP	2
Responsible Lecturer	
Teaching Hours	0
Lab Hours	20 Gruppe 1 und 2: Prof. Dr. Angelika Pahl Gruppe 3, 4 und 5: Dr. rer. nat. Michael Frischmann

Individual Study Hours	30
Planned Office Hours	6
Contents Summary	The aim of the laboratory is, on the one hand, to support students in acquiring the content of the lecture "Didactics of Physics: Consolidation of Content" through practical exercises in small groups. On the other hand, it is about the practical testing of substantial tasks, materials, media... for primary schools (focus), as well as reflecting on the experiences gained and relating them back to the theory covered in the lecture.
Course Topics	- Implementation of didactic concepts and models for science education in the field of physics with a focus on primary school practice - Acquisition of basic experimentation and modelling skills to enable scientific processes in the educational and learning area of physics and to awaken and encourage pupils' interest in natural processes - Practical examples for initiating and promoting scientific ways of thinking and working as well as problem-solving strategies such as observing, comparing, organising, describing, asking questions, carrying out and planning experiments, evaluating, drawing conclusions, reflecting, linking and applying - Practical examples of learning tasks and learning environments with a focus on the "experiment" to promote and further develop scientific skills in selected physical subject areas (e.g. "energy": energy sources, energy carriers, energy in interactions) - Planning, implementation, reflection and evaluation of experiment-based learning tasks and learning environments for primary school through to the transition to secondary school - Reflection on the importance of practical work in the natural sciences with a focus on physics and further development of one's own attitude towards working and learning through research and discovery
Teaching Format	Practical tasks in the laboratory and documentation and reflection of the results
Required Readings	See required readings for the related lecture.
Supplementary Readings	See supplementary readings for the related lecture.