UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Didattica della Matematica

2627-1-F4002Q004

Aims

Skills Building theoretical tools and critical reflections relating to methods and theories of learning and teaching mathematics. **Competencies** Being able to independently acquire and experiment methodologies, technologies and materials developed and tested over the years in the research and practice of **mathematics education**. Being able to design educational paths in mathematical disciplines on subject topics tought in secondary school.

Learning Outcomes (according to the Dublin Descriptors)
Master's Degree in Mathematics – Course: Mathematics Education

1. Knowledge and understanding
   The student will acquire a solid theoretical understanding of the main models, methods, and findings in mathematics education research, with a focus on teaching and learning processes in secondary school. They will be able to critically analyse educational theories and established or innovative teaching approaches.
2. Applying knowledge and understanding
   The student will be able to select, adapt, and implement teaching methodologies, materials, and technologies developed through research, and to apply them effectively in designing didactic activities for secondary school mathematics. They will be able to combine disciplinary rigour with attention to students' cognitive development.
3. Making judgements
   The student will develop the ability to critically reflect on teaching experiences and choices, assessing their coherence, effectiveness, and theoretical grounding. They will be able to formulate reasoned judgements about educational practices in light of research-based evidence.
4. Communication skills
   The student will be able to communicate ideas, strategies, and issues related to mathematics teaching in a clear and effective manner, using appropriate language both in academic contexts and in educational communication with students or fellow teachers.
5. Learning skills
   The student will develop the capacity for autonomous learning in the field of mathematics education,

critically engaging with the scientific literature and integrating new knowledge into their professional practice or future teaching career.

Contents

Introduction to the methods, the ideas, the historical development and the theoretical frameworks useful in teaching secondary school mathematics. **This course will be delivered only in Italian language**.

The course is split into two modules.

Detailed program

Module 1 Didactic analysis of plane Euclidean geometry as a paradigmatic case of construction, formalisation and transmission of mathematical knowledge. Starting from a selective reading of Euclid's Elements and from a comparison with modern axiomatics, the module will discuss the role of definitions, postulates, figures, constructions and proofs, with particular attention to the conceptual and linguistic difficulties that arise in teaching. The module will also address the didactic transposition of mathematical contents, the critical analysis of textbooks, levels of geometric understanding, and the role of examples, exercises and activities in the construction of concepts.

Module 2 Methods for mathematics teaching: how to determine and address the conceptual issues at the various learning levels; analyze the epistemological aspects of mathematics from a didactic point of view. Planning of activities and knowledge/skill assessment: links of the consolidated tradition of teaching mathematics by skills with the results of research in teaching and pedagogy. Methods and techniques for communicating mathematics.

Prerequisites

In-depth knowledge of the methods and contents of basic mathematics, especially about the topics taught in secondary school.

Teaching form

Both modules adopt a hybrid teaching approach, that combines lecture-based teaching (DE) and interactive teaching (DI). DE involves detailed presentation and explanation of theoretical content. DI includes active student participation through exercises and problems, short presentations, group discussions, and group or individual work. It is not possible to precisely determine in advance the number of hours dedicated to DE and DI, as these methods are dynamically intertwined to adapt to the course's needs and promote a participatory and integrated learning environment, combining theory and practice.

Lessons are conducted for a total of 56 hours (8 CFU).

The course is held in Italian as it focuses on the Italian school system.

Textbook and teaching resource

References

Module 1

GLI ELEMENTI DI EUCLIDE, a cura di Attilio Frajese e Lamberto Maccioni (UTET, 1970)
GEOMETRY: EULID AND BEYOND, di Robin Hartshorne (Springer 2000)

Module 2

DIDATTICA DELLA MATEMATICA, di Roberto Natalini, Anna Baccaglini-Frank, Pietro Di Martino, Giuseppe Rosolini (Mondadori 2018).

Contents revision

COMINCIAMO DA ZERO, di Vinicio Villani (Pitagora 2003).

COMINCIAMO DAL PUNTO, di Vinicio Villani (Pitagora 2006).

Other interesting resources

Altri testi interessanti

LEARNING TO THINK MATHEMATICALLY: PROBLEM SOLVING, METACOGNITION, AND SENSE MAKING IN MATHEMATICS di Alan H. Schoenfeld in Handbook of research on mathematics teaching and learning (A Project of the National Council of Teachers of Mathematics, 1992) (Reprint https://journals.sagepub.com/doi/abs/10.1177/002205741619600202).

MATHEMATICAL DISCOVERY di George Polya (1962).

Semester

1S

Assessment method

There are no intermediate tests.

The final exam consists in an **Integrated oral** on the two modules, with discussion and evaluation of **projects**. The ability to decline the contents and methods of mathematics into a didactic function, the autonomy in posing relevant and critical questions for the communication and evaluation of the transmission of knowledge will be assessed.

In particular, the project is a micro-lesson, which is presented during the oral discussion, accompanied by a report. The exams are individual, and the projects and reports must be traceable to a single person. Students are encouraged to work in groups, and collaborate to achieve the stated goals.

The explicit description of the nature of the projects will be illustrated during the course. **Guidelines** will be published on the *e-learning* space, and may vary according to the number and nature of course participants. The specific topics, dates and concrete methods of assessment will be **discussed** and **negotiated** with students. More information will be given in class and in the e-learning area of the course.

The final grade (max 30) expresses an overall evaluation of everything that contributes to the achievement of the objectives described above.

Qualitative evaluation of learning outcomes, aligned with standard descriptors used in higher education (EHEA / ANVUR).

30 cum laude

- Comprehensive, rigorous, and well-structured knowledge, exceeding course expectations.
- Confident, autonomous, and creative application of methods to non-standard problems.
- Excellent critical thinking and independent reflection.
- Flawless exposition, precise and effective use of formal language.

29-30

- Complete and accurate knowledge of the course content.
- Appropriate and autonomous application of methods to complex problems.
- Good independent reasoning.
- Correct technical language, clear and coherent exposition.

27–28

- Solid and well-organized knowledge.
- Correct application to standard and articulated problems.
- Well-developed synthesis and reasoning skills.
- Clear exposition with appropriate disciplinary language.

24–26

- Generally secure knowledge, with minor inaccuracies.
- Correct application of familiar methods to standard problems.
- Some autonomy in reasoning.
- Generally clear exposition, with room for improvement in precision.

21–23

- Partial and sometimes inaccurate or incomplete knowledge.
- Mechanical or uncertain application of methods.
- Limited independent reasoning; difficulties with non-standard situations.
- Unclear exposition or improper use of technical language.

18–19

- Minimal and fragmented knowledge, barely sufficient.
- Elementary and often guided application.
- No conceptual autonomy.
- Weak exposition, frequently imprecise language.

Office hours

On appointment.

Sustainable Development Goals

QUALITY EDUCATION