Course unit English denomination	Teaching and Learning Physics at University
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Teacher in charge	Marta Carli
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	Second semester
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (50% minimum of presence) ☐ No
Course unit contents	This course introduces PhD students to key concepts and tools for understanding and improving physics teaching at the university level. It combines insights from Physics Education Research (PER) with practical reflection, collaborative activities, and case studies. **Module 1** focuses on how students think and learn in physics. Participants will examine models of student knowledge and reasoning and reflect on how assumptions about learners can shape instructional choices. Drawing on examples from specific physics topics, they will analyze how targeted instructional materials can support conceptual understanding and problem-solving abilities. The role of teaching assistants in supporting student learning will also be discussed. **Module 2** addresses challenges and opportunities in active learning and student-centered approaches. Participants will critically engage with selected PER literature and international case studies, comparing them to the UniPD context. Local case studies will be examined to illustrate how research findings have informed instructional design and how the instructor have tackled implementation challenges. **Module 3** is dedicated to laboratory instruction and the development of experimental skills. Paticipants will analyze PER findings on teaching labs across different international contexts and examine the departmental ToPLab project as a local case study. This module also introduces key principles of course design (syllabus development; constructive alignment among learning

	goals, activities, and assessment), as well as the use of research-validated tools to monitor student learning outcomes. **Module 4** centers on exploring real or simulated classroom dynamics. If feasible, participants will observe a live physics lesson to analyze the teaching context, instructional strategies, and student interactions. When direct observation is not possible, alternative resources such as video recordings, lesson transcripts, and/or micro-teaching approaches will be used to prompt analysis and reflection. A facilitated debrief will support the development of a reflective, research-informed approach to teaching physics. To support engagement with the literature and evidence-based teaching, participants will be introduced to the foundations of research methods in physics education, including how studies are designed, what kinds of data are collected, and how findings are interpreted.
Learning goals	[Knowledge and understanding] - Identify key concepts and findings from Physics Education Research (PER) related to university-level physics teaching and learning. [Applying knowledge and understanding] - Critically analyze teaching practices and learning materials through the lens of PER literature and case study evidence. - Apply research-informed strategies to design short instructional activities. [Making judgements] - Develop reflective habits regarding one's own teaching practices. [Communication skills] - Engage in discussions on physics teaching and learning using terminology specific to Physics Education Research. - Present and discuss a concise teaching proposal, including theoretical justifications and reflective insights. [Learning skills] - Navigate educational research in physics to inform their future teaching practice.
Teaching methods	All lessons are designed with a student-centred approach, incorporating small-group work, whole-group discussions, and interactive presentations. Each module includes the analysis of case studies and hands-on experience with instructional activities. Asynchronous tasks on the Moodle platform are an integral component of the course and must be completed for successful course completion. They extend in-class learning and contribute to the achievement of the intended learning outcomes.
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No

Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	No specific prerequisites except bachelor-level preparation in physics are requested.
Examination methods (if applicable)	To successfully complete the course, participants are expected to engage in the following components: - Brief asynchronous assignments, one for each of the four modules, delivered through the course Moodle page. The tasks are related to the module content and may include: critical reading of papers or excerpts, forum discussions, video analysis, or other short reflective activities. - Final task: an individual oral presentation (10-15 minutes + discussion) consisting in a proposal for a lesson or activity inspired by course content. The presentation should include: a theoretical rationale, referencing at least one of the research papers discussed in the course (or another approved by the instructor); a concise lesson or activity outline; and a personal reflection. Although no grades will be assigned, formative feedback will be provided by the instructor throughout the course and during the final presentation.
Suggested readings	Specific research articles will be suggested in each module.
Additional information	