X1

Didactics of Mathematics and Science: An interdisciplinary approach

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Aims and objectives

This course is designed to provide a functional understanding of Didactics of Mathematics and Science and to highlight the interdisciplinary essence and the sociocultural breadth of its concepts and methods.

In particular the course investigates the relationship of the evolving learning processes with the scientific construction of concepts and theories in Mathematics, as well as with the conceptual and methodological development in Science. In which ways are the school context and the didactical contract, the multiple roles of the representations/constructions, the intuitive certainties and the epistemological obstacles, the errors and the paradoxes of logic, the conventions of meanings and expressions linked within the complex learning schema and the reflectrive construction of mathematics and scientific concepts?

Through the investigation of this relationship it is revealed the way that alternative and/or erroneous scientific conceptions are formed, as well as the way that theses conceptions are maintained, reproduced and disseminated in educational and social practices.

The intention of the course is to identify and to understand the difficulties and the potential of the design and didactical management of the transformations that characterise a didactical situation.

The teamwork projects about the interdisciplinary approach complement the students' systematic engagement in activities about problem-solving and didactical situations with reference to the school curricula of all levels.

Content

The course focuses on and inter-relates methodological tools and theories of the Didactics od Mathematics and Sciences and in particular:

- Didactical Engineering and the understanding-interpretation of the difficulties and the erroneous approaches linked with the didactical context, the learning experiences, the mental stages and the epistemological obstacles of the scientific development.
- Systemic approaches of the complexity of the teaching-learning phenomena. They include the multiplicity of the factors (scientific, psychological, family and social related) and of the metacognitive and the meta-didactical attitudes (conceptions and practices), which interact in the individual/collective constitution and use of scientific thinking, as well as in the cultivation of an interdisciplinary conception of each school and social context.

[1] The CVs of the lecturers and the invited speakers are cited in the Appendix.

- Topics and historical references about the birth, formation and development of scientific questions, of the methods of observation, measurement and calculation, of the empirical or mental investigation, proof, documentation or critical acceptance of conjectures and empirical evidence.

Learning outcomes

Drawing upon the research reports and the theoretical approaches of the Didactics of Mathematics and the tools of the Didactics of Science, the students will be able:

- to identify the psychological conditions, the mental representations/constructions and the expression difficulties with which the scientific knowledge and its didactics are linked.
- to discern the role of the reflective process and cooperative learning in the formalisation and documentation of the scientific process.
- to design learning activities within which are utilised the stages of experience, questioning and theory to promote an inclusive, active participation in the scientific process.
- to incorporate within the didactical situations interdisciplinary referenced activities, which allows for the critical, inquiry-based thinking, the intellectual value, the epistemological necessity and the usefulness of the scientific knowledge in the social development to be evident.

Teaching and learning methods

The teaching-learning methods include

- Theoretical lectures
- Guided activities
- Teamwork presentation-negotiation of various topics

Assessment/grading

The assessment combines formative and summative characteristics at both the individual and the team level with respect to the

- participation in lectures and guided activities
- oral presentation and written report of the teamwork projects

Teaching language

Greek

Recommended sites for scientific documentation and browsing

Except for the announced bibliographical groundwork, the literature cited in the seminars and the papers used in the teamwork projects, we recommended the following sources for the students' systematic browsing and updating.

- Proceedings of the Conferences of Didactics of Mathematics of the E.M.E. – Hellenic Mathematical Society (www.hms.gr)
- Proceedings of the Conferences of Ε.Ε.Φ. – Greek Physicists Association (www.eef.gr)
- Proceedings of the Conferences of Εν.Ε.Δι.Μ – Greek Association for Research in Mathematics Education (http://www.enedim.gr/)
- Proceedings of the Conferences of ΕΝ.Ε.Φ.Ε.Τ. – Association for the Education in Science and Technology (www.enephet.gr)
- Proceedings of the Conferences of CIEAEM – The International Commission for the Study and Improvement of Mathematics Teaching (http://www.cieaem.org/)
- Proceedings of the Conferences of IGPME – The International Group of the Psychology of Mathematics Education (http://igpme.org/)
- Proceedings of the Conferences of ERME – European Society for Research in Mathematics Education (http://www.mathematik.uni-dortmund.de/~erme/)
- Proceedings of the Conferences of ESERA – European Science Education Research association (www.esera.org)
- Proceedings of the Conferences of GIREP – Groupe International de Recherche sur l'Enseignement de la Physique (International Research Group on Physics Teaching) (www.girep.org)
- Proceedings of the Conferences of NARST – National Association for Research in Science Teaching (www.narst.org)
- Proceedings of the Conferences of EARLI – European Association for Research in Learning and Instruction (www.earli.org)
- Proceedings of the Conferences of The Learner (www.thelearner.com)
- *Έρευνα στη Διδακτική των Μαθηματικών* (Εν.Ε.Δι.Μ. journal)
- *Φυσικές Επιστήμες στην Εκπαίδευση*
- *Ευκλείδης γ΄* (E.M.E. journal)
- *Φυσικός Κόσμος* (Ε.Ε.Φ. journal)
- *HMS – International Journal for Mathematics in Education* (international E.M.E. journal)
- *Educational Studies in Mathematics*, *Journal for Research in Mathematics Education*, *For the Learning of Mathematics, International Journal of Science Education, International Journal of Science and Mathematics Education, Journal of Research in Science Teaching* (a selection of international journals)