



UNIVERSITY OF THE AEGEAN
SCHOOL OF HUMANITIES/DEPARTMENT OF PRE-SCHOOL EDUCATION AND EDUCATIONAL DESIGN
POSTGRADUATE PROGRAM:
“SCIENCE DIDACTICS AND ICT IN EDUCATION: INTERDISCIPLINARY APPROACH”
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COURSE DESCRIPTION:

**Design, development and assessment of ICT applications for teaching
and learning**

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v.2014

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1. General description and purpose

The course "*Design, development and assessment of ICT applications for teaching and learning*" refers to the development of the capability to enhance teaching and learning of Science, Technology, Engineering and Mathematics (STEM) by integrating of ICT in the educational practice, applying approaches grounded on research and modern learning theories. Students who complete the course successfully will be able to design ICT learning scripts and interventions for K12 STEM courses, to orchestrate and implement integrated cross-curricular/interdisciplinary learning experiences with ICT, to develop and enrich curricula using ICT, and to evaluate curricula and ICT applications for teaching and learning. Generally they will be able to develop theoretical and practical capacities in learning design with ICT under the view of interdisciplinary and cross-curricular approach. Furthermore, the students will develop research skills for issues of STEM Education and ICT taking an interdisciplinary point of view.

2. Course objectives

Specifically, the students of the course:

- will explore the relationship and interaction of ICT educational applications with the evolution of learning theories since the days of behaviorists and teaching machines till the modern theories of constructivists and social cognitive endorsement in collaborative learning and online learning communities.
- So they could understand the different types of ICT educational applications and they will be able to apply consciously design decisions for the development of educational ICT programs and applications
- will approach the concept of computational thinking and the potential of utilization of computing resources to solve authentic problems by applying analytical and systemic approaches. Computational thinking is the contemporary conceptual vehicle for effective and comprehensive digital literacy. In this section is included the teaching and learning approach to computer programming extending prevalent ideas with great effect as of Seymour Papert (Logo), Andrea diSessa (Boxer), Alan Kay (eToys), Mitcher Resnick (StarLogo, Scratch) etc.
- will examine the epistemological application of ICT in the disciplines of science and technology (Engineering). A key vehicle in this approach is the use of ICT as modeling environments and simulation of simple deterministic and mainly complex and/or stochastic systems. The study will cover examples from various fields such as Physics, Chemistry, Mathematics and interdisciplinary as ecology.
- will study the ideas of interdisciplinary and cross-thematic approach of science through the educational robotics. Educational robotics in conjunction with the project method is a flagship of modern educational culture of

education and innovation in the teaching of Science, Technology Engineering, Mathematics and Computer Science. Learners will have the opportunity to study the research literature and best practices from the international literature to design integrated applications.

- Will study the possibilities that give the disciplines of learning analytics and data mining in the design and development of integrated adaptive e-learning environments on a large scale through the Internet. They will also explore new methodological possibilities offered in science education e.g. for detecting and understanding obstacles and difficulties to track learning trajectories concepts etc.
- will be able to pursue comprehensive and theoretically vested learning design systems exploiting ICT, such as Dabbagh's integrated e-learning design approach and various design models for learning activities (project, webquests etc.). With the introduction of learning design models, students will better understand the relationship between pedagogical model, learning/teaching approaches/strategies, ICT and learning activities. ICTs are introduced, in these models, to improve learning approaches and the quality of social interactions during learning.

3. Thematic sections

Introduction, learning theories, teaching, multidisciplinary-interdisciplinary approach science and ICT

Introduction to the course, presentation of the purpose, objectives, content and course procedures. Meet the students and explore their interests and needs, conformation elements of the course. Presentation of the modules (thematic sections), the material and the LMS of the course. Register on the LMS and browse the environment. Workshop for familiarization with searching, organizing and editing scientific literature. Databases of scientific papers and published works. Essay writing guide. Theoretical foundations of educational ICT applications in learning theories. Clarification of the terms: interdisciplinarity, cross-curricular, trans-disciplinarity and their meaning for the approach of school knowledge and the organization of the curricula. The role of ICT in all cases and the relationship of ICT with STEM Education.

Computational modeling and simulation in the teaching of science

Introduction to scientific modeling and its epistemological value. Clarifying concepts about educational modeling and simulation. Teaching approaches using modeling and for modeling. (a) The models as a visualization medium, b) simulation models by students for experimentation, exploration, formulation and hypothesis testing, c) modification/extension/correction models, and d) modeling by students). Examples of educational research about modeling. Modeling environments (e.g. Scratch, Starlogo, Netlogo, etoys, agentsheets, stagecast, modelus, modelingspace, SIMCALC, interactive physics, crocodile clips, jphet, excel, wolfram mathematica, DGS: Gabri, Geogebra, etc.). Microwords, virtual manipulatives, repositories (e.g. photodentro, merlot). Cross-curricular approach and educational modeling. The role of the script and the story in modeling.

Systems thinking, complex systems, ICT and educational applications

Introduction to systems thinking and the science of complex systems. Trans-disciplinarity Representations of dynamical systems, flow/stocks networks, cellular automata. Application cases. Systems thinking in education and in the teaching of science.

Learning design and ICT

Methodologies of learning design with ICT, learning activities models that use ICT, the cross-thematic dimension. Dabbagh's model of e-learning design. The methodology of learning scenarios enhanced with ICT.

STEM & educational robotics

Introduction to the concept of educational robotics. Relationship between science and engineering and educational implications. Experiential workshop Lego NXT and WEDO. Application examples.

Computational thinking - Teaching ICT

Introduction to the concept of computational thinking. Curricula for computational thinking. The computational thinking as conceptual vehicle for teaching ICT in the general education.

Specific topics (Learning Analysis, communities of practice, Portable learning).

Introduction to learning analytics and its role in STEM Education. Situated learning, collaborative learning and the pedagogical model of communities of learning and practice. Mobile technologies and learning. DGBL for science, examples of serious games.

Presentation and evaluation students' work

Presentation of students' works, discussion and review.

4. Teaching Methodology

The course utilizes the blended e-learning model. Some of the educational interactions are carried out at meetings and some through distance learning system. In the meetings the themes are introduced with lecture, discussion, case studies, inquiries and workshops. In e-learning system students participate in asynchronous discussions, information resource repositories, implement collaborative activities and deliver their assignments. The final work (project) of students includes a) literature search and writing short scientific paper, b) the design and development of educational applications of ICT (microworlds, simulations, games, etc.), learning activities/scenarios. The works are presented at meetings and discussed by the students.

5. Assessment

The learning of students attending the course is assessed based a) on their active participation, b) their performance in short assignments during the course meetings, and c) the final project which they implement and present at the meetings.

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