DEMOCRITUS UNIVERSITY OF THRACE

DEPARTMENT OF PRIMARY EDUCATION OF THE SCHOOL OF EDUCATION

INTERINSTITUTIONAL POSTGRADUATE STUDY PROGRAM IN "EDUCATION SCIENCES: SCIENCE, SUSTAINABILITY AND TECHNOLOGY EDUCATION"

A8.
PROGRAM GUIDE

MARCH 2025

Table of contents

Abbreviations

IPP	Interinstitutional Postgraduate Program
PC (EPS)	Program Commitee
MT	Master Thesis
PS	Postgraduate Student
SC (SE)	Steering Commitee

1. Introduction

The Department of Primary Education of the School of Education at the Democritus University of Thrace, as the coordinating department, in collaboration with the Department of Primary Education and the Department of Early Childhood Education of the School of Social and Human Sciences at the University of Western Macedonia, and the Department of Physics of the School of Sciences at the Aristotle University of Thessaloniki, jointly organizes the Interinstitutional Postgraduate Program (IPP) entitled: "Educational Sciences: Science, Sustainability and Technology Education." The IPP offers three (3) specialization tracks: *Science Education*, *Physics Education & Educational Technology*, *Environment and Sustainability Education*. This Study Guide is published and updated annually, and is available on the official websites of the Department (https://eled.duth.gr/) and the IIPP (https://dpms-scisust.eled.duth.gr).

This Postgraduate Program Guide presents:

1. The purpose of the Interinstitutional Postgraduate Program (IPP), the criteria for the maximum and minimum number of admitted students, the categories of eligible applicants, the duration of studies, the terms of attendance, information regarding the operation of the study facilities of the Democritus University of Thrace (DUTH), the language of instruction, the organization of the academic calendar and class schedule, the evaluation of students' coursework and instructors' performance, and the provision of distance learning.
2. The curriculum, including the number of European Credit Transfer and Accumulation System (ECTS) credits awarded per course and required for the acquisition of the Postgraduate Diploma of Specialization. It also includes information on the distribution of courses across semesters, the teaching staff, the structure of the program, and short descriptions (syllabi) of compulsory and elective courses necessary for the successful completion of the IPP.
3. Issues related to the Master's Thesis, students' rights and benefits, their obligations, tuition fees, scholarships, intellectual property rights, and plagiarism.

2. Scope and Objectives of the Interinstitutional Postgraduate Program (IPP)

The Interinstitutional Postgraduate Program (IPP) aims to provide postgraduate-level teaching through interdisciplinary approaches and to prepare educators for the design and implementation of contemporary trends in primary and secondary education curricula. These trends emphasize inquiry-based teaching and learning, encouraging participants to create learning environments where students engage in scientific investigation, study of scientific texts from printed or digital sources, hands-on experimentation, problem solving, written synthesis and reporting, and more. The program addresses a complex field that integrates Science Education (SE), Sustainability and Environmental Education (SEE), and both digital and traditional Technology (T). This integration reflects two key educational imperatives: First, contemporary global challenges are increasingly linked to environmental and sustainability issues. Second, basic education must adapt to the evolving knowledge society, in which technology plays a central role by connecting ideas to practice. In addition, current research in science education informs the program's focus on the design,

development, implementation, evaluation, and refinement of Teaching and Learning Sequences (TLS) aimed at educating students in the aforementioned domains.

The IPP aims to:

1. Train current and prospective teachers in primary and secondary education in the design, implementation, and evaluation of Teaching and Learning Sequences (TLS) in the domains of Science–Sustainability–Technology. These TLS aim to support the teaching of declarative, procedural, and epistemological knowledge, with a strong emphasis on identifying, utilizing, and transforming students' representations through the integration of digital technologies. TLS foster inquiry-based learning and are grounded in educational research.
2. Educate researchers in the field of Educational Sciences, with a specialization in science and sustainability/environmental education, enhanced by the use of technology. Graduates of the IPP will acquire the theoretical and practical background, as well as the necessary skills, to work in a range of professional and research contexts related to science and environmental/sustainability education with technology, in both formal and non-formal learning environments.
3. Equally emphasize research and professional development, aiming to support graduates in pursuing doctoral studies and in becoming not only effective educators but also capable educational leaders and agents of change within the educational system.

Upon successful completion of the coursework, participants are expected to be able to:

- search for, analyze, and synthesize data and information, using appropriate technologies;
- adapt to new situations and challenges;
- work both independently and collaboratively;
- operate effectively in interdisciplinary environments;
- generate original research ideas;
- exercise critical thinking and self-reflection;
- foster free, creative, and inductive reasoning.

3. Admission Quota and Procedure

The annual number of admitted students to the Interinstitutional Postgraduate Program (IPP) is set at a maximum of seventy-five (75), distributed evenly across the three specialization tracks, with twenty-five (25) students per track, according to applicants' stated preferences. The minimum number of admitted postgraduate students is determined each academic year in the official call for applications, following a decision of the Program Commitee Program Commitee of the IPP.

Admission Procedure

1. Eligible for admission to the Interinstitutional Postgraduate Program (IPP) are graduates of first-cycle (undergraduate) programs from higher education institutions in Greece or recognized equivalent institutions abroad, holding degrees in the following fields: (a) Educational Sciences (b) Natural Sciences (c) Environmental Sciences (d) Agricultural Sciences (e) Health Sciences (f) Engineering (g) Technological Education (in fields relevant to the subject matter of the IPP).

2. The Secretariat of the coordinating Department is responsible for verifying whether the foreign higher education institution that awarded the undergraduate degree is listed in the National Registry of Recognized Foreign Institutions, and whether the specific degree type is included in the National Registry of Recognized Degree Titles. Both registries are available on the official website of DOATAP (Hellenic National Academic Recognition and Information Center).
3. Members of the E.E.P. (Special Teaching Staff), E.DI.P. (Special Technical Laboratory Staff), and E.T.E.P. (Special Administrative and Technical Staff) of the participating Departments may apply for admission as supernumerary students, limited to one per specialization track per year, provided that their academic qualifications and professional duties are relevant to the subject area of the IPP.
4. All applicants must have sufficient knowledge of the English language, while non-Greek applicants must also have adequate knowledge of the Greek language. Applicants who do not hold a valid certificate of English proficiency (at least B2 level) are required to sit for a language assessment conducted by the IPP, during which they must demonstrate the ability to translate scientific texts with ease. The same applies to non-Greek applicants who do not hold valid certificates of Greek language proficiency—they must undergo an assessment of their comprehension skills in Greek during the admission process.

4. Admission Selection Procedure – Enrollment in the IPP

A. Call for Applications

Each year, during the month of May of the preceding academic year, the Interinstitutional Postgraduate Program (IPP) publishes an official call for applications on its website, on the websites of the collaborating departments, and through any other appropriate means of communication. This call invites prospective students to express their interest in enrolling in the program. Applicants must submit their application forms along with all required supporting documents to the Secretariat of the coordinating Department, in electronic format, as specified in the call for applications. The format must meet the accepted standards of validity and file type.

B. Application Submission for Admission to the IPP

1. In alignment with the principles of **equal opportunity** and **inclusivity**, the Interinstitutional Postgraduate Program (IPP) grants the right to apply to any interested individual who meets the required qualifications.
2. The admission requirements and selection criteria are clearly defined, whether quantitative and/or qualitative in nature, and are made known to all applicants through the official call for applications.
3. Applications and all required supporting documents must be submitted electronically, via the designated platform on the website of the IPP or the coordinating Department, within the deadline specified in the call. Late submissions will not be accepted.

C. Evaluation of Applications and Enrollment in the IPP

1. The evaluation process and the point allocation for each documented qualification fall under the responsibility of the Program Commitee Program Commitee. The list of accepted, waitlisted, and rejected applicants is compiled by specialization track, based on the applicants' stated preferences.

2. The evaluation of candidates includes verification of the required qualifications, point-based assessment of supporting documents according to the criteria set out in the official call for applications, and a personal interview.
3. Successful applicants must confirm their enrollment in the IPP within five (5) days. If an applicant declines the offer, the next candidate on the waiting list is immediately contacted by phone. Enrollment is considered complete only after the submission of all required documents.
4. The Secretariat of the coordinating Department registers the admitted students, by specialization track, in the Postgraduate Student Registry of the coordinating Department. Admitted students are also provided with the IPP's Regulations, the Internal Rules of the coordinating Institution, the Academic Code of Ethics, and any other relevant documentation deemed necessary.

5. Duration of Studies – Part-Time Enrollment – Suspension of Studies

A. Duration of Studies

1. The minimum duration of study in the Interinstitutional Postgraduate Program (IPP) leading to the award of the Postgraduate Diploma of Specialization (PDS) is three (3) academic semesters, corresponding to 90 ECTS credits. This period includes the time allocated for the preparation and evaluation of the Master's Thesis, where applicable. If the curriculum includes a thesis, its duration may not be shorter than one academic semester.
2. Completion of studies in the Interinstitutional Postgraduate Program (IPP) requires:
    - fulfillment of the minimum required study period,
    - successful completion of all academic requirements and educational activities, and
    - completion of the Master's Thesis, if it is part of the student's academic track.
3. As for the maximum duration of study, postgraduate students are required to complete the program within twice the minimum prescribed duration, as defined by the regulations of the IPP.
4. Exceptions to the Maximum Duration of Studies: By way of exception, postgraduate students, after completing their initial enrollment in the Interinstitutional Postgraduate Program (IPP), may submit a formal request to the IPP's Program Committee (E.P.S.) for one of the following:
    - a temporary suspension of studies, for a period not exceeding two (2) consecutive semesters. During this suspension period, the student loses their student status, and the suspension time does not count toward the maximum allowable study duration.
    - an extension of studies, for a period of up to one (1) additional academic year. The Program Commitee Program Commitee submits the student's request, along with the justification provided, to the General Assembly of the coordinating Department, which decides to approve or reject the extension.

    Applications for either suspension or extension may be submitted only once. They must clearly state the reasons and be accompanied by supporting documentation substantiating the request. Military service is automatically recognized as a valid reason for suspension.

B. Part-Time Enrollment

1. The IPP provides the option of part-time enrollment for postgraduate students (PGS). The maximum duration of part-time studies may not exceed twice the normal duration, i.e., six (6) academic semesters. For part-time students, each academic semester is counted as half a semester. Students under part-time status are allowed to select two (2) out of the four (4) courses offered per semester, which they will attend and be assessed in.
2. The right to apply for part-time enrollment is granted to:
    - Working students, who must provide evidence of employment for at least twenty (20) hours per week. Required documentation includes a certificate from the employer and the public insurance institution or a valid employment contract.
    - Students facing serious difficulties in meeting the minimum requirements of full-time study, due to health conditions, family obligations, or other exceptional circumstances, as determined by the IPP's Program Commitee Program Commitee. Supporting documentation must accompany the application.
    - Students with disabilities, who must submit a formal disability certification from KEPA (Disability Certification Center) or a seven-member medical board of a public hospital.
    - Students with special educational needs, who must submit official documentation issued by the competent services.

    All supporting documents must be resubmitted at the beginning of each academic year, to confirm the continued validity of the conditions justifying part-time status.
3. Students under part-time status may return to full-time study by submitting a written request to the Program Commitee Program Commitee. No additional documentation is required for this change.
4. A formal Program Commitee Program Commitee determines the approval or rejection of the application for part-time status, as well as for the return to full-time status. This decision is forwarded to the General Assembly of the coordinating Department, which issues the corresponding confirmation act.

C. Suspension of Studies

1. In exceptional circumstances, postgraduate students may request a temporary suspension of studies for a period not exceeding two (2) consecutive academic semesters, by submitting a reasoned written request. The application must clearly state the requested suspension period and be accompanied by a sworn statement (in accordance with Law 1599/1986) explaining the grounds for suspension. These may include, but are not limited to: military service, health reasons, force majeure, personal, family, or financial reasons.
2. The request must be submitted to the Program Commitee Program Commitee of the IPP after the student has completed the registration process. In exceptional cases, and due to reasons of force majeure, the request may be submitted even after the registration period has ended. The Program Commitee may request additional supporting documents to verify the stated reasons. Suspension of studies is granted by formal decision of the Program Commitee.
3. Students who have been granted suspension for two consecutive semesters may, upon request to the Program Commitee, terminate the suspension early and return to

the program. This request must be submitted no later than two weeks before the start of the second semester of the suspension. Upon their return, students remain subject to the academic regulations and curriculum in effect at the time of their original enrollment.

D. Dismissal of Postgraduate Students

1. Decisions regarding the dismissal of postgraduate students are made by the Program Commitee Program Commitee of the Interinstitutional Postgraduate Program (IPP), following a recommendation by the Program Director. The Committee acts in accordance with the relevant provisions of the Internal Regulation of Postgraduate Studies.
2. Indicative grounds for dismissal include:
    - a written request for withdrawal submitted by the student;
    - insufficient academic progress, evidenced by lack of participation in the educational process (e.g., absence from classes, failure to sit for examinations);
    - exceeding the maximum permitted duration of studies as defined in the IPP regulations;
    - failure to meet other obligations set by the Internal Regulation of the Program;
    - conduct that violates academic integrity and ethics, as defined by applicable legislation and the Academic Code of Conduct of the Democritus University of Thrace.

6. Terms of Enrollment and Attendance

Prior to enrollment, each applicant must carefully read and accept the Regulations governing the operation of the Interinstitutional Postgraduate Program (IPP). Acceptance of the Regulations constitutes a fundamental condition for both the acquisition and maintenance of postgraduate student status.

All admitted students participate in the IPP under the terms and conditions explicitly defined in the program's regulations.

7. Library

To support both education and research, the Democritus University of Thrace operates a unified, decentralized, and autonomous Central Library Unit under the name: "Library and Information Center of DUTH." The Central Library (https://lib.duth.gr/), by decision of the university administration, is based in Komotini.

Due to the geographical distribution of the University across four cities in Thrace (Komotini, Xanthi, Alexandroupoli, and Orestiada), the Central Library is administratively organized into nine (9) Faculty Libraries and Departmental Library Units, as follows:

- Library of the Faculty of Law and the Faculty of Social, Political & Economic Sciences
- Library of the Faculty of Physical Education and Sport Science
- Library of the Department of History & Ethnology
- Library of the Department of Greek Philology
- Library of the Department of Language, Literature and Culture of the Black Sea Countries
- Library of the Polytechnic School
- Library of the Faculty of Health Sciences
- Library of the School of Education Sciences

- Library of the School of Agricultural and Forestry Sciences

Through the Central Library's website (https://lib.duth.gr), postgraduate students may search for resources (books, journals, etc.) and identify the location of materials across the different library branches, in order to proceed with borrowing. In addition, equivalent academic libraries are available at the campuses of the collaborating institutions of the IPP. The central libraries of these institutions are:

- Central Library of Aristotle University of Thessaloniki https://www.lib.auth.gr/en/b001
- Central Library of the University of Western Macedonia https://library.uowm.gr

8. Language of Instruction and Thesis Writing

The language of instruction for all courses offered in the Interinstitutional Postgraduate Program (IPP) is Greek. The Master's Thesis may be written in either Greek or English, upon request by the student and with the approval of both the thesis supervisor and the Director of the IPP. In cases where the thesis is written in English, it must be accompanied by a comprehensive summary in Greek.

9. Academic Calendar and Course Schedule

Courses in the Interinstitutional Postgraduate Program (IPP) begin in October. Each semester (fall and spring) consists of 13 weeks of instruction. At the end of each semester, there is a period of 3 to 4 weeks allocated for the evaluation and assessment of postgraduate students.

At the beginning of each semester, the course schedule is established. Each course may be taught by one or more instructors, and for every course, a course coordinator is appointed by the Program Commitee Program Commitee.

Attendance is mandatory and is monitored by the instructor(s). Students are allowed to miss up to 20% of the total contact hours for each course. In cases where absences exceed this limit due to serious reasons (excluding professional obligations), the student may submit a written request to the Program Commitee Program Commitee, which will decide whether to approve the exception.

10. Assessment

The assessment of student performance in each course and other educational activities is the responsibility of the instructor(s) and may include written or oral examinations, the preparation and/or presentation of assignments, practical exercises, or a combination of these methods. The assessment criteria for each course are communicated to students at the beginning of the semester by the course coordinator.

Courses offered in the fall semester are assessed during the January examination period, and courses offered in the spring semester during the June examination period. The September resit examination period includes assessments for courses from both semesters. Final grades are submitted after the completion of the course and its evaluation, under the responsibility of the course coordinator. Grades are officially recorded as follows:

- February and September for fall semester courses
- June and September for spring semester courses

The grading scale ranges from 0 to 10, with 5.0 as the minimum passing grade. Grades are reported with one decimal point.

In specific cases, written or oral examinations may be conducted remotely, using secure digital platforms that ensure user authentication, identity verification, and monitoring of the examination process, where necessary.

For courses where written assignments form part of the assessment, the assignment topics are announced in a timely manner, and the submission deadlines are included in the semester schedule provided to students.

If a student fails the same course more than three (3) times, they may submit a written request to the Director of the IPP to be assessed by a three-member examination committee composed of faculty members of the IPP. The original course instructor(s) may not participate in this committee. The reassessment may take place at any point during the academic year.

Examination materials (e.g., papers, assignments, answer sheets) that are not returned to students are kept on file for twelve (12) months after the end of the respective examination period.

11. Distance Learning

The educational process of the Interinstitutional Postgraduate Program (IPP) may be organized using a hybrid or blended learning model, which combines in-person instruction with synchronous distance learning methods.

Up to 60% of instruction may be delivered through synchronous online teaching. The collaborating departments provide the necessary infrastructure to support remote teaching, including videoconferencing classrooms and licensed educational software platforms for distance learning.

Each postgraduate student is required to have access to basic technological equipment, including a computer with internet access, webcam, and microphone, in order to attend classes and participate in assessment procedures. Any additional technological requirements for participation in teaching and evaluation activities will be specified in the annual call for applications issued by the IPP.

12. Curriculum Structure

The total number of European Credit Transfer and Accumulation System (ECTS) credits required for the award of the Postgraduate Diploma of Specialization (PDS) is ninety (90).

The standard duration of studies for the completion of the Interinstitutional Postgraduate Program (IPP) is three (3) academic semesters. The IPP offers three (3) specialization tracks: "*Science Education*", "*Environment and Sustainability Education*", and "*Physics Education and Educational Technology".* The structure of the curriculum for all three specialization tracks is outlined as follows:

Semester	Science Education Track	Environment and Sustainability Education Track	Physics Education and Educational Technology Track
A	Common courses for all tracks		
B	One common course		

	specialization courses	specialization courses	specialization courses
C	EITHER Master's Thesis OR Two common courses + two specialization courses	EITHER Master's Thesis OR Two common courses + two specialization courses	EITHER Master's Thesis OR Two common courses + two specialization courses

To obtain the degree, students must successfully complete all required courses during the first and second semesters (A and B), and either submit and defend a Master's Thesis, or complete all required courses offered in the third semester (C), according to the selected track.

Course Schedule and Structure

Each course consists of thirty-nine (39) instructional hours per semester, delivered through a hybrid teaching model that combines 40% in-person instruction with 60% synchronous distance learning. Courses are categorized as **Common courses** (shared across all specialization tracks), and **Specialization-specific courses**, which are further classified as **Compulsory** (required for each track), and **Optional** (students choose from a predefined list). Each semester includes two elective courses per specialization track, which are listed in separate tables following the detailed semester structure. The full course schedule of the IPP, organized by semester and specialization track, is structured as follows:

Semester A			
Applicable to all three tracks: "Science Education", "Environment and Sustainability Education", and "Physics Education and Educational Technology"			
Course Code	Course Title	Course Type	ECTS
K-1A	Psychological and Epistemological Approaches in Science and Environmental Education	Compulsory	8
K-2A	Contemporary Educational Approaches in Science and Environmental Education	Compulsory	8
K-3A	Teaching-Learning Environments in Science and Environmental Education: Design, Development & Evaluation	Compulsory	7
K-4A	Non-formal Teaching-Learning Environments in Science and Environmental Education	Compulsory	7
Total ECTS for Semester A			30

Semester B			
Science Education Track			
Course Code	Course Title	Course Type	ECTS
K-1B	Educational Research Methodology	Compulsory	8
ΔΦΕ-2Β	Contemporary Approaches and Digital Technologies in Science Education in Primary Level Education	Specialization compulsory	8
ΔΦΕ-3Β	Professional Development and Pedagogical Content Knowledge	Specialization compulsory	7
ΔΦΕ-4Β	Optional Course (one of the two optional courses in the table immediately below)	Specialization optional	7

Total ECTS for Semester B	30

Semester B			
Optional courses in Science Education Track			
Course Code	Course Title	Course Type	ECTS
ФЕТ-3В	The Laboratory Approach to the Science Teaching	Specialization optional	7
ПЕР-3В	Education for Environment and Sustainability: Contemporary Issues and Approaches	Specialization optional	7

Semester C			
Science Education Track			
Course Code	Course Title	Course Type	ECTS
ΔΙΠΛ	Master Dissertation	Compulsory	30
Total ECTS for Semester C			30

Semester C			
Science Education Track			
Course Code	Course Title	Course Type	ECTS
Κ-1Γ	Instructional Design and Contemporary Educational Activities	Compulsory	8
Κ-2Γ	Design and Development of Teaching Materials	Compulsory	8
ΔΦΕ-3Γ	Intercultural and Inclusive Approaches in Science Education	Specialization compulsory	7
ΔΦΕ-4Γ	Optional Course (one of the two optional courses in the table immediately below)	Specialization optional	7
Total ECTS for Semester C			30

Semester C			
Optional courses in Science Education Track			
Course Code	Course Title	Course Type	ECTS
ΦΕΤ-3Γ	Contemporary Science Issues and their Instruction	Specialization optional	7
ΠΕΡ-3Γ	Communication, Literacy and Public Understanding: Contemporary Issues and Approaches	Specialization optional	7

Semester B			
Environment and Sustainability Education Track			
Course Code	Course Title	Course Type	ECTS
Κ-1Β	Educational Research Methodology	Compulsory	8
ΠΕΡ-2Β	Digital Approaches to Education for Environment and Sustainability	Specialization compulsory	8
ΠΕΡ-3Β	Education for Environment and Sustainability: Contemporary Issues and Approaches	Specialization compulsory	7
ΠΕΡ-4Β	Optional Course (one of the two optional courses in the table immediately below)	Specialization optional	7
Total ECTS for Semester B			30

Semester B			
Optional courses in Environment and Sustainability Education Track			
Course Code	Course Title	Course Type	ECTS
ΦΕΤ-3Β	The Laboratory Approach to the Science Teaching	Specialization optional	7

ΔΦΕ-3Β	Professional Development and Pedagogical Content Knowledge	Specialization optional	7

Semester C			
Environment and Sustainability Education Track			
Course Code	Course Title	Course Type	ECTS
ΔΙΠΛ	Master Dissertation	Compulsory	30
Total ECTS for Semester B			30

Semester C			
Environment and Sustainability Education Track			
Course Code	Course Title	Course Type	ECTS
Κ-1Γ	Instructional Design and Contemporary Educational Activities	Compulsory	8
Κ-2Γ	Design and Development of Teaching Materials	Compulsory	8
ΠΕΡ-3Γ	Communication, Literacy and Public Understanding: Contemporary Issues and Approaches	Specialization compulsory	7
ΠΕΡ-4Γ	Optional Course (one of the two optional courses in the table immediately below)	Specialization optional	7
Total ECTS for Semester C			30

Semester C			
Optional courses in Environment and Sustainability Education Track			
Course Code	Course Title	Course Type	ECTS
ΦΕΤ-3Γ	Contemporary Science Issues and their Instruction	Specialization optional	7
ΔΦΕ-3Γ	Intercultural and Inclusive Approaches in Science Education	Specialization optional	7

Semester B			
Physics Education and Educational Technology Track			
Course Code	Course Title	Course Type	ECTS
Κ-1Β	Educational Research Methodology	Compulsory	8
ΦΕΤ-2Β	Teaching & Learning in Physics with Digital Technology	Specialization compulsory	8
ΦΕΤ-3Β	The Laboratory Approach to the Science Teaching	Specialization compulsory	7
ΦΕΤ-4Β	Optional Course (one of the two optional courses in the table immediately below)	Specialization optional	7
Total ECTS for Semester C			30

Semester B			
Optional courses in Physics Education and Educational Technology Track			
Course Code	Course Title	Course Type	ECTS
ΠΕΡ-3Β	Education for Environment and Sustainability: Contemporary Issues and Approaches	Specialization optional	7
ΔΦΕ-3Β	Professional Development and Pedagogical Content Knowledge	Specialization optional	7

Semester C			
Physics Education and Educational Technology Track			
Course Code	Course Title	Course Type	ECTS
ΔΙΠΛ	Master Dissertation	Compulsory	30
Total ECTS for Semester C			30

Semester C			
Physics Education and Educational Technology Track			
Course Code	Course Title	Course Type	ECTS
Κ-1Γ	Instructional Design and Contemporary Educational Activities	Compulsory	8
Κ-2Γ	Design and Development of Teaching Materials	Compulsory	8
ΦΕΤ-3Γ	Contemporary Science Issues and their Instruction	Specialization compulsory	7
ΦΕΤ-4Γ	Optional Course (one of the two optional courses in the table immediately below)	Specialization optional	7
Total ECTS for Semester C			30

Semester C			
Optional courses in Physics Education and Educational Technology Track			
Course Code	Course Title	Course Type	ECTS
ΠΕΡ-3Γ	Communication, Literacy and Public Understanding: Contemporary Issues and Approaches	Specialization optional	7
ΔΦΕ-3Γ	Intercultural and Inclusive Approaches in Science Education	Specialization optional	7

13. Courses and Instructors

The following table lists the courses offered in the Interinstitutional Postgraduate Program (IPP), including the course codes, titles, and the instructors responsible for each course.

Course code	Course Title	Instructors
Κ-1Α	Psychological and Epistemological Approaches in Science and Environmental Education	D. Pnevmatikos V. Tselfes N. Kanderakis C. Stefanidou G. Papageorgiou N. Zarkadis
Κ-2Α	Contemporary Educational Approaches in Science and Environmental Education	C. Psillos P. Kariotoglou E. Hatzikraniotis A. Molohidis A. Zoupidis P. Papadopoulou
Κ-3Α	Teaching-Learning Environments in Science and Environmental Education: Design, Development & Evaluation	I. Lefkos E. Petridou A. Sofianidis G. Peikos L. Manou I. Starakis N. Zarkadis
Κ-4Α	Non-formal Teaching-Learning Environments in Science and Environmental Education	P. Kariotoglou A. Molohidis G. Malandrakis M. Karnezou A. Papanikolaou
Κ-1Β	Educational Research Methodology	D. Stamovlasis A. Retali A. Markos
Κ-1Γ	Instructional Design and Contemporary Educational Activities	A. Molohidis G. Malandrakis E. Petridou
Κ-2Γ	Design and Development of Teaching Materials	I. Lefkos E. Petridou A. Sofianidis
ΔΦΕ-2Β	Contemporary Approaches and Digital Technologies in Science Education in Primary Level Education	A. Zoupidis A. Sofianidis S. Hadjileontiadou
ΔΦΕ-3Β	Professional Development and Pedagogical Content Knowledge	A. Zoupidis P. Kariotoglou M. Haitidou C. Tsaliki
ΔΦΕ-3Γ	Intercultural and Inclusive Approaches in Science Education	G. Mavrommatis A. Koutsoklenis C. Maligkoudi A. Sofianidis

		N. Stylianidou
ΠΕΡ-2Β	Digital Approaches to Education for Environment and Sustainability	P. Papadopoulou G. Malandrakis A. Papanikolaou A. Sofianidis A. Amprazis
ΠΕΡ-3Β	Education for Environment and Sustainability: Contemporary Issues and Approaches	P. Papadopoulou A. Mogias G. Malandrakis A. Papanikolaou A. Amprazis
ΠΕΡ-3Γ	Communication, Literacy and Public Understanding: Contemporary Issues and Approaches	P. Papadopoulou G. Malandrakis A. Papanikolaou A. Sofianidis A. Amprazis
ΦΕΤ-2Β	Teaching & Learning in Physics with Digital Technology	E. Hatzikraniotis A. Molohidis H. Polatoglou E. Petridou
ΦΕΤ-3Β	The Laboratory Approach to the Science Teaching	E. Hatzikraniotis A. Molohidis P. Papadopoulou S. Pavlidis C. Makri
ΦΕΤ-3Γ	Contemporary Science Issues and their Instruction	E. Hatzikraniotis A. Laskarakis A. Molohidis

IPP Instructors

A. Democritus University of Thrace		
a/a	Instructor	Research interests
1	Zarkadis Nikolaos PostDoc Researcher nikoszar@gmail.com	Conceptual understanding and factors influencing students' comprehension of the microworld. Exploration of the nature of knowledge in related scientific domains. Teaching practices for fostering the understanding of environmental issues.
2	Zoupidis Anastasios Assistant Professor azoupidis@eled.duth.gr	Inquiry-based teaching and learning environments, teacher professional development, and contemporary trends in science education curricula.
3	Koutsoklenis Athanasios Assistant Professor akoutsok@eled.duth.gr	Inclusive pedagogy and education of individuals with special educational needs.
4	Maligkoudi Christina Assistant Professor cmaligko@eled.duth.gr	Research interests include education of minority groups, issues of intercultural and inclusive education, bilingual education, and teaching of the Greek language.
5	Markos Aggelos Professor	Data analysis in the social sciences, multivariate statistical analysis, and psychometric evaluation.

	amarkos@eled.duth.gr	
6	Mavrommatis Giorgos Associate Professor gmavromm@psed.duth.gr	Minority and intercultural education, education of historical and immigrant minorities, with a focus on Greece and particularly on the issue of educating children from the minority in Thrace.
7	Mogias Athanasios Associate Professor amogias@eled.duth.gr	Education for the Protection of the Natural Environment, Environmental Education, Ocean and Climate Literacy.
8	Papageorgiou Georgios Professor gpapageo@eled.duth.gr	Chemistry with an emphasis on Chemistry Education and Organic Chemistry.
9	Hadjileontiadou Sofia Assistant Professor schatzil@eled.duth.gr	Digital technologies in educational practice, learning design, modeling and gamification in digital learning environments, educational robotics and STEAM education.

B. University of Western Macedonia		
a/a	Instructor	Research interests
10	Amprazis Alexandros PostDoc Researcher alexamprazis@hotmail.com	Education for sustainable development, learning in the natural environment, and teaching about plant organisms.
11	Kariotoglou Petros Emeritus Professor pkariotog@uowm.gr	Study of learners' cognitive structure, design, development, implementation and evaluation of Teaching and Learning Sequences, and the organization of visits to Science and Technology centers.
12	Papadopoulou Penelope Professor ppapadopoulou@uowm.gr	Biology Education, Environmental Education, and Education for Sustainability.
13	Papanikolaou Anastasios Assistant Professor apapanikolaou@uowm.gr	Environmental Education and Education for Sustainability.
14	Pnevmatikos Dimitrios Professor dpnevmat@uowm.gr	Developmental Psychology, Conceptual Development and Learning, Emotional and Moral Development, Motivation in Education, Psychology of Development.
15	Retali Anna Carolina Assistant Professor kretali@uowm.gr	Research Methodology in Educational Sciences, Factors Related to Student Performance in the PISA Programme.
16	Sofianidis Aggelos EDIP asofianidis@uowm.gr	Science Education, Pre-service Teacher Education in Early Childhood and Primary Science Teaching and Learning, Development of Inclusive Approaches to Science Teaching and Learning through the Use of Emerging Immersive Technologies, with Emphasis on Augmented Reality Technologies.

C. Aristotle University of Thessaloniki		
a/a	Instructor	Research interests
17	Laskarakis Argirios Associate Professor alask@physics.auth.gr	Physics and Materials Technology at the Nanoscale – Development of Thin Films and Nanomaterials.
18	Malandrakis Giorgos	Environmental Education, Education for Sustainability.

	Associate Professor gmalandrakis@eled.auth.gr	
19	Molohidis Anastasios Associate Professor tasosmol@physics.auth.gr	Teaching and Learning of Physics in Basic Education, Initial Teacher Education and In-Service Training, Formal and Informal Learning Contexts, Design – Development – Implementation – Evaluation of Innovative Teaching and Learning Sequences Using ICT.
20	Pavlidis Spiros Emeritus Professor pavlides@geo.auth.gr	Neotectonic Structure and Evolution of Seismically Active Regions of Greece, Paleoseismology – Seismotectonics – Archaeoseismology, Volcanotectonics, Active Tectonics – Geodynamics of the Aegean, Seismic Sea Waves (Tsunamis), History, Philosophy, and Didactics of Geosciences.
21	Petridou Eleni EDIP elepet@physics.auth.gr	Design, development, implementation, and evaluation of Teaching and Learning Sequences (TLS) in Science Education; Utilization of scientific models and ICT in the educational process.
22	Polatoglou Hariton Emeritus Professor hariton@physics.auth.gr	Study of Physics teaching and the development of advanced technology teaching tools.
23	Stamovlasis Dimitrios Professor stadi@edlit.auth.gr	Neo-Piagetian learning theories, Science education, Methodological and epistemological issues of contemporary Social Sciences related to theory construction, Application of advanced statistical methods in the analysis of Educational Research data, Nonlinear dynamics, complexity, catastrophe theory, entropy and related fields, and their application in the social and behavioral sciences.
24	Hatzikraniotis Evripidis Professor evris@physics.auth.gr	Development and evaluation of Teaching-Learning Sequences on STEM topics, Nanotechnology, inquiry-based learning and experimentation with digital media and the use of mobile devices.
25	Psillos Dimitrios Retired Professor psillos@eled.auth.gr	Modeling students' and teachers' reasoning and skills in science and ICT; development and evaluation of innovative, evidence-based teaching practices and ICT-based learning environments for the improvement of science education.

D. External collaborators		
a/a	Instructor	Research interests
26	Kanderakis Nikolaos Dr in History of Science, Teacher nikanderakis@yahoo.gr	The construction of the concept of work in mechanics: philosophers, mathematicians, and engineers in interaction.
27	Karnezou Maria Management and Coordination in the Educational Programs Department of NOESIS karnezou@noesis.edu.gr	Non-formal science education and the role of educators.

28	Lefkos Ioannis EDIP PAMAK lefkos@uom.edu.gr	Applications of Informatics and Digital Technologies in Education, Utilization of Digital Technologies, STEM Approaches, Scientific Literacy and Robotics.
29	Manou Leonidas Dr in Science Education, Teacher lmanou1@gmail.com	Nanotechnology in Education and Educational Design, Development and Evaluation of Teaching and Learning Sequences for Teacher Education in Nanotechnology.
30	Makri Kiriaki Dr in Geology Education, Teacher kmakri@geo.auth.gr	Geoscience Education, Historical Evolution of Geoscience Teaching in Greece.
31	Peikos Giorgos PostDoc Researcher UC giorgospeikos@gmail.com	Development and evaluation of Teaching-Learning Sequences, Study of conceptual change and critical thinking.
32	Starakis Ioannis EDIP EKPA gstarakakis@ecd.uoa.gr	Didactics of Physics and Astronomy, Students' conceptions, Design–Implementation–Evaluation of Teaching-Learning Sequences, The role of experimentation in teaching.
33	Stefanidou Constantina EDIP EKPA sconstant@primedu.uoa.gr	Science Education, Epistemological views of students and teachers, STEM education, Didactic use of the history of science, Informal learning in science education.
34	Stylianidou Nayia SEP member of Frederick University (Cyprus) dledu.sn@frederick.ac.cy	Universal Design for Learning, Creative Writing, Blended Learning, Augmented Reality, Teacher Professional Development, Media Literacy.
35	Tsaliki Christina Dr in Science Education, Teacher tsalikix@gmail.com	Teacher Education – Teachers' Beliefs and Practices, Study of Teachers' Instructional Design Ability in Science Education within Blended Learning Environments.
36	Tselfes Vasilis Emeritus Professor EKPA tselfesv@ecd.uoa.gr	Physics and the Application of Complexity Theory in the Human Sciences, Meta-scientific Approaches in Science Education, Adaptations of Science Teaching to Educational Environment Variables, Transformations of Science Content in Interdisciplinary Teaching and Learning Approaches – Science Curriculum Development, Scientific Knowledge and Theatrical Expression.
37	Haitidou Maria Dr in Science Education, Teacher chaitidou@gmail.com	The development of pedagogical content knowledge in science education through teachers' reflection fostered by innovative teaching and learning sequences.

14. Brief description of the courses

A. Common compulsory courses

K-1A	Psychological and Epistemological Approaches in Science and Environmental Education	8 ECTS

SPECIALIZATION	All specializations
SEMESTER	1st
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	D. Pnevmatikos, V. Tselfes, N. Kanderakis, C. Stefanidou, G. Papageorgiou, N. Zarkadis

COURSE OBJECTIVE

The course has a dual objective:

1. On the one hand, it aims to train postgraduate students in key dimensions and issues related to learning and development during school age and adolescence. Additionally, it seeks to connect basic psychological research with educational practice, particularly in science and technoscience education.
2. On the other hand, it aims to familiarize students with philosophical and epistemological perspectives, focusing on the fundamental concepts that underpin the production, structure, and teaching of scientific knowledge. The course highlights science not as a neutral and static body of knowledge, but as a dynamic, socially and historically situated process—one that is also reflected in science curricula. Through this lens, students are encouraged to think critically about the nature of science, its methodology, and the implications these have for teaching and learning.

COURSE CONTENT

In relation to the first objective:

- Thinking: Thinking as representation, problem solving, and dialogical reasoning
- Knowledge and how it is constructed
- Dual Process Theories and their implications for educational practice
- Framework theories and the conceptual change approach
- Mental models and the reorganization of knowledge
- Refutational texts
- Tools of scientific inquiry and understanding: Procedural knowledge
- Epistemic beliefs

In relation to the second objective:

- Exploration of the nature of scientific knowledge and how it is formed, transformed, and integrated into Science Curriculum Frameworks. Text analysis of Science Curriculum documents.

- Critical evaluation of theoretical models representing "practice," such as those of A. Pickering (internal perspective) and I. Hacking (external perspective). Systematic applications of these models in targeted analyses / critical readings of teaching-learning practices and Science Curricula.
- Study of the epistemological structures embedded in Curriculum Frameworks, i.e., how they represent the relationship between theory and experimentation, the role of experience and evidence, and how they are shaped by historical and social conditions.
- Introduction to a tripolar model for structuring Science Curricula (institutional, instructional, and epistemological poles).
- Analysis of how epistemological and philosophical perspectives influence instructional design, educational practices in science teaching, and learning outcomes.

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to:

- Analyze and interpret major theories of cognitive development and learning—such as conceptual change, mental models, and metacognition—and relate them to the teaching of Science.
- Evaluate thinking and problem-solving processes, emphasizing the role of creativity and metacognitive thinking in the educational process.
- Link students' epistemological beliefs to instructional practices, recognizing how their views on the nature of knowledge influence learning.
- Analyze the role of self-regulation in learning and academic achievement, understanding strategies that enhance self-regulated learning.
- Recognize the importance of emotions and socio-cognitive factors in the educational process, connecting cognitive development with interpersonal communication in the classroom.
- Apply interventions aimed at fostering students' creative and reflective thinking by designing instructional strategies grounded in research on the psychology of learning.
- Analyze and utilize scientific knowledge as a dynamic, socially and historically shaped process, deconstructing the view of science as neutral and static.
- Evaluate and transform Science Curricula through different epistemological and philosophical perspectives, identifying and connecting their institutional, instructional, and epistemological parameters.
- Select and apply appropriate theoretical models from the Sociology of Knowledge and Cultural Studies (e.g., A. Pickering, O. Patterson), Philosophy (e.g., I. Hacking, A. N. Whitehead), and Social Psychology (e.g., I. Ajzen & M. Fishbein) in the analysis of teaching and learning practices.
- Design and assess innovative science teaching and learning proposals, tailored to contemporary societal challenges (e.g., climate crisis, uncertainty management).

RECOMMENDED LITERATURE

- Πνευματικός, Δ. (2022). Εννοιολογική αλλαγή και διδασκαλία υπό το πρίσμα της Θεωρίας Πλαισίου. Psychology: *The Journal of the Hellenic Psychological Society*, 27(1), 117-122.
- Vosniadou, S. (2001). How Children Learn. Educational Practices Series-7. UNESCO

- Vosniadou, S., & Brewer, W. F. (1987). Theories of knowledge restructuring in development. *Review of Educational Research*, 57(1), 51-67.
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- Vosniadou, S. (2019, April). The development of students' understanding of science. In Frontiers in Education (Vol. 4, p. 32). Frontiers Media SA.
- Vosniadou, S., Pnevmatikos, D., Makris, N., Lepenioti, D., Eikospentaki, K., Chountala, A., & Kyrianakis, G. (2018). The recruitment of shifting and inhibition in on-line science and mathematics tasks. *Cognitive Science*, 42(6), 1860-1886.
- Καραμανίδου, Α., & Πνευματικός, Δ. (2024). Η παρέμβαση των διαισθητικών γνώσεων μέσω των θεωριών διπλής επεξεργασίας. Πανελλήνιο Συνέδριο της Διδακτικής των Φυσικών Επιστημών και Νέων Τεχνολογιών στην Εκπαίδευση, 13, 377-382.
- Χριστοδούλου, Π., & Πνευματικός, Δ. (2023). Μια διδακτική μαθησιακή ακολουθία για την προώθηση διαδικαστικής και δηλωτικής γνώσης με τη χρήση ρομπότ κοινωνικής αρωγής: Βασικές αρχές διδακτικού σχεδιασμού και η αποτελεσματικότητά τους. Πανελλήνιο Συνέδριο της Διδακτικής των Φυσικών Επιστημών και Νέων Τεχνολογιών στην Εκπαίδευση.
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- Alters, B. (1997). Whose Nature of Science? *Journal of Research in Science Teaching*, 34(1), 39–55.
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- Hacking, I. (1995). *Representing and Intervening* (12th edition). Cambridge University Press.
- Καριώτογλου, Π. και Τσελφές, Β. (2000). Αναλυτικά Προγράμματα Φυσικών Επιστημών: Επιστημολογική, Διδακτική και Θεσμική προσέγγιση. *Επιθεώρηση Φυσικής*, 31, 19-28.
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- Pickering, A. (1995). *The Mangle of Practice*. Chicago: The University Chicago Press.
- Pickering, A. (Ed). (1992). *Science as practice and culture*. The University Chicago Press.
- Psillos, D., Tselfes,V. & Kariotoglou, P. (2004), An epistemological analysis of the evolution of didactical activities in teaching-learning sequences: the case of fluids, *International Journal of Science Education*, 26, 555-578.
- Radder, H. (1996). *In and about the world*. State University Press.
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- Τσελφές, Β. (2003). Μια πρόταση για τη διδασκαλία των Εργαστηριακών Φυσικών Επιστημών στηριγμένη στην κατά Ian Hacking προσέγγιση της «εσωτερικής ζωής»

τους, στο Κ. Σκορδούλης & Λ. Χαλκιά (Επιμ.), *Η συμβολή της Ιστορίας και της Φιλοσοφίας των Φυσικών Επιστημών στη Διδασκαλία των Φυσικών Επιστημών*, Αθήνα: ΠΤΔΕ, ΕΚΠΑ, 259-271.

K-2A	Contemporary Educational Approaches in Science and Environmental Education	8 ECTS

SPECIALIZATION	All specializations
SEMESTER	1st
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	D. Psillos, P. Kariotoglou, E. Hatzikraniotis, A. Molohidis, A. Zoupidis, P. Papadopoulou

COURSE OBJECTIVE

The course aims at an in-depth exploration of key concepts related to Science Teaching. It introduces fundamental teaching concepts (such as the aims and objectives of instruction, lesson planning, organization, implementation and assessment of teaching, metacognition, the role of "errors" and their pedagogical value, etc.) and discusses contemporary approaches to teaching methodology, including inquiry-based learning, collaborative learning, problem-solving strategies, and the development of creative thinking.

COURSE CONTENT

- Elements of Constructivism – Inquiry-based Learning
- 21st Century Skills
- The Inquiry Continuum – The DIEDIA Inquiry Model
- Multiple Representations – Scaffolding
- Simulations and Virtual Laboratories
- Experimental Design – Control of Variables Strategy (CVS)
- Models and Modeling Processes
- Teaching and Learning Sequences
- Technological Pedagogical Content Knowledge (TPACK)
- The Nature of Science – The Nature of Scientific Inquiry

LEARNING OUTCOMES

After the successful completion of the course, postgraduate students will be able to:

- understand learning theories and teaching models for the design and development of instructional interventions,
- distinguish between various teaching models for instructional design,
- apply different teaching models to design innovative instructional interventions,
- design and develop instructional learning sequences,
- utilize multiple representations and evaluate their affordances by integrating them into instructional design,

- incorporate both traditional and modern tools into their teaching plans, and
- develop assessment tools for evaluating students' knowledge and skills.

RECOMMENDED LITERATURE

- D. Psillos, P. Kariotoglou (Eds) (2016) Iterative Design of Teaching Learning Sequences: Introducing the Science of Materials in European Schools. Springer, ISBN 978-94-007-7807-8.
- T. A. Mikropoulos (Ed.)(2018), Research on e-Learning and ICT in Education, Springer, https://doi.org/10.1007/978-3-319-95059-4_18
- D. Sokołowska, M. Michelini (Eds)(2018), The Role of Laboratory Work in Improving Physics Teaching and Learning, Springer, ISBN 978-3-319-96183-5
- D. F. Treagust, R. Duit, H. E. Fischer (Eds)(2017) Multiple Representations in Physics Education. Springer, ISBN: 978-3-319-58912-1
- S. Ainsworth (1999) The functions of multiple representations. Computers & Education 33, 131–152.

K-3A	Teaching-Learning Environments in Science and Environmental Education: Design, Development & Evaluation	7 ECTS

SPECIALIZATION	All specializations
SEMESTER	1st
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	I. Lefkos, E. Petridou, A. Sofianidis, G. Peikos, L. Manou, I. Starakis, N. Zarkadis

COURSE OBJECTIVE

The course introduces teaching models, conceptions of learning and motivation theory, as well as instructional strategies (inductive-hypothetical, deductive, inductive-deductive, guided inquiry, teaching of procedural knowledge). It also addresses the concept and limitations of the "teaching model" and explores the characteristics and design principles of an instructional learning sequence.

COURSE CONTENT

- Design and Development of Worksheets.
- Design and Development of Teaching Scenarios
- Didactic Transformation Transformation of Content
- Teaching-Learning Sequence (TLS)
- Design, Development, and Evaluation of TLS
- Iterativity and Transferability in Teaching-Learning Sequences

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Identify and describe fundamental teaching models and learning theories applied to Science and Environmental Education.
- Analyze and compare various instructional strategies (e.g., inductive, deductive, guided inquiry) in terms of their aims and implementation within science learning environments.
- Explain the concept and limitations of a “teaching model” and assess its appropriateness in relation to learning objectives and student characteristics.
- Apply principles of didactic content transformation to convert scientific knowledge into teachable content suitable for the classroom.
- Design comprehensive worksheets and instructional scenarios tailored to the needs of specific student groups.
- Develop Teaching-Learning Sequences (TLS) that incorporate theoretical principles, address cognitive obstacles, and emphasize procedural knowledge in science.
- Critically evaluate existing TLS in terms of their pedagogical adequacy, scientific accuracy, and transferability.
- Implement tools and methods to assess the effectiveness of instructional interventions in the field of Science Education.
- Justify their instructional decisions using learning theories and student motivation frameworks, aiming to enhance student engagement and interest in science.
- Collaborate creatively to design and improve instructional scenarios, utilizing feedback and dialogue as means of professional development.

RECOMMENDED LITERATURE

- Καριώτογλου, Π. (2006). Παιδαγωγική γνώση περιεχομένου φυσικών επιστημών. Θεσσαλονίκη: Γράφημα.
- Χαλκιά, Κ. (2012). Διδάσκοντας φυσικές επιστήμες. Αθήνα: Εκδόσεις Πατάκη.
- Καριώτογλου, Π. Π. (2021). Ο Διδακτικός Μετασχηματισμός Περιεχομένου και η Αναγκαιότητα στη Διδακτική Φυσικών Επιστημών: Ζητήματα, Ευρήματα και Προτάσεις. Έρευνα για την Εκπαίδευση στις Φυσικές Επιστήμες και την Τεχνολογία, 1(1), 39-62.
- Ζουπίδης, Α. (2012). Διδασκαλία και μάθηση με τη χρήση μοντέλων φυσικών επιστημών και τεχνολογίας: εφαρμογή στα φαινόμενα της πλεύσης και της βύθισης (Doctoral dissertation).
- Méheut, M., & Psillos, D. (2004). Teaching–learning sequences: aims and tools for science education research. International Journal of Science Education, 26(5), 515-535.
- Psillos, D., & Kariotoglou, P. (Eds.). (2015). Iterative Design of Teaching-Learning Sequences: Introducing the Science of Materials in European Schools. Springer.
- Guisasola, J., Zuza, K., Ametller, J., & Gutierrez-Berraondo, J. (2017). Evaluating and redesigning teaching learning sequences at the introductory physics level. Physical Review Physics Education Research, 13(2), 020139.
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- Viiri, J., & Savinainen, A. (2008). Teaching-learning sequences: A comparison of learning demand analysis and educational reconstruction. Latin-American Journal of Physics Education, 2(2), 1.

K-4A	Non-formal Teaching-Learning Environments in Science and Environmental Education	7 ECTS

SPECIALIZATION	All specializations
SEMESTER	1st
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	P. Kariotoglou, A. Molohidis, G. Malandrakis, M. Karnezou, A. Papanikolaou

COURSE OBJECTIVE

Basic concepts and principles of non-formal education are introduced, with emphasis on student visits to techno-scientific museums and scientific laboratories.

Postgraduate students, drawing on contemporary research (through the study and discussion of key research articles), are trained in the design, implementation, and evaluation of student visits to non-formal education settings.

COURSE CONTENT

- Museums – Techno-scientific Centers.
- The constructivist museum – Virtual museums.
- Other site visits (e.g., museums, aquariums, technology & science centers), natural environments, human-made environments, professional spaces.
- Field education (e.g., measurements, observations, interviews, photographs, audio recordings, videos).
- Activities before, during, and after the visit.
- Environmental Education Centers – Protected area management agencies.
- Evaluation and dissemination methods (e.g., posters, digital stories, blogs, websites, poster displays, tree planting)
- The role of the educator in organizing and conducting field visits
- The role of students during field visits
- Contemporary issues in field visits – Research on field trips
- Connecting teachers' views and practices in a techno-scientific museum
- Museum–School relationship (complementarity, particularities, challenges, opportunities).
- Didactic Transformation of Content in exhibits with complex theoretical background, e.g., black holes at NOESIS.

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Distinguish between formal, non-formal, and informal education.
- Recognize the importance of techno-scientific museums and scientific laboratories as spaces of non-formal learning.
- Develop the ability to analyze and discuss research articles related to non-formal education.
- Integrate findings from contemporary research into the design of visits to non-formal learning settings.
- Design and adapt activities before, during, and after educational visits in accordance with pedagogical principles and instructional goals.
- Acquire skills for evaluating the effectiveness of a student visit and for disseminating its outcomes.
- Describe pedagogical approaches applied in museums and other non-formal education contexts.
- Understand the role of technology, virtual museums, and digital storytelling in the visit experience.
- Collaborate with teachers, museum professionals, scientists, and institutions to organize educational visits.
- Develop communication skills with both students and other professionals to enhance the educational value of school visits.

RECOMMENDED LITERATURE

- Κολιόπουλος, Δ., Μέλη, Κ., Αραπάκη, Ξ., Σισσαμπέρη, Ν., Γεωργοπούλου, Π., & Παππά, Ε. (2022). *Ειδικά θέματα Διδακτικής και Μουσειολογίας Φυσικών Επιστημών*. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. http://dx.doi.org/10.57713/kallipos-55.1
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- Ματσαγγούρας, Η. (2012). *Από τη Βιωματική Μάθηση στο Συνεργατικό Μοντέλο Βιωματικών Δράσεων.*
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- Νικονάνου, Ν., Μπούνια, Α., Φιλιππουπολίτη, Α., Χουρμουζιάδη, Α., & Γιαννούτσου, Ν. (2015).
- *Μουσειακή μάθηση και εμπειρία στον 21ο αιώνα.* Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-918
- Falk, J. H. and Dierking L. D. (2013). *The Museum Experience Revisited.* Routledge. *https://doi.org/10.4324/9781315417851*
- Hein, G. E. (1998). *Learning in the Museum.* Routledge.
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- Scheersoi, A. and Tunnicliffe, S.D. (2019). *Natural History Dioramas – Traditional Exhibits for Current Educational Themes*. Springer https://link.springer.com/book/10.1007/978-3-030-00175-9
- Schroth, S.T. (2023*). Outdoor Education. A Pathway to Experiential, Environmental, and Sustainable Learning*. Palgrave Studies in Alternative Education. Palgrave Macmillan.
- *Environmental Education Research*
- *International Journal of Science Education: Part B:*
- *Journal of Environmental Education*
- *Journal of Museum Education*
- *Journal of Outdoor and Environmental Education*

K-1B	Educational Research Methodology	8 ECTS

SPECIALIZATION	All specializations
SEMESTER	2nd
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
ΔΙΔΑΣΚΟΝΤΕΣ ΤΟΥ ΜΑΘΗΜΑΤΟΣ	D. Stamovlasis, A. Retali, A. Markos

COURSE OBJECTIVE

The course aims to provide in-depth preparation and orientation for postgraduate students in both the theoretical study and practical application of fundamental research methods in the social and human sciences.

It introduces the epistemological foundations of scientific research, such as scientific explanation and prediction, formulation and testing of hypotheses, etc. It explores the main methods of data collection, including interviews, surveys, observation, sociometry, and more, and analyzes the differing functions of quantitative and qualitative methods within the logic of scientific inquiry.

Postgraduate students are trained in measurement in educational settings, the design of research processes, hypothesis testing, and the examination of research validity and reliability. They also learn to analyze research data using SPSS software.

COURSE CONTENT

- Scientific writing and principles of publication
- Qualitative educational research
- Quantitative educational research
- Literature review: search/reading

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Recognize and explain the basic epistemological principles underlying educational research and distinguish the concepts of scientific explanation and prediction.
- Systematically compare methodological approaches (quantitative, qualitative, mixed) and justify their selection based on the nature of the research questions
- Design comprehensive research protocols using appropriate data collection methods (e.g., interviews, observation, questionnaires) and justify their methodological choices.
- Formulate precise and clear research questions and hypotheses based on the theoretical framework of the study.
- Apply basic techniques of data collection, analysis, and presentation using specialized software (e.g., SPSS, Jamovi, NVivo), and interpret the results.
- Evaluate the validity, reliability, and generalizability of research findings by identifying methodological limitations and proposing improvements.
- Conduct a literature review with scientific justification, applying appropriate techniques for searching and evaluating sources in international databases.
- Develop academic writing skills, following international standards for presenting research papers and strictly adhering to academic ethics.
- Compare different research designs and select the appropriate one for specific pedagogical or social issues.
- Participate in collaborative processes of designing, implementing, and reflecting on educational research, enhancing their professional identity as researchers.

RECOMMENDED LITERATURE

- Bryman, A. (2017). *Μέθοδοι κοινωνικής έρευνας* (επιμ. Α. Αϊδίνης, μτφρ. Π. Σακελλαρίου). Αθήνα: Gutenberg.
- Creswell, J. W., & Creswell, J. D. (2019). *Σχεδιασμός, διεξαγωγή και αξιολόγηση της ποσοτικής και ποιοτικής έρευνας* (2η έκδ., μτφρ. Ν. Κουβαράκου). Αθήνα: Προπομπός.
- Ίσαρη, Φ., & Πουρκός, Μ. (2015). *Ποιοτική μεθοδολογία έρευνας: Εφαρμογές στην ψυχολογία και στην εκπαίδευση*. Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/5826
- Σταμοβλάσης, Δ., & Βαϊοπούλου, Γ. (2021). *Μεθοδολογία έρευνας στις κοινωνικές επιστήμες: Επιστημολογία, σχεδιασμός, συλλογή και ανάλυση ποσοτικών και ποιοτικών δεδομένων. Εκδόσεις Ζυγός.*
- Τσιώλης, Γ. (2014). *Μέθοδοι και τεχνικές ανάλυσης στην ποιοτική κοινωνική έρευνα*. Αθήνα: Κριτική.

Κ-1Γ	Instructional Design and Contemporary Educational Activities	8 ECTS

SPECIALIZATION	All specializations
SEMESTER	3rd
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek

COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	A. Molohidis, G. Malandrakis, E. Petridou

COURSE OBJECTIVE

The aim of the course is to familiarize postgraduate students with innovative educational initiatives and to train them in the design of such activities.

Initially, students will explore and analyze innovative educational actions implemented within various frameworks such as Erasmus programs (SciArt, STEM and Entrepreneurship), Educational Clubs (Physics and Theatre), non-formal education (Connected-Noesis), CSI-type competitions ("Playing with Science"), and interdisciplinary competitions (EOES). Subsequently, students will design their own original innovative educational activities, choosing the appropriate framework.

Additionally, they will be trained in presenting and evaluating the activities they have designed, providing well-argued justification for the anticipated benefits for students.

COURSE CONTENT

Theoretical Component:

- Introduction to Innovative Educational Activities within the framework of:
  - Erasmus Programs (SciArt, STEAM & Entrepreneurship)
  - Educational Clubs (Physics and Theatre)
  - Non-Formal Education (Connected-Noesis)
  - Competitions (CSI-type, EOES)
- Analysis of these actions through student assignments

Practical Component:

- Students collaboratively design Innovative Educational Activities
- Students present the Innovative Educational Activities they have developed

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Analyze innovative educational activities within the context of Erasmus programs, Educational Clubs, Non-Formal Education, Competitions, etc., identifying their objectives, learning benefits, and the skills and attitudes developed by students.
- Design and evaluate innovative educational activities within the framework of Erasmus programs, Educational Clubs, Non-Formal Education, Competitions, etc.
- Present and partially implement the innovative educational activities they have designed.

RECOMMENDED LITERATURE

- M.S. Khine & S. Areepattamannil (2019). *STEAM Education-Theory and Practice*, Springer, ISBN 978-3-030-04003-1
- Leah M. Melber (2007) *Informal Learning and Field Trips*, Corwin Sage Company.
- E. Weitkamp & C. Almeida (2022) *Science & Theatre: Communicating Science and Technology with Performing Arts*, Emerald Publishing, ISBN: 978-1800436411
- Κ. Καλοβρέκτης, Σ. Ψυχάρης (2017) *Διδακτική και σχεδιασμός εκπαιδευτικών δραστηριοτήτων STEM και ΤΠΕ.* Εκδ. Τζιόλας, ISBN: 9789604187065.

К-2Г	Design and Development of Teaching Materials	8 ECTS

SPECIALIZATION	All specializations
SEMESTER	1st
COURSE TYPE	Compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	I. Lefkos, E. Petridou, A. Sofianidis

COURSE OBJECTIVE

The aim of the course is to provide theoretical support and practical training for students in designing and implementing worksheets, teaching scenarios, and lesson plans under real classroom conditions.

Students are encouraged to take initiative and develop autonomy, while gradually cultivating skills in instructional design, classroom observation, comprehension, interpretation, critical analysis, synthesis, and reflection on teaching practice.

COURSE CONTENT

Postgraduate students deepen their understanding through the study of relevant literature and the writing of assignments on topics related to the architecture of teaching.
The course includes:

- the design and development of teaching materials,
- the creation of teaching scenarios, and
- the design of tools for the assessment of teaching.

LEARNING OUTCOMES

Upon successful completion of the course, postgraduate students will be able to:

- understand theories and practices for designing and developing teaching materials,
- istinguish between various instructional design models for teaching material,
- apply these instructional models to create educational content,
- transform scientific knowledge into teachable content using different design approaches,
- adapt scientific content into engaging student-centered activities,
- deepen their understanding through the study of relevant literature.

RECOMMENDED LITERATURE

- C. Hodell, ISD From the Ground Up: A No-Nonsense Approach to Instructional Design, ATD Press, 2025.
- D. J. Llewellyn, Teaching High School Science Through Inquiry and Argumentation, SAGE, 2012.
- L. Chitman-Booker, K. Kopp, The 5Es of Inquiry-Based Science, Teacher Created Materials, 2013.

- W. Harlen, Assessment & Inquiry-Based Science Education: Issues in Policy and Practice, Global Network of Science Academies (IAP) Science Education Programme, 2013.
- Κ. Χαλκιά, Διδάσκοντας Φυσικές Επιστήμες: Θεωρητικά Ζητήματα, Προβληματισμοί, Προτάσεις, Πατάκης, 2012.

B. Specialization courses

ΔΦΕ-2Β	Contemporary Approaches and Digital Technologies in Science Education in Primary Level Education	8 ECTS

SPECIALIZATION	**Science Education**
SEMESTER	2nd
COURSE TYPE	Specialization compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	A. Zoupidis, A. Sofianidis, S. Hadjileontiadou

COURSE OBJECTIVE

Postgraduate students are trained in utilizing digital technologies to create learning environments for Science Education in primary education.

COURSE CONTENT

- Digital literacy and media & technology education, including:
  - Participation and collaboration tools (e.g., Kahoot, Mentimeter),
  - Immersive technologies,
  - Expression and communication – digital and multimodal books (e.g., Storyjumper, Storyboard),
  - Visual programming environments (e.g., Scratch, Makey Makey)
  - Simulations (e.g., Algodoo),
  - Educational robotics, STEM & STEAM, 3D printing
  - Creation of alternative reality games – escape rooms,
- Instructional and learning design using contemporary approaches and technologies.

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Recognize the fundamental principles of digital literacy and media education in relation to the teaching of Science in Primary Education.
- Select and utilize appropriate digital technologies for participation and collaboration (such as Kahoot, Mentimeter) to activate and engage students in Science learning.
- Design and implement multimodal and digital narratives (via Storyjumper, Storyboard, etc.) to support students' understanding of scientific concepts.
- Operate basic visual programming environments (such as Scratch, Makey Makey) for the development of interdisciplinary STEM/STEAM activities in Science education.

- Apply educational simulations (such as Algodoo) to explore natural phenomena and enhance the experimental approach to teaching.
- Develop educational activities involving robotics, 3D printing, and other STEM/STEAM technologies tailored to the needs of Primary Education.
- Create educational games involving alternative reality and escape rooms to foster active learning and inquiry-based engagement in Science.
- Evaluate the appropriateness and pedagogical value of various digital tools and environments based on students' needs and instructional priorities.
- Design and justify complete learning scenarios and instructional sequences in Science using contemporary approaches and technologies.
- Reflect on the role of digital technologies in Science teaching, identifying challenges, opportunities, and prospects for professional development.
- Design (individually or collaboratively) small-scale research projects concerning the role of digital technologies in Science learning and teaching.
- Critically utilize the potential of generative artificial intelligence in the teaching of Science.

RECOMMENDED LITERATURE

- Yu, S., et al. (eds.) (2019). *Shaping Future Schools with Digital Technology. An international Handbook.* Series Title: Perspectives on Rethinking and Reforming Education, Springer. https://doi.org/10.1007/978-981-13-9439-3.
- Thoms, LJ., Becker, S., Kremser, E. (2023). *Teaching and Learning Physics with Digital Technologies—What Digitalization-Related Competencies Are Needed*? In: Streit-Bianchi, M., Michelini, M., Bonivento, W., Tuveri, M. (eds) New Challenges and Opportunities in Physics Education. Challenges in Physics Education. Springer, Cham. https://doi.org/10.1007/978-3-031-37387-9_21
- Leask, M., & Younie, S. (2024). *Teaching and Learning with Technologies in the Primary School* (3rd ed.). Routledge. https://doi.org/10.4324/9781003408925
- Φεσάκης, Γ., & Κωνσταντοπούλου, Α. (2022). *Σχεδιασμός τεχνολογικά ενισχυμένων εκπαιδευτικών σεναρίων για την προσχολική εκπαίδευση* [Προπτυχιακό εγχειρίδιο]. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-31.
- Σοφός, Α., Κώστας, Α., Παράσχου, Β., Σπανός, Δ., Γιασιράνης, Σ., Τζόρτζογλου, Φ., & Βρατσάλη, Ν. (2023). *Σχεδιασμοί εκπαιδευτικού υλικού & τεχνολογίες για την ψηφιακή εκπαίδευση* [Προπτυχιακό εγχειρίδιο]. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-170.
- Καρασαββίδης, Η. (2024). *Σοβαρά Ψηφιακά Παιχνίδια* [Προπτυχιακό εγχειρίδιο]. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-1039.
- Μπράτιτσης, Θ., & Καπανιάρης, Α. (2024). *Ψηφιακή αφήγηση και εκπαίδευση* [Μεταπτυχιακό εγχειρίδιο]. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-432.
- Πρακτικά συνεδρίων ΕΝΕΦΕΤ https://www.enephet.gr/index.php?page=proceedings-conferences

ΔΦΕ-3Β	Professional Development and Pedagogical Content Knowledge	7 ECTS

SPECIALIZATION	**Science Education**
SEMESTER	2nd
COURSE TYPE	Specialization compulsory Optional for the other specializations
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	A. Zoupidis, P. Kariotoglou, M. Haitidou, C. Tsaliki

COURSE OBJECTIVE

Basic concepts and principles of Pedagogical Content Knowledge are introduced, with an emphasis on curricula, teaching strategies, and the didactic transformation of content. Postgraduate students are trained in the design, implementation, and evaluation of research-based teaching scenarios.

COURSE CONTENT

- Introduction to PCK – Models of Pedagogical Content Knowledge
- The teaching framework
- Curricula
- Nature of Science and Science Education
- Teaching models and strategies (e.g., Refutation texts)
- Knowledge of reference scientific content
- Knowledge of scientific practices
- Didactic Transformation of Content (including workshop)
- Knowledge for assessment
- Teachers' professional development
- The relationship between teachers' beliefs and practices in Science Education

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Define and analyze the concept of Pedagogical Content Knowledge (PCK) and compare different models of PCK, recognizing their significance for science teaching.
- Describe and interpret the key elements of Science Education curricula and utilize them in designing teaching interventions.
- Identify the Nature of Science (NoS) and integrate relevant principles and practices into their teaching approach.
- Apply teaching models and strategies (such as controversial texts, inquiry-based learning, etc.) in instructional scenarios adapted to their students' needs.
- Analyze reference scientific content and transform this knowledge into teachable content appropriate for the classroom.
- Incorporate scientific practices (e.g., experimentation, argumentation, modeling) in the design of instructional activities.

- Design, implement, and evaluate teaching scenarios based on research-based principles, focusing on improving students' understanding of scientific concepts.
- Apply assessment principles for diagnosing, supporting, and providing feedback on students' learning in Science Education.
- Analyze the relationship between their teaching practices and their personal beliefs about teaching and learning in Science Education and develop a reflective stance to improve their professional identity.
- Design professional development plans based on contemporary approaches, recognizing the dynamic nature of PCK and the ongoing need for training and self-evaluation**.**

RECOMMENDED LITERATURE

- Capps, D. K., Crawford, B. A., & Constas, M. A. (2012). A review of empirical literature on inquiry professional development: Alignment with best practices and a critique of the findings. *Journal of Science Teacher Education, 23*(3), 291-318.
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning policy institute.
- Kennedy, M. M. (2016). How does professional development improve teaching?. *Review of educational research, 86*(4), 945-980.
- Loughran, J. (2014). Developing understandings of practice: Science teacher learning. In N. G.Lederman& S. K. Abell (Eds.), Handbook of research on science education (Vol. II, pp. 811–829). New York, NY: Routledge.
- Tsaliki, C., Papadopoulou, P., Malandrakis, G., & Kariotoglou, P. (2024). A Long-Term Study on the Effect of a Professional Development Program on Science Teachers' Inquiry. *Education Sciences, 14*(6), 621.
- Tsaliki, C., Papadopoulou, P., Malandrakis, G., & Kariotoglou, P. (2022). Evaluating inquiry practices: Can a professional development program reform science teachers' practices?. *Journal of Science Teacher Education, 33*(8), 815-836.
- Τσαλίκη, Χ. (2021). Μελέτη της ικανότητας διδακτικού σχεδιασμού εκπαιδευτικών στις Φυσικές Επιστήμες σε μικτά μαθησιακά περιβάλλοντα (Doctoral dissertation, Πανεπιστήμιο Δυτικής Μακεδονίας. Σχολή Κοινωνικών και Ανθρωπιστικών Επιστημών. Τμήμα Παιδαγωγικό Νηπιαγωγών).
- Carlson, J., Daehler, K. R., Alonzo, A. C., Barendsen, E., Berry, A., Borowski, A., ... & Wilson, C. D. (2019). The refined consensus model of pedagogical content knowledge in science education. In A. Hume, R. Cooper, & A. Borowski (Eds), *Repositioning pedagogical content knowledge in teachers' knowledge for teaching science*, 77-94. Springer Singapore. ISBN 978-981-13-5898-2 (eBook). https://doi.org/10.1007/978-981-13-5898-2
- Chaitidou, M., Spyrtou, A., Kariotoglou, P., & Dimitriadou, C. (2018). Professional Development in Inquiry-Oriented Pedagogical Content Knowledge among Primary School Teachers. *The International Journal of Science, Mathematics and Technology Learning*, *25*(2), 17-36. doi:10.18848/2327-7971/CGP/v25i02/17-36.
- Χαϊτίδου Μ. (2022). Τα Μοντέλα της Παιδαγωγικής Γνώσης Περιεχομένου Φυσικών Επιστημών: επιστημολογική προσέγγιση και συνοπτική περιγραφή. *Έρευνα για την Εκπαίδευση στις Φυσικές Επιστήμες και την Τεχνολογία*, *2*(1), 1–38. https://doi.org/10.12681/riste.31563. Διαδικτυακό ISSN: 2732-8546.

- Χαϊτίδου Μ. (2019). *Η Εξέλιξη της Παιδαγωγικής Γνώσης Περιεχομένου στις Φυσικές Επιστήμες μέσω Αναστοχασμού των Εκπαιδευτικών σε ένα Πρόγραμμα Καινοτόμων Διδακτικώ Μαθησιακών Σειρών*. Αδημοσίευτη Διδακτορική Διατριβή. Παιδαγωγικό Τμήμα Δημοτικής Εκπαίδευσης, Πανεπιστήμιο Δυτικής Μακεδονίας. doi 10.12681/eadd/46483.

ΔΦΕ-3Γ	Intercultural and Inclusive Approaches in Science Education	7 ECTS

SPECIALIZATION	**Science Education**
SEMESTER	3rd
COURSE TYPE	Specialization compulsory Optional for the other specializations
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	G. Mavrommatis, A. Koutsoklenis, H. Maligkoudi, A. Sofianidis, N. Stylianidou

COURSE OBJECTIVE

The primary aim of the course is for students to understand that different "cultures" encompass diverse forms of know-how and value systems. Subsequently, students are introduced to the key concepts and principles of intercultural education and inclusive pedagogy. Postgraduate students are trained in the design, implementation, and evaluation of learning environments, content, teaching and learning processes, etc., which are characterized by multimodality, multiculturalism, inclusivity, and differentiated instruction in the teaching of Science.

COURSE CONTENT

- On ideology and representations; Rational and non-rational interpretative frameworks of the natural world and humanity's place within it (management).
- Basic principles of intercultural education; Issues of bilingualism and science education; Case study of curriculum: Science teaching within the context of minority education for Muslim students in Thrace.
- Education and disability; Inclusive education in Science; Differentiated instruction in Science, e.g., adaptations (as changes in *how* content is taught), modifications (as changes in *what* is taught), and interventions (as intensive and targeted cultivation of a concept or skill).
- Universal Design for Learning in Science (including a workshop); The use of multimodality in inclusive science teaching – Augmented assessment approach.

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Recognize the importance of different cultural frameworks and value systems in the understanding and interpretation of the natural world.

- Analyze the basic principles of intercultural education and integrate them into the teaching of Science in primary education.
- Design and implement learning environments and instructional scenarios in Science that incorporate multiculturalism, multimodality, and inclusion.
- Apply principles of differentiated instruction in Science through adaptations, modifications, and targeted interventions, in order to address the needs of all students.
- Utilize the framework of Universal Design for Learning (UDL) to develop Science activities that promote participation and equitable access to knowledge.
- Integrate multimodal tools and practices into the teaching process to support students with diverse learning profiles and needs.
- Understand the core characteristics of inclusive education and identify ways to support students with disabilities through Science teaching.
- Develop assessment strategies (such as the Augmented Assessment Approach) that take student diversity into account and foster their active engagement in the learning process.

RECOMMENDED LITERATURE

- Μπέργκερ Π., Λούκμαν Τ., 2003, *Η κοινωνική κατασκευή της πραγματικότητας,* Αθήνα, Νήσος
- Selin, H. (Ed.). (2013). *Encyclopaedia of the history of science, technology, and medicine in non-westen cultures*. Springer Science & Business Media.
- Tomlinson, C. A. (2015). *Πώς να διαφοροποιήσουμε τη διδασκαλία σε τάξεις μεικτής ικανότητας*. Γρηγόρης.
- Βαλιαντή, Σ., & Νεοφύτου, Λ. (2017). *Διαφοροποιημένη διδασκαλία. Λειτουργική και αποτελεσματική εφαρμογή*. Πεδίο.
- Ζώνιου-Σιδέρη, Α., Λαμπροπούλου, Κ., Παπασταυρινίδου, Γ., Τσερμίδου, Λ., & Χριστοπούλου, Α. (2020). Διαφοροποιημένη παιδαγωγική & ενταξιακή εκπαίδευση: θεωρητικές επισημάνσεις, προβληματισμοί και προοπτικές. *Διάλογοι! Θεωρία και πράξη στις επιστήμες αγωγής και εκπαίδευσης, 6*, 61–76. https://doi.org/10.12681/dial.23334
- Πώς γίνεται ένα ιγκλού. https://www.youtube.com/watch?v=7jfWm2jTFf4
- Κβαντική φυσική. https://www.youtube.com/watch?v=9QSUsOkptxM&t=4s

ΠΕΡ-2Β	Digital Approaches to Education for Environment and Sustainability	8 ECTS

SPECIALIZATION	**Environment and Sustainability Education**
SEMESTER	2nd
COURSE TYPE	Specialization compulsory
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	P. Penelope, G. Malandrakis, A. Papanikolaou, A. Sofianidis, A. Amprazis

COURSE OBJECTIVE

Understanding the role of digital technologies and developing skills for selecting and creating digital materials for Environmental and Sustainability Education.

COURSE CONTENT

The course covers topics such as:

- Searching for data and sources on the Web
- Simulations in Environment and Sustainability Education
- Serious Games for the Environment and Sustainability
- Digital Footprint Calculators
- Technologies for Environmental Education (Google Maps, Google Earth, GIS)
- Participation & Collaboration Technologies
- Immersive Technologies (AR & VR)
- Tools for Creating Multimodal Books (Digital and Augmented Books)
- Alternate Reality Games and Design
- Universal Design for Learning (UDL)
- The role of Digital Technologies in inclusive teaching – STEAM approaches and inclusion.

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- Identify and evaluate digital sources and data on the internet, using them to teach issues related to the environment and sustainability.
- Use geoinformation tools to investigate, assess, and highlight environmental and sustainability issues through educational scenarios.
- Analyze simulations related to environmental and sustainability topics, and select, adapt, and integrate the most appropriate ones into learning scenarios, evaluating their effectiveness.
- Identify, design, and implement serious games within the framework of Education for the Environment and Sustainability.
- Utilize digital footprint calculators in the context of Environment and Sustainability Education.
- Develop collaborative learning environments by using digital platforms for participation, interaction, and communication.
- Integrate augmented and virtual reality technologies (AR & VR) into teaching, creating immersive educational experiences that support the understanding of environmental and sustainability issues.
- Design and create multimodal digital books (digital and augmented books), enriching the learning process through interactive and multimedia content.
- Develop and implement alternate reality games (ARGs) to support Environment and Sustainability Education.
- Apply the principles of Universal Design for Learning (UDL) in inclusive instructional planning, incorporating digital technologies and STEAM approaches to create accessible learning environments for all.

RECOMMENDED LITERATURE

- Abad-Segura, E., Gonzalez-Zamar, M. D., Rosa, A. L. D. L., & Morales Cevallos, M. B. (2020). Sustainability of educational technologies: An approach to augmented reality research. *Sustainability*, 12(10), 4091.
- CAST (2024). *Universal Design for Learning Guidelines version 3.0*. Retrieved from https://udlguidelines.cast.org
- Γκότζος, Δ., Γρίλλια, Π., Παπανικολάου, Α., Γαβριλάκης, Κ., Λιαράκου, Γ., Μεγάλου, Ε., Παρταλά, Ό. (2017). *Περιβαλλοντική Αδικία: Μια παιδαγωγική προσέγγιση με την αξιοποίηση της Ψηφιακής Αφήγησης*. Πάτρα: Ινστιτούτο Τεχνολογίας Υπολογιστών & Εκδόσεων (ΙΤΥΕ) «Διόφαντος». ISBN 978-960-06-5655-8.
- Collins, A., Galli, A., Patrizi, N., & Pulselli, F. M. (2018). Learning and teaching sustainability: The contribution of Ecological Footprint calculators. *Journal of cleaner production*, 174, 1000-1010.
- Czok, V., Krug, M., Müller, S., Huwer, J., & Weitzel, H. (2023). Learning effects of augmented reality and game-based learning for science teaching in higher education in the context of education for sustainable development. *Sustainability*, 15(21), 15313.
- De la Torre, R., Onggo, B. S., Corlu, C. G., Nogal, M., & Juan, A. A. (2021). The role of simulation and serious games in teaching concepts on circular economy and sustainable energy. *Energies*, 14(4), 1138.
- Ho, S. J., Hsu, Y. S., Lai, C. H., Chen, F. H., & Yang, M. H. (2022). Applying game-based experiential learning to comprehensive sustainable development-based education. *Sustainability*, 14(3), 1172.
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- Environmental Education Research
- Journal of Environmental Education
- Journal of Outdoor and Environmental Education

ΠΕΡ-3Β	Education for Environment and Sustainability: Contemporary Issues and Approaches	7 ECTS

SPECIALIZATION	**Environment and Sustainability Education**
SEMESTER	2nd
COURSE TYPE	Specialization compulsory Optional for the other specializations
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses

COURSE INSTRUCTORS	P. Papadopoulou, A. Mogias, G. Malandrakis, A. Papanikolaou, A. Amprazis

COURSE OBJECTIVE

Strengthening teachers' awareness and capacity to act on environmental and sustainability issues within the framework of their professional educational practice.

COURSE CONTENT

Thematic areas of the course include:

- The historical development of Environment Education and Education for Sustainability
- The 17 United Nations Sustainable Development Goals (SDGs)
- Major environmental issues (biodiversity, water, energy, climate, etc.)
- The family of environmental footprints: the ecological footprint
- Teachers' competences for Education for Sustainability
- Transversal (Soft Skills)
- Teaching values: The VAKE (Values and Knowledge Education) strategy
- Gender issues, intercultural issues, and sustainability
- SDG 4, 5, 10 and Inclusive Education
- Environmental citizenship

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- recognize the historical development of Environment and Sustainability Education, understanding its core principles, theories, and key milestones
- critically interpret the 17 United Nations Sustainable Development Goals (SDGs), linking them to current environmental, social, and economic issues within the framework of Environment and Sustainability Education
- investigate major environmental issues (such as biodiversity, water, climate, energy, pollution) and evaluate their causes, impacts, and potential solutions in the context of Environment and Sustainability Education
- apply sustainability indicators such as environmental footprints (e.g., ecological, carbon, water) within Environment and Sustainability Education
- cultivate sustainability competences in the context of Environment and Sustainability Education
- develop transversal (soft) skills related to sustainability and integrate them into educational practices
- recognize the importance of values in Environment and Sustainability Education and incorporate the VaKE (Values and Knowledge Education) method
- address gender and intercultural issues in relation to sustainability across diverse educational settings
- connect the UN SDGs with inclusive education practices by designing and implementing teaching methodologies that support the participation of all learners
- design and adapt activities that promote environmental citizenship

RECOMMENDED LITERATURE

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implementing ESD at the school level. *Environmental Education Research*, 28(12), 1691-1729.
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- Δημητρίου, Α. (2009). *Περιβαλλοντική Εκπαίδευση: περιβάλλον, αειφορία. Θεωρητικές και παιδαγωγικές προσεγγίσεις*. Επίκεντρο.
- Δημητρίου, Α. (2023). Από τη «Σιωπηλή άνοιξη» στους «17 Στόχους για την Αειφόρο Ανάπτυξη». Αποτυπώνοντας τη διαχρονική διαδρομή της Εκπαίδευσης για το Περιβάλλον και την Αειφορία. Περιβαλλοντική Εκπαίδευση για την Αειφορία, 5(1), 11-33.
- Φλογαΐτη, Ε., Λιαράκου, Γ., & Γαβριλάκης, Κ. (2021). *Συμμετοχικές μέθοδοι διδασκαλίας και μάθησης: Εφαρμογές στην εκπαίδευση για το περιβάλλον και την αειφορία*. Πεδίο.
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental Education Research*, 8(3), 239-260.
- Leite, S. (2022). Using the SDGs for global citizenship education: Definitions, challenges, and opportunities. *Globalisation, Societies and Education*, 20(3), 401-413.
- Λιαράκου, Γ. (2023). Οι παιδαγωγικοί στόχοι της Εκπαίδευσης για το Περιβάλλον και την Αειφορία. *Περιβαλλοντική Εκπαίδευση για την Αειφορία*, 5(1), 34-47.
- Μανωλάς, Ε. (Επιμ.) (2017). *Περιβαλλοντική Κοινωνιολογία*. Gutenberg. ISBN: 9789600118414.
- Μανωλάς, Ε. (Επιμ.) (2021). *Η Περιβαλλοντική σκέψη στον 20ο αιώνα*. Δίσιγμα. ISBN: 9786182020562.
- Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. Sustainability, 9(10), 1889.
- Rieckmann, M. (2018). Learning to transform the world: Key competencies in Education for Sustainable Development. *Issues and trends in education for sustainable development*, 39(1), 39-59.
- Van Poeck, K., Vandenplas, E., & Östman, L. (2024). Teaching action-oriented knowledge on sustainability issues. *Environmental Education Research*, 30(3), 334-360.
- Weyringer, S., Patry, J. L., Pnevmatikos, D., & Børhaug, F. B. (2022). *The VaKE handbook: Theory and practice of values and knowledge education* (Vol. 18). Brill.
- Environmental Education Research
- Journal of Environmental Education
- Journal of Outdoor and Environmental Education

ΠΕΡ-3Γ	Communication, Literacy and Public Understanding: Contemporary Issues and Approaches	7 ECTS

SPECIALIZATION	**Environment and Sustainability Education**
SEMESTER	3rd
COURSE TYPE	Specialization compulsory

	Optional for the other specializations
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	P. Papadopoulou, G. Malandrakis, A. Papanikolaou, A. Sofianidis, A. Amprazis

COURSE OBJECTIVE

Understanding the importance of effective environmental communication, developing relevant skills, and addressing challenges in order to better inform, engage, and mobilize diverse audiences and communities on issues and approaches related to Environmental Sciences.

COURSE CONTENT

Thematic content of the course includes:

- Public understanding of science & environmental awareness
- Citizen science: participation and barriers
- Representations of the environment and environmental crisis in the media
- Social movements and collectives (grassroots, social networks, NGOs)
- Open science
- Communication strategies on environmental and sustainability issues
- Communication techniques for environmental topics
- Media literacy and education for the environment and sustainability (e.g., greenwashing)
- Socio-scientific issues (SSI)
- Argumentation in scientific and socio-scientific contexts
- Issues of responsible research and innovation (RRI)

LEARNING OUTCOMES

Upon successful completion of the course, participants will be able to:

- understand the role of public understanding of science in promoting environmental awareness among diverse audiences,
- recognize the importance of citizen science in advancing sustainability,
- acquire skills to assess perceptions of living organisms and nature,
- investigate environmental risks and evaluate alternative approaches for effectively informing the public,
- critically analyze the role of the media in shaping knowledge, perceptions, and attitudes toward the environment and environmental crisis,
- evaluate the actions of social movements and grassroots collectives,
- utilize the potential of Open Science,
- design, implement, and assess communication strategies on environmental and sustainability issues, using appropriate techniques, tools, and media for effective message dissemination,
- analyze phenomena of misinformation related to environmental and sustainability issues (e.g., greenwashing),

- construct effective argumentation in scientific and socio-scientific contexts (Socio-scientific Issues – SSI),
- adopt principles and processes of Responsible Research and Innovation (RRI).

RECOMMENDED LITERATURE

- Álvarez-García, O., & Sureda-Negre, J. (2023). Greenwashing and education: An evidence-based approach. *The Journal of Environmental Education*, 54(4), 265-277.
- Amprazis, A., & Papadopoulou, P. (2020). Plant blindness: a faddish research interest or a substantive impediment to achieve sustainable development goals?. *Environmental Education Research*, 26(8), 1065-1087.
- Armstrong, A. K., Krasny, M. E., & Schuldt, J. P. (2018). *Communicating climate change: A guide for educators*. Cornell University Press.
- Brereton, P. (2022). Essential Concepts of Environmental Communication: An A–Z Guide. Routledge.
- Γαβριλάκης, Κ. (2023). Συνεργασία σχολείου και κοινότητας προς την αειφορία. *Περιβαλλοντική Εκπαίδευση για την Αειφορία*, 5(1), 218-233.
- Daskolia, M. (Ed.) (2023). *Environmental Education for Sustainability and Citizen: Science Integrating environmental Citizen Observatories into school educational practice*. National & Kapodistrian University of Athens Press. ISBN: 978960-466-306-4
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- Haklay, M., Dörler, D., Heigl, F., Manzoni, M., Hecker, S., Vohland, K., ... & Perelló, J. (2021). What is citizen science? The challenges of definition. *The science of citizen science*, 13(1), 34-51.
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- Malandrakis, G., Papadopoulou, P., Gavrilakis, C., & Mogias, A. (2019). An education for sustainable development self-efficacy scale for primary pre-service teachers: Construction and validation. *The Journal of Environmental Education*, 50(1), 23-36.
- Μανωλάς, Ε. (Επιμ.) (2020). *Πράσινες Μη Κυβερνητικές Οργανώσεις στο Παγκόσμιο Σύστημα*. Θεσσαλονίκη: Δίσιγμα. ISBN: 9786185242831.
- Papadopoulou, P., & Athanasiou, K. (2015). Children ideas for "animal" compared to teachers' conceptions. *International Journal of Innovation and Research in Educational Sciences*, 2(6), 462-471.
- Τσαμπούκου - Σκαναβή, Κ. (2004). *Περιβάλλον και Επικοινωνία: Δικαίωμα στην επιλογή*. Αθήνα: Καλειδοσκόπιο. ISBN: 9789607846443.
- Environmental Education Research
- Journal of Environmental Education
- Environmental Communication

ΦΕΤ-2Β	Teaching & Learning in Physics with Digital Technology	8 ECTS

SPECIALIZATION	**Physics Education and Educational Technology**
SEMESTER	2nd
COURSE TYPE	Specialization compulsory

PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	E. Hatzikraniotis, A. Molohidis, C. Polatoglou, E. Petridou

COURSE OBJECTIVE

The aim of the course is to introduce and train students in the use of digital technologies in experimental science teaching.

Postgraduate students will explore various types of digital technologies that can support experimental instruction, including computer-based and computer-assisted experiments. They will also become familiar with contemporary technologies such as microcontroller-based experiments, smartphone-based experimentation, Internet of Things (IoT) applications, Web 2.0 tools, and MOOC platforms.

Students will be trained to use digital technologies—such as simulations, virtual labs, sensor-based experiments, video analysis, and remote experiments—to design and implement experimental learning environments.

COURSE CONTENT

- Digital Literacy
- Teaching & Learning with Digital Technologies I: Methodologies such as Computer-Supported Collaborative Learning (CSCL), Problem-Based Learning (PBL), Project-Based Learning, STEM-Based Learning, and Game-Based Learning.
- Teaching & Learning with Digital Technologies II: Techniques such as Microcomputer-Based Laboratories (MBL), Mobile-Based Learning, and Modelling-Based Learning.
- Teaching & Learning with Digital Technologies III: Tools including Virtual Reality (VR), Augmented Reality (AR), ChatGPT, Scratch, and Educational Robotics.
- Technologies for Participation & Collaboration
- Laboratory Activities exploring the different dimensions of Digital Technologies.

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to:

- Utilize various forms of digital technologies in experimental science teaching, such as computer-based and computer-simulated experiments.
- Employ digital tools—including simulations, virtual labs, sensor-based experiments, video measurements, and remote experimentation—for the design of experimental learning environments.
- Become familiar with contemporary technologies such as microcontroller-based experiments, smartphone-based applications, Internet of Things (IoT), Web 2.0 tools, and MOOC platforms.

RECOMMENDED LITERATURE

- Σ. Δημητριάδης, *Θεωρίες Μάθησης & Εκπαιδευτικό Λογισμικό,* Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών, 2015
- J. Kuhn, P. Vogt, *Smartphones as Mobile Minilabs in Physics*, Springer, 2022

- J. Antony, *Design of Experiments for Engineers and Scientists*, Elsevier, 2003
- S. Staacks, S. Hütz, H. Heinke and C. Stampfer, *Advanced tools for smartphone- based experiments: phyphox*, Phys. Educ. 53 (2018) 045009
- Th. Pierratos, H.M. Polatoglou, *Utilizing the phyphox app for measuring kinematics variables with a smartphone,* Phys. Educ. 55 (2020) 025019

ΦΕΤ-3Β	The Laboratory Approach to the Science Teaching	7 ECTS

SPECIALIZATION	**Physics Education and Educational Technology**
SEMESTER	2nd
COURSE TYPE	Specialization compulsory Optional for the other specializations
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	E. Hatzikraniotis, A. Molohidis, P. Papadopoulou, S. Pavlidis, K. Makri

COURSE OBJECTIVE

The aim of the course is for postgraduate students to deepen their understanding of topics such as measurements and errors in the school laboratory and their didactic use, different aspects and stages of experimentation, experimental methodology, and the role of the worksheet.

Postgraduate students will practice designing worksheets for various types of experiments (demonstration, discovery-based, inquiry-based, collaborative) and across the stages of experimentation (hypothesis formulation, experimental design, measurement, data handling, parameterization, conclusion).

COURSE CONTENT

- Design and Development of Worksheets in Experimental and Laboratory Teaching
- Types of experiments: real, YouTube-based, simulated, and video experiments
- Laboratory and Experimental Teaching in Physics
- Laboratory Teaching in Chemistry
- Laboratory Teaching in Geography and Geology
- Laboratory Teaching in Astronomy
- Laboratory Teaching in Environmental Sciences
- Laboratory Teaching in Biology

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to:

- Explore in depth issues such as measurements and errors in the school laboratory.
- Effectively incorporate the aspects and stages of experimentation into teaching.
- Apply the experimental methodology in educational settings.
- Develop worksheets for various types of experiments (demonstration, discovery-based, inquiry-based, cooperative/group experiments).

- Implement the different stages of experimentation (hypothesis, experimental design, measurements, data management, parameterization, conclusion).

RECOMMENDED LITERATURE

- Β. Γκάγκας, *Οδηγός Εργαστηριακών Ασκήσεων για το μάθημα «Διδασκαλία & Μάθηση με Ψηφιακές Τεχνολογίες»*, Εργαστηριακές σημειώσεις,ΠΜΣ «Διδακτική της Φυσικής & Εκπαιδευτική Τεχνολογία, ΑΠΘ, 2022.
- M. W. Hackling, *Working Scientifically: Implementing and Assessing Open Investigation Work in Science,* Department of Education and Training, Western Australia, 2005
- J. Haysom, M. Bowen, Predict-Observe-Explain: Activities Enhancing Scientific Understanding, NSTA Press, 2010
- Y. Kraftmakher*, Experiments & Demonstrations in Physics*, World Scientific Publishing, 2015
- *Εργαστηριακοί Οδηγοί PASCO Scientific για τα διάφορα γνωστικά αντικείμενα: Advanced Physics through Inquiry / Advanced Chemistry Through Inquiry / Advanced Biology Through Inquiry / Middle School Life Science Teacher Guide / Middle School Earth Science Teacher Guide* (2014)

ΦΕΤ-3Γ	Contemporary Science Issues and their Instruction	7 ECTS

SPECIALIZATION	**Physics Education and Educational Technology**
SEMESTER	3rd
COURSE TYPE	Specialization compulsory Optional for the other specializations
PREREQUISITE COURSE	None
LANGUAGE OF INSTRUCTION & ASSESSMENT	Greek
COURSE WEBSITE	https://eclass.duth.gr/courses
COURSE INSTRUCTORS	E. Hatzikraniotis, A. Laskarakis, A. Molohidis

COURSE OBJECTIVE

The aim of the course is to familiarize students with contemporary topics in Physics, in order to develop their ability to transform this content for educational purposes.

Postgraduate students will engage in in-depth study of the relevant literature and, through their assignments, will identify the fundamental principles, concepts, and ideas of each area, and will transform this content into teachable form.

COURSE CONTENT

- Introduction to the Scientific Content of Contemporary Topics in Physics & Technology (Complexity & Chaos, Nanoscience & Nanotechnology, Biomimetics, etc.)
- Theories of Didactic Transformation of Scientific Content
- Laboratory Exercise on Scanning Electron Microscopy (SEM)
- Practical Exercises on transforming scientific content into teachable formats appropriate for different levels of education.

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to:

- Demonstrate knowledge of theories and practices related to the transformation of scientific content for teaching purposes across various educational levels.
- Understand the fundamental principles, concepts, and ideas of each domain (e.g., Complexity & Chaos, Nanoscience & Nanotechnology, Biomimetics).
- Transform scientific content in contemporary Physics topics such as Nanoscience & Nanotechnology or Biomimetics into teachable material.
- Apply content transformation to create student-appropriate activities related to Physics topics such as Nanoscience & Nanotechnology or Biomimetics.
- Deepen their understanding of the subject matter through the study of relevant literature.

RECOMMENDED LITERATURE

- Λ. Μάνου, Ανάπτυξη & Αξιολόγηση Διδακτικών-Μαθησιακών Προσεγγίσεων για την Εκπαίδευση Εκπαιδευτικών στη Νανοτεχνολογία, Διδακτορική Διατριβή, Πανεπιστήμιο Δυτικής Μακεδονίας, 2019.
- C. Binns. Introduction to Nanoscience & Nanotechnology, Willey, 2010.
- S Bhusham, Biomimetics: Bioinspired Hierarchical-Structured Surfaces for Green Science and Technology, Springer, 2016.
- Y. Stevens L-A. M. Sutherland, J. S. Krajcik, The big ideas of nanoscale science & engineering: a guidebook for secondary teachers, NSTA Press, 2009.
- R. Duit, Science Education Research Internationally: Conceptions, Research Methods, Domains

15. Master Thesis (MT)

The Master's Thesis (MT) must fall within the scientific scope of the Interinstitutional Postgraduate Program (IPP) and should make use of the knowledge, skills, attitudes, and competencies acquired during the coursework. At the end of the second semester, under the responsibility of the IPP Director, a list of proposed thesis topics is prepared and announced. Postgraduate students are then invited to submit their preferences to the IPP Secretariat.

The Director of the IPP reviews all submitted applications and matches postgraduate students with appropriate thesis topics and supervisors. Subsequently, each student, in collaboration with their supervisor, defines the proposed title of the Master's Thesis and submits an abstract of the proposed work. The IPP Program Committee (PC) officially assigns the thesis project to each student and appoints a three-member examination committee, which includes the supervisor. The supervision of Master's Theses is governed by the provisions outlined in Article 8, paragraphs 3, 4, and 5 of the present Regulation.

The duration of the Master's Thesis (MT) may not be shorter than one academic semester. A postgraduate student who fails to submit the relevant application within the specified deadline postpones, under their own responsibility, the commencement of the thesis work by at least one semester.

During the course of the thesis, the IPP Program Committee (PC) may proceed with the replacement of the supervisor if there is an objective inability to continue the supervision or if there is a compelling reason.

The Master's Thesis (MT) is written in the Greek language and must be accompanied by a short abstract of approximately 300 words in either English, French, or German. Following consultation with the supervisor and approval by the IPP Program Committee (PC), the thesis may be written in English, provided it includes an extended abstract in Greek describing the methodology and main findings of the work. Upon final submission of the MT, the initial pages must indicate the institution and the Interinstitutional Postgraduate Program (IPP) under which the thesis was completed, the name of the supervisor, and the members of the examination committee, along with their academic titles and ranks.

The text of the Master's Thesis (MT) must comply with the specifications and structure of a scientific paper. It should include a description of the research topic, presentation of findings or results, methodology, assumptions, references, and any other necessary supporting or explanatory elements (such as required figures, diagrams, photographs, images, etc.).

Upon completion of the Master's Thesis (MT), the student shall submit final copies of the thesis to the supervisor and the other two members of the Three-Member Examination Committee, along with the plagiarism report generated by the plagiarism detection software (Turnitin) provided by the university's central library. At the same time, the student must submit to the committee a signed declaration stating that the MT is their own original work and not the result of plagiarism, either in whole or in part.

Following a thorough review of the thesis, the Three-Member Examination Committee sets the date for the public defense/evaluation of the Master's Thesis (MT).

After the presentation and defense of the MT, the Examination Committee submits the final grade to the Secretariat, along with the student's signed declaration stating that the MT is their own original work and not the result of plagiarism, either in whole or in part. In the event of a negative evaluation, the student has the right, in the following academic year, to change both the topic and the supervisor.

The final, complete version of the MT, in both printed and electronic form, must be submitted to the Library of Democritus University of Thrace and to the departmental archive.

16. Rights and Benefits

Postgraduate students are entitled to the same rights, benefits, and services as undergraduate students, with the exception of the right to receive free textbooks (in accordance with Law 4485/2017, Article 34, Paragraph 3).

More specifically, postgraduate students:

- Have the right to use the email services of the Democritus University of Thrace (DUTH).
- Have access to the libraries of DUTH and the partner institutions, as well as to electronic journal subscriptions and other online resources through their institutional accounts.
- May use the infrastructure and laboratory equipment of the cooperating departments, in consultation with their thesis supervisor, for the purposes of coursework and the preparation of their Master's Dissertation.
- Are entitled to participate, in accordance with applicable legislation, in the collective governance bodies.
- May take part in research projects/programs of the partner institutions and receive compensation for their contributions within co-funded, self-funded, or other funded research schemes.
- May participate in mobility programs such as ERASMUS+, or in other mobility-related actions (e.g. project-based participation or scholarship programs).

The Interinstitutional Postgraduate Program (IPP) actively ensures equal access for postgraduate students with disabilities and special educational needs. It provides appropriate accommodations and adjustments to facilitate their participation in the educational process and the successful completion of their studies.

17. Obligations of Postgraduate Students

Postgraduate students enroll in and participate in the Interinstitutional Postgraduate Program (IPP) under the terms and conditions set forth in the program's Regulations. Acceptance of these terms is a fundamental requirement for obtaining and maintaining the status of a postgraduate student.

Postgraduate students of the Interinstitutional Postgraduate Program (IPP) are required to:

- attend all courses offered as part of the IPP curriculum;
- submit required assignments within the specified deadlines;
- participate in examinations as scheduled;
- observe the principles of academic integrity, show respect for the facilities and equipment of the collaborating institutions, maintain cleanliness and order, and report any issues to their academic supervisor or the Director of the IPP;
- be fully informed of and comply with the Academic Code of Integrity, the Internal Regulations, and all decisions made by the official bodies of the IPP that pertain to them;
- stay informed about the IPP structure, the academic calendar, and the educational procedures in place;
- fulfill all obligations toward the IPP and represent and promote the program and its partner institutions through their academic activities;

- actively engage with the international academic community by attending conferences, symposia, and seminars;
- participate in academic events (seminars, conferences) organized by the IPP and/or its partner departments;
- cite their affiliation with the IPP in all publications, presentations, or communications resulting from their academic work in the program;
- pay tuition fees as outlined in the present Regulation.

In the event that a postgraduate student fails to fulfill their obligations, a written reminder is issued by the Director of the IPP, with a copy forwarded to the IPP's Program Committee (PC). If, after a reasonable period of time, the student still fails to comply, the SC may decide to proceed with the student's removal from the official registry of postgraduate students in the program.

18. Tuition Fees

The collection of tuition fees is deemed necessary for covering the operational costs of the Interinstitutional Postgraduate Program (IPP), as outlined in the official budget published in the Government Gazette (FEK) establishing the program.

Tuition fees amount to eight hundred euros (€800) per semester and are payable at the beginning of each semester. For the standard duration of three semesters, the total tuition fees amount to two thousand four hundred euros (€2,400).

In the event of interruption or suspension of studies, tuition fees already paid are non-refundable but are credited toward the continuation of studies at the IPP.

Payment of tuition fees may be made either by the student or by a third party (individual or legal entity) on behalf of the student and is deposited into the Special Account for Research Funds (ELKE) of the Democritus University of Thrace, which is responsible for their management. The IPP provides the possibility of tuition fee exemption, in accordance with current legislation.

19. Scholarships

Subject to financial availability, the Interinstitutional Postgraduate Program (IPP) may award scholarships and excellence awards to postgraduate students. The maximum number of scholarships may reach up to 30% of enrolled students per semester. The Steering Committee (SC) is responsible for determining the number of scholarships awarded, the grading algorithm based on objective academic criteria, and the selection of eligible full-time students.

The following indicative criteria may be used in the scholarship evaluation algorithm:

- Academic criteria: For students in their first semester, the admission ranking score is considered. For students in later semesters, eligibility requires having successfully passed all previous courses, and the grade point average (GPA) is considered.
- Financial criteria: The taxable income (individual or family) is assessed according to the applicable regulations regarding dependent family members.
- Social criteria: Based on individual status (e.g., divorced dependents, person with disabilities), or family status (e.g., child of a large or single-parent family, orphan of both parents under the age of 25, or having siblings concurrently enrolled in undergraduate or postgraduate programs).

- Service to the IPP: The student's potential contribution to the program (e.g., grading assistance, examination invigilation, support for computer labs or teaching infrastructure) is also considered.

Excellence awards are granted exclusively based on academic criteria, which may include (but are not limited to) those listed above, as well as scientific publications, conference presentations, awards, and honors.

The procedure for awarding scholarships or excellence awards is as follows:

- Following a recommendation by the Steering Committee (SC), an official call for applications is published, inviting eligible students to apply for scholarships or excellence awards. Applicants must complete all required fields in the application form and submit the necessary supporting documents, as specified in the call, to the Secretariat of the IPP within the deadlines stated in the announcement. The application form serves as a formal declaration under Greek Law 1599/1986.
- The Steering Committee (SC) evaluates and ranks all applications based on the pre-established criteria and compiles a list of eligible candidates.

20. Intellectual Property and Academic Integrity

All assignments and the Master's Thesis submitted by postgraduate students within the framework of the IPP must be entirely their own intellectual work, in full compliance with the principles of academic integrity. Students are formally informed, at the beginning of their studies in the IPP, about the rules of academic conduct and the relevant regulations on intellectual property rights.

The intellectual property rights of the Master's Thesis or any other academic work submitted within the framework of the Interinstitutional Postgraduate Program (IPP) belong to the postgraduate student and are protected under the Greek Copyright Law (Law 2121/1993), as well as all other relevant and current legislation. In cases where the work results from collaboration with the thesis supervisor, course instructor(s), and/or other researchers, the intellectual property rights of the published or unpublished results are jointly held by the involved parties, in accordance with principles of scientific ethics. These individuals also retain the right to co-author and publish the results in scientific journals. Additionally, any potential patent rights or opportunities for commercial exploitation of the Master's Thesis or other academic work are protected under Law 2121/1993 and are jointly held by the postgraduate student, the supervisor, the collaborating researchers, and the IPP itself.

An inviolable principle of academic integrity for all postgraduate students is the strict avoidance of plagiarism or copying in the preparation of any assignments or written work throughout the duration of their studies. When submitting a Master's Thesis or any other academic assignment in the context of the IPP, students are obliged to explicitly acknowledge whether they have partially or fully used the work or ideas of others. The unauthorized use of intellectual work created by third parties and its presentation as one's own is strictly prohibited. Likewise, students are forbidden to submit collaborative work as individual submissions, without full and accurate disclosure of co-authorship.

The following actions are considered forms of plagiarism or academic misconduct**:** the intentional use of substantial portions of another person's work, the reuse of assignments that have already been submitted for credit in another course or academic program, and the submission of AI-generated content presented as original work, with the aim of receiving a grade or academic credit to which the student is not rightfully entitled.

Plagiarism is defined as the copying of another person's work, in whole or in part, without proper attribution. It also includes the use of any portion of another person's work without appropriate citation. Furthermore, the inclusion of any supporting material or documentation, even from studies in which the student has participated, without explicit reference, constitutes an act of plagiarism.

Plagiarism and copying are considered serious academic offenses and may result in penalties ranging from grade reduction to assignment nullification (grade of zero). The instructors of each course are responsible for identifying incidents of plagiarism or unauthorized copying. In cases of repeated offenses, despite prior warnings, instructors must notify the Director of the IPP, who refers the case to the Program Commitee Program Commitee for disciplinary action. If the violation is discovered after graduation, the Program Commitee initiates procedures for the revocation of the awarded Postgraduate Diploma of Specialization.