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"

A9.
COURSE OUTLINES

MARCH 2025

Table of Contents

Introduction

The Interinstitutional Postgraduate Program (IPP) offers three (3) specialization directions: *Science Education*, *Physics Education & Educational Technology*, and *Environment and Sustainability Education.* Postgraduate students enroll in one specialization pathway, which cannot be changed after enrollment.

1. The detailed curriculum for each direction, including course descriptions, is published on the official website of the IPP.

2. The total number of ECTS (European Credit Transfer and Accumulation System) credits required to obtain the IPP diploma is ninety (90), distributed evenly across the three (3) semesters of study. In the first semester, all students attend a common core of courses regardless of their specialization. In the second semester, students attend specialization-specific courses. The Master's Thesis (MT) is optional. Students may complete the program and graduate either: a) by attending courses during all three semesters (90 ECTS from coursework), or b) by attending courses during the first two semesters (60 ECTS) and completing a Master's Thesis (30 ECTS) in the third semester. The thesis must be publicly defended and positively evaluated.

3. Each semester-long course includes thirty-nine (39) teaching hours. The program follows a blended learning model, with 40% face-to-face and 60% distance learning sessions.

4. Changes in course content are permitted within the framework defined by current legislation and the Government Gazette (FEK) that established the IPP.

5. The Program Director is responsible for organizing the official teaching schedule.

6. Attendance is mandatory for all lectures and classes. Instructors are required to keep attendance records. Students who attend less than 80% of a course's sessions are not eligible for assessment in that course.

7. The language of instruction is Greek. If a visiting professor is from abroad, the course may be taught in English. Notes and bibliography may also be provided in English.

8. Each course is completed over 13 weeks.

1st SEMESTER COURSES

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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION			
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education			
LEVEL OF STUDIES	IPP - LEVEL 7			
COURSE CODE	**K-1A**	**SEMESTER**	**1ST**	
COURSE TITLE	**Psychological and Epistemological Approaches in Science and Environmental Education**			
INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*			**WEEKLY TEACHING HOURS**	**ECTS**
Lectures			3	8
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.				
TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND common compulsory course for all specializations			
PREREQUISITE COURSES:	NONE			
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK			
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses			

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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).

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

Course objective:

The course has a dual objective:

- 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.
- 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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

<table>
<tr><td>TEACHING METHOD
Face-to-face, distance learning, etc.</td><td>Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Training, Communication with Students</td><td>Use of ICT in teaching and communicating with students
• digital slides
• videos
• MsTeams/ e-class, webmail</td></tr>
<tr><td>TEACHING ORGANIZATION
The teaching methods and techniques are described in detail.
Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.</td><td><table><tr><th>Activity</th><th>Semester Workload</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Seminars</td><td>20</td></tr><tr><td>Field Exercise</td><td>0</td></tr><tr><td>Laboratory</td><td>0</td></tr></table></td></tr>
</table>

The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.	Literature review and analysis	78
	Writing assignments	50
	Presentation of assignments	10
	Final assessment	3
	Total Course	**200**

STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

5. RECOMMENDED LITERATURE

1. 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.
2. Vosniadou, S. (2001). How Children Learn. Educational Practices Series-7. UNESCO
3. Vosniadou, S., & Brewer, W. F. (1987). Theories of knowledge restructuring in development. *Review of Educational Research*, 57(1), 51-67.
4. Vosniadou, S. (1994). Capturing and modeling the process of conceptual change. *Learning and Instruction*, 4(1), 45-69.
5. Vosniadou, S., Ioannides, C., Dimitrakopoulou, A., & Papademetriou, E. (2001). Designing learning environments to promote conceptual change in science. *Learning and Instruction*, 11(4-5), 381-419.
6. Vosniadou, S. (2019, April). The development of students' understanding of science. In Frontiers in Education (Vol. 4, p. 32). Frontiers Media SA.
7. 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.
8. 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.
9. 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.
10. Zoupidis, A., Pnevmatikos, D., Spyrtou, A., & Kariotoglou, P. (2016). The impact of the acquisition of Control of Variables Strategy and nature of models in floating-sinking phenomena reasoning and understanding of density as property of materials. *Instructional Science*, 44(4), 315-334.
11. Alters, B. (1997). Whose Nature of Science? *Journal of Research in Science Teaching*, 34(1), 39–55.
12. Hacking, I. (1992). The Self Vindication of the Laboratory Sciences, in A. Pickering (ed.), *Science as practice and culture*. The University Chicago Press, 29-64.
13. Hacking, I. (1995). *Representing and Intervening* (12th edition). Cambridge University Press.
14. Καριώτογλου, Π. και Τσελφές, Β. (2000). Αναλυτικά Προγράμματα Φυσικών Επιστημών: Επιστημολογική, Διδακτική και Θεσμική προσέγγιση. *Επιθεώρηση Φυσικής*, 31, 19-28.
15. Knorr-Cetina, K. (1981). *The Manufacture of Knowledge*, Pergamon Press.
16. Pickering, A. (1995). *The Mangle of Practice*. Chicago: The University Chicago Press.
17. Pickering, A. (Ed). (1992). *Science as practice and culture*. The University Chicago Press.

18. 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.
19. Radder, H. (1996). *In and about the world*. State University Press.
20. Tselfes, V., Kariotoglou, P. & Epsimos, G. (2005). Developing a three-pole framework for studying Science Curricula. In *proceedings of ESERA '05: Contributions of research to enhancing students' interest in learning science*, Barcelona: ESERA (ISBN 689-1129-1), 70-73 (και στο http://na-serv.did.gu.se/ESERA05/cd/pdfs/eBook. pdf#page=70).
21. 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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**K-2A**	**SEMESTER**	**1ST**
COURSE TITLE	**Contemporary Educational Approaches in Science and Environmental Education**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Laboratory Exercises, and Presentations	3	8
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND common compulsory course for all specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and *Project design and management*

information, using the necessary technologies *Adapting to new situations* *Decision making* *Working independently* *Teamwork* *Working in an international environment* *Working in an interdisciplinary environment* *Generating new research ideas*	*Respect for diversity and multiculturalism* *Respect for the natural environment* *Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues* *Exercise of criticism and self-criticism* *Promotion of free, creative, and inductive thinking*

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	• Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies. • Workshops (in-person and online) for the design and presentation of educational activities.

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Training, Communication with Students</td><td>Use of ICT in teaching and communicating with students
digital slides
videos
digital course platform (e-learning)
Zoom, webmail
digital technologies used in various educational activities</td></tr>
<tr><td>TEACHING ORGANIZATION
The teaching methods and techniques are described in detail.
Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.

The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.</td><td><table><tr><th>Activity</th><th>Semester Workload</th></tr><tr><td>Lectures</td><td>24</td></tr><tr><td>Laboratory exercises</td><td>6</td></tr><tr><td>Presentation of assignments</td><td>9</td></tr><tr><td>Study development and activity design</td><td>81</td></tr><tr><td>Literature review and analysis</td><td>80</td></tr><tr><td></td><td></td></tr><tr><td>Total Course</td><td>200</td></tr></table></td></tr>
<tr><td>STUDENT ASSESSMENT
Description of the assessment process

Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others

Clearly defined assessment criteria are specified and whether and where they are accessible to students.</td><td>Assessment Language: Greek

Assessment Methods:
For the final assessment of the students, the following are taken into account:
their participation throughout the course (20%)
the portfolio of assignments submitted (60%)
presentations of assigned assignments (20%)</td></tr>
</table>

5. RECOMMENDED LITERATURE

1. 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.
2. 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
3. D. Sokołowska, M. Michelini (Eds)(2018), The Role of Laboratory Work in Improving Physics Teaching and Learning, Springer, ISBN 978-3-319-96183-5
4. D. F. Treagust, R. Duit, H. E. Fischer (Eds)(2017) Multiple Representations in Physics Education. Springer, ISBN: 978-3-319-58912-1
5. 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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**K-3A**	**SEMESTER**	**1ST**
COURSE TITLE	**Teaching-Learning Environments in Science and Environmental Education: Design, Development & Evaluation**		
INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*		**WEEKLY TEACHING HOURS**	**ECTS**
Lectures		3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.			
TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND common compulsory course for all specializations		
PREREQUISITE COURSES:	NONE		
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses		

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using lecture methods, flipped classroom, study and discussion of

<table>
<tr><td></td><td>key research articles, peer teaching, etc. active learning techniques/strategies.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Training, Communication with Students</td><td>Use of ICT in teaching and communicating with students
• digital slides
• videos
• MsTeams/ e-class, webmail</td></tr>
<tr><td>TEACHING ORGANIZATION
The teaching methods and techniques are described in detail.
Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.

The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Seminars</td><td>20</td></tr>
<tr><td>Field Exercise</td><td>0</td></tr>
<tr><td>Laboratory</td><td>0</td></tr>
<tr><td>Literature review and analysis</td><td>68</td></tr>
<tr><td>Writing assignments</td><td>35</td></tr>
<tr><td>Presentation of assignments</td><td>10</td></tr>
<tr><td>Final assessment</td><td>3</td></tr>
<tr><td>Total Course</td><td>175</td></tr>
</table>
</td></tr>
<tr><td>STUDENT ASSESSMENT
Description of the assessment process

Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others

Clearly defined assessment criteria are specified and whether and where they are accessible to students.</td><td>The following are considered for the assessment of students:
• their participation throughout the course (20%)
• the portfolio of assignments submitted (60%)
• presentations of assigned assignments (10%)
and
• performance on the final assignment (study, development, presentation, support) (10%)</td></tr>
</table>

5. RECOMMENDED LITERATURE

1. Καριώτογλου, Π. (2006). Παιδαγωγική γνώση περιεχομένου φυσικών επιστημών. *Θεσσαλονίκη: Γράφημα*.
2. Χαλκιά, Κ. (2012). Διδάσκοντας φυσικές επιστήμες. *Αθήνα: Εκδόσεις Πατάκη*.
3. 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.
4. Ζουπίδης, Α. (2012). *Διδασκαλία και μάθηση με τη χρήση μοντέλων φυσικών επιστημών και τεχνολογίας: εφαρμογή στα φαινόμενα της πλεύσης και της βύθισης* (Doctoral dissertation).
5. Méheut, M., & Psillos, D. (2004). Teaching–learning sequences: aims and tools for science education research. *International Journal of Science Education*, *26*(5), 515-535.
6. Psillos, D., & Kariotoglou, P. (Eds.). (2015). *Iterative Design of Teaching-Learning Sequences: Introducing the Science of Materials in European Schools*. Springer.
7. 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.
8. Duschl, R., Maeng, S., & Sezen, A. (2011). Learning progressions and teaching sequences: A review and analysis. *Studies in Science Education*, *47*(2), 123-182.
9. 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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**K-4A**	**SEMESTER**	**1ST**
COURSE TITLE	**Non-formal Teaching-Learning Environments in Science and Environmental Education**		
INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*		**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Workshops, Field Research		3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.			
TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND common compulsory course for all specializations		
PREREQUISITE COURSES:	NONE		
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses		

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Autonomous work
- Working in a team
- Working in an interdisciplinary environment
- Respect for the natural environment
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using lectures, flipped classroom methods, study and discussion of key research articles, peer teaching, and other active learning techniques/strategies. Workshops (e.g., Workshop on Creating Digital Educational Resources for Museum Visits or Designing and Evaluating Educational Field Trips outside the Classroom). In addition, visits are organized to non-formal education settings such as the Science Dissemination Center and Technology Museum (NOESIS), Environmental Education Centers and Wetlands, Research Laboratories (e.g., the Seismological Center, the Meteorological Park, etc.), where fieldwork activities are carried out.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

Activity	*Semester Workload*
Lectures	30
Field Exercise	3
Laboratory	6
Literature review and analysis	78
Writing assignments	55
Presentation of assignments	
Final assessment	3
Total Course	**175**

Clearly defined assessment criteria are specified and whether and where they are accessible to students.	

5. RECOMMENDED LITERATURE

6. 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
7. Καρνέζου, Μ. (2010). *Μελέτη της οργάνωσης και πραγματοποίησης επισκέψεων σε Τεχνοεπιστημονικά Μουσεία.* Διδακτορική διατριβή . ΠΤΝ-ΠΔΜ. Εθνικό αρχείο διδακτορικών διατριβών https://www.didaktorika.gr/eadd/handle/10442/22718
8. Ματσαγγούρας, Η. (2012). *Από τη Βιωματική Μάθηση στο Συνεργατικό Μοντέλο Βιωματικών Δράσεων.*
9. http://ebooks.edu.gr/info/newps/Παρουσιάσεις/Βιωματικές%20δράσεις,%20από%20τη%20βιωματική%20%20μάθηση%20στο%20συνεργατικό%20μοντέλο%20βιωματικών%20δράσεων.pdf
10. Νικονάνου, Ν., Μπούνια, Α., Φιλιππουπολίτη, Α., Χουρμουζιάδη, Α., & Γιαννούτσου, Ν. (2015).
11. *Μουσειακή μάθηση και εμπειρία στον 21ο αιώνα.* Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-918
12. Falk, J. H. and Dierking L. D. (2013). *The Museum Experience Revisited.* Routledge. *https://doi.org/10.4324/9781315417851*
13. Hein, G. E. (1998). *Learning in the Museum.* Routledge.
14. Institute of Play. (2012). *Q Design Pack: Games and Learning*. Institute of Play. https://clalliance.org/wp-content/uploads/2020/02/Design-Pack-Games-And-Learning.pdf
15. National Research Council. (2009). *Learning science in informal environments: People, places, and pursuits*. The National Academies Press. http://nap.nationalacademies.org/12190
16. 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
17. Schroth, S.T. (2023*). Outdoor Education. A Pathway to Experiential, Environmental, and Sustainable Learning*. Palgrave Studies in Alternative Education. Palgrave Macmillan.
18. *Journals*
19. *Curator*
20. *Environmental Education Research*
21. *International Journal of Science Education: Part B:*
22. *Journal of Environmental Education*
23. *Journal of Museum Education*
24. *Journal of Outdoor and Environmental Education*

2nd SEMESTER COURSES

K-1B Educational Research Methodology

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**K-1B**	**SEMESTER**	**2nd**
COURSE TITLE	**Educational Research Methodology**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	3	8

Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND common compulsory course for all specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies	*Project design and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
Decision making	*Respect for the natural environment*
Working independently	*Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues*
Teamwork	*Exercise of criticism and self-criticism*
Working in an international environment	*Promotion of free, creative, and inductive thinking*

Working in an interdisciplinary environment
Generating new research ideas

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive*	

Activity	*Semester Workload*
Lectures	39
Seminars	20
Field Exercise	0
Laboratory	0

Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc. *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	Literature review and analysis	78
	Writing assignments	40
	Presentation of assignments	20
	Final assessment	3
	Total Course	**200**
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)	

5. RECOMMENDED LITERATURE

1. Bryman, A. (2017). *Μέθοδοι κοινωνικής έρευνας* (επιμ. Α. Αϊδίνης, μτφρ. Π. Σακελλαρίου). Αθήνα: Gutenberg.
2. Creswell, J. W., & Creswell, J. D. (2019). *Σχεδιασμός, διεξαγωγή και αξιολόγηση της ποσοτικής και ποιοτικής έρευνας* (2η έκδ., μτφρ. Ν. Κουβαράκου). Αθήνα: Προπομπός.
3. 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
4. Σταμοβλάσης, Δ., & Βαϊοπούλου, Γ. (2021). *Μεθοδολογία έρευνας στις κοινωνικές επιστήμες: Επιστημολογία, σχεδιασμός, συλλογή και ανάλυση ποσοτικών και ποιοτικών δεδομένων. Εκδόσεις Ζυγός.*
5. Τσιώλης, Γ. (2014). *Μέθοδοι και τεχνικές ανάλυσης στην ποιοτική κοινωνική έρευνα*. Αθήνα: Κριτική.

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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΔΦΕ-2Β**	**SEMESTER**	**2nd**
COURSE TITLE	**Contemporary Approaches and Digital Technologies in Science Education in Primary Level Education**		
INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*		**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Workshops		3	8
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.			
TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Science Education specialization		
PREREQUISITE COURSES:	NONE		
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses		

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

Activity	*Semester Workload*
Lectures	39
Seminars	20
Field Exercise	0
Laboratory	15
Literature review and analysis	68
Writing assignments	35
Presentation of assignments	20
Final assessment	3
Total Course	**200**

5. RECOMMENDED LITERATURE

1. 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.
2. 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

3. Leask, M., & Younie, S. (2024). *Teaching and Learning with Technologies in the Primary School* (3rd ed.). Routledge. https://doi.org/10.4324/9781003408925

4. 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.

5. 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.

6. Καρασαββίδης, Η. (2024). *Σοβαρά Ψηφιακά Παιχνίδια* [Προπτυχιακό εγχειρίδιο]. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-1039.

7. Μπράτιτσης, Θ., & Καπανιάρης, Α. (2024). *Ψηφιακή αφήγηση και εκπαίδευση* [Μεταπτυχιακό εγχειρίδιο]. Κάλλιπος, Ανοικτές Ακαδημαϊκές Εκδόσεις. https://dx.doi.org/10.57713/kallipos-432.

8. Πρακτικά συνεδρίων ΕΝΕΦΕΤ https://www.enephet.gr/index.php?page=proceedings-conferences

ΔΦΕ-3Β Professional Development and Pedagogical Content Knowledge

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΔΦΕ-3Β**	**SEMESTER**	**2nd**
COURSE TITLE	**Professional Development and Pedagogical Content Knowledge**		
INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*		**WEEKLY TEACHING HOURS**	**ECTS**
Lectures		3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.			
TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Science Education specialization Optional for the other specializations		
PREREQUISITE COURSES:	NONE		
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses		

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

Activity	*Semester Workload*
Lectures	39
Seminars	20
Field Exercise	0
Laboratory	0
Literature review and analysis	68
Writing assignments	35
Presentation of assignments	10
Final assessment	3
Total Course	**175**

5. RECOMMENDED LITERATURE

1. 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.
2. Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning policy institute.
3. Kennedy, M. M. (2016). How does professional development improve teaching?. *Review of educational research, 86*(4), 945-980.
4. 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.

5. 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.

6. 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.

7. 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).

8. 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

9. 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.

10. 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.

11. 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.

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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΠΕΡ-2Β**	**SEMESTER**	**2nd**
COURSE TITLE	**Digital Approaches to Education for Environment and Sustainability**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
	3	8
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	SKILLS DEVELOPMENT Compulsory course for Environment and Sustainability Education specialization
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Project design and management
- Respect for diversity and multiculturalism
- Respect for the natural environment
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using active learning techniques/strategies, lectures, flipped classroom methods, study and discussion of key research articles, peer teaching, etc. Workshops (e.g., development of educational material using digital applications). In addition, visits are organized to non-formal education settings such as Environmental Education Centers, Research Laboratories, and sites of environmental interest, where fieldwork activities are carried out.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • digital applications • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	

Activity	*Semester Workload*
Lectures	39
Seminars	16
Field Exercise	3
Laboratory	6
Literature review and analysis	78
Writing assignments	55
Presentation of assignments	
Final assessment	3
Total Course	**200**

STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

5. RECOMMENDED LITERATURE

1. 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.
2. CAST (2024). *Universal Design for Learning Guidelines version 3.0*. Retrieved from https://udlguidelines.cast.org
3. 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.
4. 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.
5. 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.
6. 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.
7. 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.
8. Hwang, S. (2013). Placing GIS in sustainability education. *Journal of Geography in Higher Education*, 37(2), 276-291.
9. Jagannathan, S. (Ed.). (2021). *Reimagining digital learning for sustainable development: how upskilling, data analytics, and educational technologies close the skills gap*. Routledge.
10. Λιαράκου, Γ. (2023). Οι παιδαγωγικοί στόχοι της Εκπαίδευσης για το Περιβάλλον και την Αειφορία. *Περιβαλλοντική Εκπαίδευση για την Αειφορία*, 5(1), 34-47.
11. Meyer, A., Rose, D. H., & Gordon, D. T. (2014). *Universal design for learning: Theory and practice*. CAST Professional Publishing.
12. Rodrigues-Silva, J., & Alsina, Á. (2023). STEM/STEAM in early childhood education for sustainability (ECEfS): A systematic review. *Sustainability*, 15(4), 3721.
13. Environmental Education Research
14. Journal of Environmental Education
15. Journal of Outdoor and Environmental Education

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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΠΕΡ-3Β**	**SEMESTER**	**2nd**
COURSE TITLE	**Education for Environment and Sustainability: Contemporary Issues and Approaches**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
	3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Environment and Sustainability Education specialization Optional for the other specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Project design and management
- Respect for diversity and multiculturalism
- Respect for the natural environment
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using active learning techniques/strategies, lectures, flipped classroom methods, study and discussion of key research articles, peer teaching, etc. Workshops (e.g., development of educational material using digital applications). In addition, visits are organized to non-formal education settings such as Environmental Education Centers, Research Laboratories, and sites of environmental interest, where fieldwork activities are carried out.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

Activity	*Semester Workload*
Lectures	39
Field Exercise	3
Laboratory	6
Literature review and analysis	69
Writing assignments	55
Presentation of assignments	
Final assessment	3
Total Course	**175**

5. RECOMMENDED LITERATURE

1. Brandt, J. O., Barth, M., Hale, A., & Merritt, E. (2022). Developing ESD-specific professional action competence for teachers: knowledge, skills, and attitudes in implementing ESD at the school level. *Environmental Education Research*, 28(12), 1691-1729.
2. Cebrián, G., Junyent, M., & Mulà, I. (2020). Competencies in education for sustainable development: Emerging teaching and research developments. *Sustainability*, 12(2), 579.
3. Δημητρίου, Α. (2009). *Περιβαλλοντική Εκπαίδευση: περιβάλλον, αειφορία. Θεωρητικές και παιδαγωγικές προσεγγίσεις*. Επίκεντρο.
4. 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.
5. Φλογαΐτη, Ε., Λιαράκου, Γ., & Γαβριλάκης, Κ. (2021). *Συμμετοχικές μέθοδοι διδασκαλίας και μάθησης: Εφαρμογές στην εκπαίδευση για το περιβάλλον και την αειφορία*. Πεδίο.
6. 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.
7. Leite, S. (2022). Using the SDGs for global citizenship education: Definitions, challenges, and opportunities. *Globalisation, Societies and Education*, 20(3), 401-413.
8. Λιαράκου, Γ. (2023). Οι παιδαγωγικοί στόχοι της Εκπαίδευσης για το Περιβάλλον και την Αειφορία. *Περιβαλλοντική Εκπαίδευση για την Αειφορία*, 5(1), 34-47.
9. Μανωλάς, Ε. (Επιμ.) (2017). *Περιβαλλοντική Κοινωνιολογία*. Gutenberg. ISBN: 9789600118414.
10. Μανωλάς, Ε. (Επιμ.) (2021). *Η Περιβαλλοντική σκέψη στον 20ο αιώνα*. Δίσιγμα. ISBN: 9786182020562.
11. 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.
12. 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.
13. Van Poeck, K., Vandenplas, E., & Östman, L. (2024). Teaching action-oriented knowledge on sustainability issues. *Environmental Education Research*, 30(3), 334-360.
14. 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.
15. Environmental Education Research
16. Journal of Environmental Education
17. Journal of Outdoor and Environmental Education

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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΦΕΤ-2Β**	**SEMESTER**	**2nd**
COURSE TITLE	**Teaching & Learning in Physics with Digital Technology**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Laboratory Exercises, and Presentations	3	8
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Physics Education and Educational Technology specialization
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies	*Project design and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
Decision making	*Respect for the natural environment*
Working independently	*Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues*

Teamwork *Working in an international environment* *Working in an interdisciplinary environment* *Generating new research ideas*	*Exercise of criticism and self-criticism* *Promotion of free, creative, and inductive thinking*

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	• Both in person and remotely, using lecture methods, flipped classroom, study and

<table>
<tr><td></td><td>discussion of key research articles, peer teaching, etc. active learning techniques/strategies.
• Laboratory exercises to familiarize students with various aspects of digital technologies</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Training, Communication with Students</td><td>Use of ICT in teaching and communicating with students
• digital slides
• videos
• MsTeams/ e-class, webmail
• Laboratory exercises using digital technologies.</td></tr>
<tr><td>TEACHING ORGANIZATION
The teaching methods and techniques are described in detail.
Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.

The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Laboratory exercises</td><td>15</td></tr>
<tr><td>Presentation of assignments</td><td>9</td></tr>
<tr><td>Literature review and analysis</td><td>69</td></tr>
<tr><td>Writing assignments</td><td>65</td></tr>
<tr><td>Final assessment</td><td>3</td></tr>
<tr><td>Total Course</td><td>200</td></tr>
</table>
</td></tr>
<tr><td>STUDENT ASSESSMENT
Description of the assessment process

Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others

Clearly defined assessment criteria are specified and whether and where they are accessible to students.</td><td>Assessment Language: Greek

Assessment Methods:
Formative:
• Students’ participation throughout the course (20%)
• Portfolio of submitted assignments (20%)
• Laboratory work/reports (20%)
• Public presentation of laboratory reports (20%)
Summative:
• Final project performance (study, development, presentation, and defense) (20%)</td></tr>
</table>

5. RECOMMENDED LITERATURE

1. Σ. Δημητριάδης, *Θεωρίες Μάθησης & Εκπαιδευτικό Λογισμικό,* Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών, 2015
2. J. Kuhn, P. Vogt, *Smartphones as Mobile Minilabs in Physics*, Springer, 2022
3. .J Antony, *Design of Experiments for Engineers and Scientists*, Elsevier, 2003
4. S. Staacks, S. Hütz, H. Heinke and C. Stampfer, *Advanced tools for smartphone- based experiments: phyphox*, Phys. Educ. 53 (2018) 045009
5. 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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΦΕΤ-3Β**	**SEMESTER**	**2nd**
COURSE TITLE	**The Laboratory Approach to the Science Teaching**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Laboratory Exercises, and Presentations	3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Physics Education and Educational Technology specialization Optional for the other specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing Learning Outcomes*

Upon successful completion of the course, participants 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).

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies	*Project design and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
	Respect for the natural environment

Decision making *Working independently* *Teamwork* *Working in an international environment* *Working in an interdisciplinary environment* *Generating new research ideas*	*Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues* *Exercise of criticism and self-criticism* *Promotion of free, creative, and inductive thinking*

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	• Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies. • Laboratory exercises aimed at familiarizing students with laboratory practices across various scientific disciplines (e.g., Physics, Chemistry, Biology, etc.)

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Training, Communication with Students</td><td>Use of ICT in teaching and communicating with students
digital slides
videos
MsTeams/ e-class, webmail
Laboratory exercises</td></tr>
<tr><td>TEACHING ORGANIZATION
The teaching methods and techniques are described in detail.
Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.

The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.</td><td><table><tr><th>Activity</th><th>Semester Workload</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Laboratory exercises</td><td>15</td></tr><tr><td>Presentation of assignments</td><td>9</td></tr><tr><td>Literature review and analysis</td><td>55</td></tr><tr><td>Writing assignments</td><td>54</td></tr><tr><td>Final assessment</td><td>3</td></tr><tr><td>Total Course</td><td>175</td></tr></table></td></tr>
<tr><td>STUDENT ASSESSMENT
Description of the assessment process

Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others

Clearly defined assessment criteria are specified and whether and where they are accessible to students.</td><td>Assessment Language: Greek

Assessment Methods:
Formative:
Students’ participation throughout the course (20%)
Portfolio of submitted assignments (20%)
Laboratory work/reports (20%)
Public presentation of laboratory reports (20%)
Summative:
Final project performance (study, development, presentation, and defense) (20%)</td></tr>
</table>

5. RECOMMENDED LITERATURE

1. Β. Γκάγκας, *Οδηγός Εργαστηριακών Ασκήσεων για το μάθημα «Διδασκαλία & Μάθηση με Ψηφιακές Τεχνολογίες»*, Εργαστηριακές σημειώσεις, ΠΜΣ «Διδακτική της Φυσικής & Εκπαιδευτική Τεχνολογία, ΑΠΘ, 2022.
2. M. W. Hackling, *Working Scientifically: Implementing and Assessing Open Investigation Work in Science,* Department of Education and Training, Western Australia, 2005
3. J. Haysom, M. Bowen, Predict-Observe-Explain: Activities Enhancing Scientific Understanding, NSTA Press, 2010
4. Y. Kraftmakher*, Experiments & Demonstrations in Physics*, World Scientific Publishing, 2015
5. *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)

3rd SEMESTER COURSES

ΔΙΠΛ Master Thesis

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΔΙΠΛ**	**SEMESTER**	**3rd**
COURSE TITLE	**Master Thesis**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
	0	30
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	SCIENTIFIC FIELD common compulsory thesis for all specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing Learning Outcomes*

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

- demonstrate in-depth knowledge of the topic addressed in their thesis
- have a comprehensive understanding of the subject areas covered by the Interinstitutional Postgraduate Program (IPP)
- search for and critically evaluate international literature
- analyze data

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

Generating new research ideas
• Searching, analyzing, and synthesizing data and information, using the necessary technologies • Generating new research ideas • Promoting free, creative, and inductive thinking

3. COURSE CONTENT

• Completion of a Master's thesis

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Collaboration with the supervising Professor
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	Oral Examination by a Three-Member Committee

Activity	***Semester Workload***
Semester Project Preparation & Writing	350
Preparation / Examination	50
Study and Analysis of Literature	350
Total Course	**750**

5. RECOMMENDED LITERATURE

K-1Γ Instructional Design and Contemporary Educational Activities

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education
LEVEL OF STUDIES	IPP - LEVEL 7

COURSE CODE	**K-1Γ**	**SEMESTER**	**3rd**
COURSE TITLE	Instructional Design and Contemporary Educational Activities		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Laboratory Exercises, and Presentations	3	8
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	SKILLS DEVELOPMENT common compulsory course for all specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Working in a team

- Working in an interdisciplinary environment
- Generating new research ideas
- Project design and management
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely presentation, study, and discussion of innovative educational actions using lecture methods and flipped classroom strategies Both in person and remotely workshops for the design and presentation of educational activities
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • Digital course platform (e-learning) • Zoom, webmail

	• Digital technology used in various educational activities
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	**Activity** / **Semester Workload** Lectures: 39 Presentation of activities: 9 Study development – Design of activities: 72 Literature review and analysis: 50 Educational visits and field-based activities: 30 Total Course: **200**
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	Assessment Language: Greek Assessment Methods: Formative: • Students' participation throughout the course (20%) • Design of educational activities (60%) • Presentation of educational activities (20%)

5. RECOMMENDED LITERATURE

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

K-2Γ Design and Development of Teaching Materials

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**K-2Γ**	**SEMESTER**	**3rd**
COURSE TITLE	Design and Development of Teaching Materials		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Laboratory Exercises, and Presentations	3	8

Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		
TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	SKILLS DEVELOPMENT common compulsory course for all specializations	
PREREQUISITE COURSES:	NONE	
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK	
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO	
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses	

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing Learning Outcomes*

Upon successful completion of the course, participants 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Working in a team
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	• Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, peer teaching, etc. active learning techniques/strategies. • Laboratory exercises to familiarize students with various aspects of design and development of teaching material
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail • Laboratory exercises
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	

Activity	*Semester Workload*
Lectures	39
Laboratory exercises	6
Presentation of assignments	9
Literature review and analysis	73
Writing assignments	70
Final assessment	3
Total Course	**200**

STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others*	Assessment Language**:** Greek Assessment Methods: Formative: • Students' participation throughout the course (20%) • Portfolio of submitted assignments (30%)

Clearly defined assessment criteria are specified and whether and where they are accessible to students.	• Public presentation of laboratory reports (30%) Summative: • Final project performance (study, development, presentation, and defense) (20%)

5. RECOMMENDED LITERATURE

1. C. Hodell, *ISD From the Ground Up: A No-Nonsense Approach to Instructional Design*, ATD Press, 2025.
2. D. J. Llewellyn, Teaching High School Science Through Inquiry and Argumentation, SAGE, 2012.
3. L. Chitman-Booker, K. Kopp, The 5Es of Inquiry-Based Science, Teacher Created Materials, 2013.
4. W. Harlen, Assessment & Inquiry-Based Science Education: Issues in Policy and Practice, Global Network of Science Academies (IAP) Science Education Programme, 2013.
5. Κ. Χαλκιά, Διδάσκοντας Φυσικές Επιστήμες: Θεωρητικά Ζητήματα, Προβληματισμοί, Προτάσεις, Πατάκης, 2012.

ΔΦΕ-3Γ Intercultural and Inclusive Approaches in Science Education

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΔΦΕ-3Γ**	**SEMESTER**	**3rd**
COURSE TITLE	**Intercultural and Inclusive Approaches in Science Education**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Workshops	3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Science Education specialization Optional for the other specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using lecture methods, flipped classroom, etc. active learning techniques/strategies.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

Activity	*Semester Workload*
Lectures	39
Seminars	20
Field exercises	0
Workshop	5
Literature review and analysis	68
Writing assignments	30
Presentation of assignments	10
Final assessment	3
Total Course	**175**

5. RECOMMENDED LITERATURE

1. Μπέργκερ Π., Λούκμαν Τ., 2003, *Η κοινωνική κατασκευή της πραγματικότητας,* Αθήνα, Νήσος
2. Selin, H. (Ed.). (2013). *Encyclopaedia of the history of science, technology, and medicine in non-westen cultures*. Springer Science & Business Media.
3. Tomlinson, C. A. (2015). *Πώς να διαφοροποιήσουμε τη διδασκαλία σε τάξεις μεικτής ικανότητας*. Γρηγόρης.
4. Βαλιαντή, Σ., & Νεοφύτου, Λ. (2017). *Διαφοροποιημένη διδασκαλία. Λειτουργική και αποτελεσματική εφαρμογή*. Πεδίο.
5. 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
6. Πώς γίνεται ένα ιγκλού. https://www.youtube.com/watch?v=7jfWm2jTFf4
7. Κβαντική φυσική. https://www.youtube.com/watch?v=9QSUsOkptxM&t=4s

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

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΠΕΡ-3Γ**	**SEMESTER**	**1st**
COURSE TITLE	**Communication, Literacy and Public Understanding: Contemporary Issues and Approaches**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
	3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	SKILLS DEVELOPMENT Compulsory course for Environment and Sustainability Education specialization Optional for the other specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing 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).

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Decision making
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Project design and management
- Respect for diversity and multiculturalism
- Respect for the natural environment
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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)

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, distance learning, etc.*	Both in person and remotely, using active learning strategies/techniques, lecture methods, flipped classroom approaches, study and discussion of key research articles, peer teaching, etc. Workshops (e.g., design, implementation, and evaluation of communication strategies and techniques addressing local/national environmental and sustainability issues). In addition, visits are organized to non-formal education settings such as Environmental Education Centers, Research Laboratories, and sites of environmental interest, where fieldwork activities are conducted.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in Teaching, Laboratory Training, Communication with Students*	Use of ICT in teaching and communicating with students • digital slides • videos • MsTeams/ e-class, webmail
TEACHING ORGANIZATION *The teaching methods and techniques are described in detail.* *Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.* *The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.*	
STUDENT ASSESSMENT *Description of the assessment process* *Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other/Others* *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	The following are considered for the assessment of students: • their participation throughout the course (20%) • the portfolio of assignments submitted (60%) • presentations of assigned assignments (10%) and • performance on the final assignment (study, development, presentation, support) (10%)

Activity	*Semester Workload*
Lectures	39
Field exercises	3
Workshop	6
Literature review and analysis	69
Writing assignments	55
Presentation of assignments	
Final assessment	3
Total Course	**175**

5. RECOMMENDED LITERATURE

1. Álvarez-García, O., & Sureda-Negre, J. (2023). Greenwashing and education: An evidence-based approach. *The Journal of Environmental Education*, 54(4), 265-277.
2. 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.
3. Armstrong, A. K., Krasny, M. E., & Schuldt, J. P. (2018). *Communicating climate change: A guide for educators*. Cornell University Press.
4. Brereton, P. (2022). Essential Concepts of Environmental Communication: An A–Z Guide. Routledge.
5. Γαβριλάκης, Κ. (2023). Συνεργασία σχολείου και κοινότητας προς την αειφορία. *Περιβαλλοντική Εκπαίδευση για την Αειφορία*, 5(1), 218-233.
6. 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
7. de Freitas Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. D. L. (2020). Concepts and forms of greenwashing: A systematic review. *Environmental Sciences Europe*, 32, 1-12.
8. 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.
9. Jurin, R. R., Roush, D., & Danter, J. (2010). *Environmental communication*. Dordrecht, The Netherlands: Springer.
10. 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.
11. Μανωλάς, Ε. (Επιμ.) (2020). *Πράσινες Μη Κυβερνητικές Οργανώσεις στο Παγκόσμιο Σύστημα*. Θεσσαλονίκη: Δίσιγμα. ISBN: 9786185242831.
12. 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.
13. Τσαμπούκου - Σκαναβή, Κ. (2004). *Περιβάλλον και Επικοινωνία: Δικαίωμα στην επιλογή*. Αθήνα: Καλειδοσκόπιο. ISBN: 9789607846443.
14. Environmental Education Research
15. Journal of Environmental Education
16. Environmental Communication

ΦΕΤ-3Γ Contemporary Science Issues and their Instruction

1. GENERAL

SCHOOL	SCHOOL OF EDUCATION		
DEPARTMENT/IPP	Department of Primary Education / IPP Education Sciences: Science, Sustainability and Technology Education		
LEVEL OF STUDIES	IPP - LEVEL 7		
COURSE CODE	**ΦΕΤ-3Γ**	**SEMESTER**	**2nd**
COURSE TITLE	**Contemporary Science Issues and their Instruction**		

INDEPENDENT TEACHING ACTIVITIES *in cases where credit units are awarded for distinct parts of the course, e.g. lectures, laboratory exercises, etc. If credit units are awarded uniformly for the entire course, enter the weekly teaching hours and the total number of credit units.*	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures, Laboratory exercises and Presentations	3	7
Add rows if necessary. The teaching organization and teaching methods used are described in detail in 4.		

TYPE OF COURSE *Background, General Knowledge, Scientific Field, Skills Development*	BACKGROUND Compulsory course for Physics Education and Educational Technology specialization Optional for the other specializations
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION & ASSESSMENT:	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course describe the specific knowledge, skills, and abilities of an appropriate level that students will acquire after successfully completing the course. See Appendix A.

- *Description of the Level of Learning Outcomes for each cycle of studies in accordance with the European Higher Education Area Qualifications Framework*
- *Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Summary Guide to Writing Learning Outcomes*

Upon successful completion of the course, participants 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.

General Skills

Taking into account the general skills that graduates should have acquired (as listed in the Diploma Supplement and set out below), which of these does the course aim to develop?

Searching, analyzing, and synthesizing data and information, using the necessary technologies
Adapting to new situations
Decision making
Working independently
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project design and management
Respect for diversity and multiculturalism
Respect for the natural environment
Demonstration of social, professional, and ethical responsibility and sensitivity to gender issues
Exercise of criticism and self-criticism
Promotion of free, creative, and inductive thinking

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adapting to new situations
- Working independently
- Working in a team
- Working in an interdisciplinary environment
- Generating new research ideas
- Exercising criticism and self-criticism
- Promoting free, creative, and inductive thinking

3. COURSE CONTENT

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.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD
Face-to-face, distance learning, etc.

- Both in person and remotely, using lecture methods, flipped classroom, study and discussion of key research articles, etc. active learning techniques/strategies.
- Laboratory exercises to familiarize students with various aspects of digital technology

USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Training, Communication with Students

Use of ICT in teaching and communicating with students

- digital slides
- videos
- MsTeams/ e-class, webmail
- Laboratory exercises

TEACHING ORGANIZATION

The teaching methods and techniques are described in detail.
Lectures, seminars, laboratory exercises, field exercises, study and analysis of bibliography, tutorials, practical training (placement), clinical exercises, Artistic Workshop, Interactive Teaching, Educational Visits, Project Work, Writing Assignments, Artistic Creation, etc.

The student's study hours for each learning activity are recorded, as well as the hours of unsupervised study, so that the total workload for the semester corresponds to ECTS standards.

Activity	*Semester Workload*
Lectures	39
Laboratory exercises	6
Presentation of assignments	9
Literature review and analysis	62
Writing assignments	56
Final assessment	3
Total Course	**175**

STUDENT ASSESSMENT
Description of the assessment process

Assessment Language, Assessment Methods, Formative or Summative, Multiple Choice Test, Short Answer Questions, Essay Questions, Problem Solving, Written Assignment, Report/Essay, Oral Examination, Public Presentation, Laboratory Work, Clinical

Assessment Language: Greek

Assessment Methods:
Formative:

- Students' participation throughout the course (20%)

Examination of a Patient, Artistic Interpretation, Other/Others *Clearly defined assessment criteria are specified and whether and where they are accessible to students.*	• Portfolio of submitted assignments (20%) • Laboratory tasks/reports (20%) • Public presentation of laboratory reports (20%) Summative: • Final project performance (study, development, presentation, and defense) (20%)

5. RECOMMENDED LITERATURE

1. Λ. Μάνου, *Ανάπτυξη & Αξιολόγηση Διδακτικών-Μαθησιακών Προσεγγίσεων για την Εκπαίδευση Εκπαιδευτικών στη Νανοτεχνολογία*, Διδακτορική Διατριβή, Πανεπιστήμιο Δυτικής Μακεδονίας, 2019.
2. C. Binns. *Introduction to Nanoscience & Nanotechnology*, Willey, 2010.
3. S Bhusham, *Biomimetics: Bioinspired Hierarchical-Structured Surfaces for Green Science and Technology*, Springer, 2016.
4. Y. Stevens L-A. M. Sutherland, J. S. Krajcik, *The big ideas of nanoscale science & engineering: a guidebook for secondary teachers*, NSTA Press, 2009.
5. R. Duit, *Science Education Research Internationally: Conceptions, Research Methods, Domains of Research*, Eurasia Journal of Mathematics, Science & Technology Education, 2007, 3(1), 3-15