DOCTORAL (PHD) STUDIES

COURSE UNIT DESCRIPTION

Course unit title	Scientific areas	Faculty	Institute, department
Technology-enhanced learning	Informatics Engineering (T 007)	Faculty of Mathematics and Informatics	Institute of Data Science and Digital Technologies, Education Systems Group

Study method	Number of credits	Study method	Number of credits
Lectures		Consultations	2
Individual works	3	Seminars	2 (spring semester)

Summary

The aim of this course is to provide PhD students with an interdisciplinary theoretical and methodological foundation for research in technology-enhanced learning, developing the ability to critically analyse the use of digital technologies in education, to design and conduct research at the intersection of computer science, informatics engineering and education, and to apply advanced data analytics and artificial intelligence tools.

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

1. Interpret theoretical and practical problems related to digital technologies in education and engage in scientific discussions on the topic with other researchers.
2. Apply technological knowledge and skills when conducting research at the intersection of computer science, informatics engineering and education.
3. Design a scientific study in the area of technology-enhanced learning.
4. Select technological solutions and tools suitable for solving contemporary educational problems.
5. Evaluate and further develop their technological and educational competencies.

This course provides a systematic foundation for researching technology-enhanced learning and the learning/teaching of informatics, integrating advances in the learning sciences, data analytics, applications of artificial intelligence (AI) and engineering of digital learning technologies. The focus is on understanding key principles of the learning sciences and applying them to the design of technology-enhanced learning environments, as well as on conducting research at the intersection of computer science/informatics engineering and education sciences. The course examines the latest paradigms and perspectives on methodologies in computer science, informatics engineering and the learning sciences, digital learning technologies and their application in education.

1. **Technology-enhanced learning as a field of research.** The learning sciences: theoretical foundations and interdisciplinarity. Learning engineering. Educational neuroscience. Sociotechnical perspectives and contemporary research directions in the field.
2. **Learning theories relevant to technology-enhanced learning.** Sociocultural foundations of learning. Cognitive foundations of learning. Constructivist and constructionist learning theories. Embodied and distributed learning. The role of learning theories in the design of learning environments.
3. **Design of digital and hybrid learning environments.** Constructive alignment. Assessment and feedback. Application of principles of inclusive education and Universal Design for Learning (UDL). Design thinking for designing digital and hybrid learning environments.

4. **E-learning and digital learning ecosystems.** E-learning. Structure, components, interoperability and standards of learning management systems (LMS) and learning experience platforms (LXP). Personalisation of learning systems. Mobile learning. Microlearning. Learning objects: concept, classification, metadata and standards. Planning and development of digital learning content. Massive Open Online Courses (MOOCs). Open educational resources.
5. **Research methods for technology-enhanced learning.** Research methods in the learning sciences. Design-based research. Methods of collaboration and interaction analysis. Methods of text and discourse analysis. Key principles of cognitive research. Design science research. Video-based research methods. Microgenetic method. Experimental / quasi-experimental method. Application of mixed-methods research.
6. **Learning analytics and educational data mining.** Research on learning process data. Modelling learning processes. Application of machine learning methods for learning process data analytics. Multimodal data analytics. Use of learning data to improve learning, personalise learning activities or adjust teaching strategies.
7. **Contemporary teaching/learning methods and learning analytics.** Learning analytics for self-regulated learning, collaborative learning, discourse analysis and modelling, and learning emotion analytics. Learning feedback loops. Methods for automated assessment.
8. **Applications of learning sciences ideas and digital technologies in contemporary pedagogy.** Technological Pedagogical Content Knowledge (TPACK). Models for assessing digital literacy competences. Technology acceptance models. Models of learning and innovation transfer. The role of digital technologies in integrated education. STEAM education models. Motivation and learning through discovery in constructivist learning environments. Contemporary sociocultural perspectives of learning. Teacher education and technology. Development of innovations in education. Perspectives and challenges of learning sciences and education.
9. **Computational thinking, programming teaching and learning.** Concepts and definitions of computational thinking development, interdisciplinarity and relevance in contemporary society. Relationship between computational thinking, programming and algorithmic thinking. Models of computational thinking development. Programming as the basis of informatics literacy. Programming as a tool for a deeper understanding of technology. Programming paradigms. Tools and environments for learning programming.
10. **Artificial intelligence in education.** Intelligent tutoring systems, recommender systems, chatbots and virtual assistants for learning. Generative AI for learning, teaching and research on learning processes. Specifics of teaching AI at different levels of education. Ethical aspects of applying AI in education and responsible AI use.
11. **Assessment in the age of artificial intelligence.** Assessment of learning achievements in AI-enriched learning environments. Academic integrity and assessment: authentic assessment, oral defences. E-portfolio: concept, models, possibilities for application in education and professional activities. e-Quizzes, learner monitoring in digital learning environments, analysis of summaries, collective notes, etc.
12. **Research ethics in technology-enhanced learning.** Ethical, legal and social impact assessment of technological learning systems and scientific research (privacy, informed consent, academic integrity, accessibility; risk assessment and mitigation of AI systems in education).

Practical assignments

- Individual study of the literature and discussion during seminars.
- In-depth study and presentation of selected topics (written submission and oral presentation).
- Design of a research plan on a selected topic in the field of technology-enhanced learning (written description and oral presentation).

Main literature

Sawyer, R. K. (Ed.). The Cambridge Handbook of the Learning Sciences (3rd ed.). Cambridge University Press, 2022.

Lang, C., Siemens, G., Wise, A. F., Gašević, D., & Merceron, A. (Eds.). Handbook of Learning Analytics (2nd ed.). SoLAR, 2022. https://doi.org/10.18608/hla22

Giannakos, M., Spikol, D., Di Mitri, D., Sharma, K., Ochoa, X., & Hammad, R. (Eds.). The Multimodal Learning Analytics Handbook. Springer, 2022. https://doi.org/10.1007/978-3-031-08076-0
Selwyn, N. Education and Technology: Key Issues and Debates (3rd ed.). Bloomsbury Academic, 2021.
UNESCO. Guidance for Generative AI in Education and Research. UNESCO, 2023 (last update: 2026).
European Commission. ResearchComp: The European Competence Framework for Researchers. Publications Office / European Commission, 2024-2025.
Duval, E., Sharples, M., Sutherland, R. (Eds.) Technology Enhanced Learning. Springer, 2017.
Isaias, P.; Sampson, D.G.; Ifenthaler, D. (Eds.) Technology Supported Innovations in School Education. Springer, Cham, 2020.
Russell S., Norvig P. Artificial Intelligence: A Modern Approach, 4th edition, Pearson, 2020.
Additional literature
European Commission, Joint Research Centre. DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes. EUR 31006 EN, 2022.
UNESCO. AI Competency Framework for Teachers. UNESCO, 2024 (last update: 2026).
European Union. Regulation (EU) 2024/1689 (Artificial Intelligence Act): provisions relevant to AI systems used in education and vocational training.
Bennedsen J., Caspersen M. E., Kolling M. Reflections on the Teaching of Programming. Methods and Implementations. LNCS 4821, Springer, 2008.
Biggs J. Teaching for Quality Learning at University. Buckingham: Open University Press, 2000.
Bitinas B. Educational research: system and process. Vilnius: Kronta, 2006. (original title in Lithuanian: "Edukologinis tyrimas: sistema ir procesas").
Kampylis, P., Law N., Punie, N. Y. (Eds.) ICT enabled innovation for learning in Europe and Asia. Report, 2013.
Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teachers' knowledge. Teachers College Record, 108 (6), 1017–1054.
Caena F., Redecker C. (2019) Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu)

Lecturer(s) (name, surname)	Science degree	Main publications
Tatjana Jevsikova	Dr.	http://www.elaba.mb.vu.lt/dmsti/?aut=Tatjana+Jevsikova
Valentina Dagienė	Dr.	http://www.elaba.mb.vu.lt/dmsti/?aut=Valentina+Dagienė
Anita Juškevičienė	Dr.	http://www.elaba.mb.vu.lt/dmsti/?aut=Anita+Juškevičienė