



PhD ICT KES

Co-founded by the Erasmus+

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The development and implementation of PhD Curricula in ICT for
Kosovo Education System

WP 2.3.3

A three-year PhD curricula in ICT

Programme: Erasmus KA 2

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Reference material

This PhD study program has been prepared based on several study programs in various universities around the globe, and also based on the criterias for evaluation of the PhD programs in the country.

The list of materials that have been analyzed include the following:

- Standards for Evaluation of Doctoral Programmes, Kosovo Accreditation Agency, June 2020,
- Regulation of Doctoral Studies at the University of Prishtina “Hasan Prishtina”,
- A Computing Curricula Series Report, ACM/IEEE, December 31, 2020,
- Model of Doctoral Education of the Technical University of Munich,
- The doctoral program at the Faculty of Informatics, Vienna University of Technology,
- Curriculum for third-cycle studies in the field of Computer and Information Science at the graduate level, Linnaeus University,
- The doctoral education at Norwegian University of Science and technology (NTNU),
- PhD study program in ICT of the University of Nebraska Omaha.

Vision and mission statement

Vision

This PhD program in Information and Communication Technologies (ICT) aims to prepare future graduates to tackle digitalisation challenges through research and innovation activities in order to put knowledge in motion for growth, sustainable and economical development of Kosovo society.

Mission

Through training early stage researchers in this ICT PhD programme, through cooperation with European Higher Education Institutions and societal and industrial stakeholders, we prepare experts that valorise the latest research results into impact for implementing the PhD programme vision.

Learning outcomes/objectives of the PhD study program in ICT

The main learning outcomes of this PhD programme are defined in the form of knowledge, skills and general competence, as described below.

Knowledge

A PhD graduate should be able to:

- be at the cutting edge of knowledge and systematic understanding in a specific academic discipline covered by the PhD programme,
- conduct independent research in identifying and analyzing problems and in evaluating and synthesizing novel knowledge, new theories, artifacts or new methods,
- show proficiency with scientific methodology in general and with the specific research area methods in particular.

Discipline skills

A PhD graduate should be able to:

- compose research questions, plan and carry out research in a specific ICT discipline,
- devise research at a high international level, and argue complex technical questions and challenge established knowledge and practices in the area,
- simulate critical thinking to evaluate appropriate scientific and technological methodologies to devise comprehensive solutions to the problems in ICT,

- develop ICT governance skills on change management to support technology innovation and decision making,
- develop transferable skills in ICT.

Generic Skills

A PhD graduate should be able to:

- conduct research with professional and ethical integrity upon completion of the PhD degree,
- participate in solving complex multidisciplinary scientific problems, provide research and development via recognized national and international channels, participate in debates in the field in international forums and assess the need to take the initiative to drive innovation,
- promptly acquire and contribute towards new knowledge in the field,
- Demonstrate intellectual independence and scientific integrity.

The structure of the PhD study program

In accordance with the PhD evaluation standards of Kosovo Accreditation Agency, the PhD study program in ICT requires a total 180 ECTS credits (as summarized in Table 1), which can be attained within a three to four years of full-time study period, or upto seven years of part-time study period. The course and seminar work consist of a total of 33 ECTS credits, whereas the remaining 147 ECTS represent the individual research work of the PhD student. The structure of the PhD program (as depicted in Figure 1) is designed to fully achieve the above outlined learning outcomes.

Table 1 Distribution of ECTS credits for different PhD components

PhD component		ECTS credits
Coursework (the taught part of the programme)	Fundamental courses	11
	Professional (subject) related courses	14
	Soft skills courses	5
PhD seminar (presentation and attendance)		3
Thesis proposal (preparation and presentation)		27
Publication in peer reviewed journals and conference proceedings		60
PhD thesis writing and defense		60
Total		180

The coursework (the taught part of the programme) consists of three categories of courses:

- Fundamental courses for PhD studies in ICT (11 ECTS credits) - which should be completed in the first semester,
- Professional (subject) related courses (14 ECTS credits) - which should be completed in the first semester,
- Soft skills courses (5 ECTS credits) - can be taken any time during the course of PhD studies.

In addition to the coursework, the PhD students, over the course of their studies, will be required to present their progress at least once per year in the PhD seminar of the respective faculty/department/research group. In return, the PhD student will be awarded 3 ECTS credits.

The student will be assigned a supervisor (mentor) at the moment of the enrolment into the PhD studies, where the student will work under her/his supervision to prepare a thesis proposal that will be submitted in the second semester. By the end of the second semester, the thesis proposal will need to be approved by the council of doctoral studies, after which the student will get 27 ECTS credits.

Students will accumulate 60 ECTS credits after they publish their research work in peer reviewed journals and conference proceedings that publish papers that are closely related to the students' research topic.

Finally, the PhD students will accumulate the last 60 ECTS credits when she/he writes the PhD thesis and defends it in front of the examination committee.

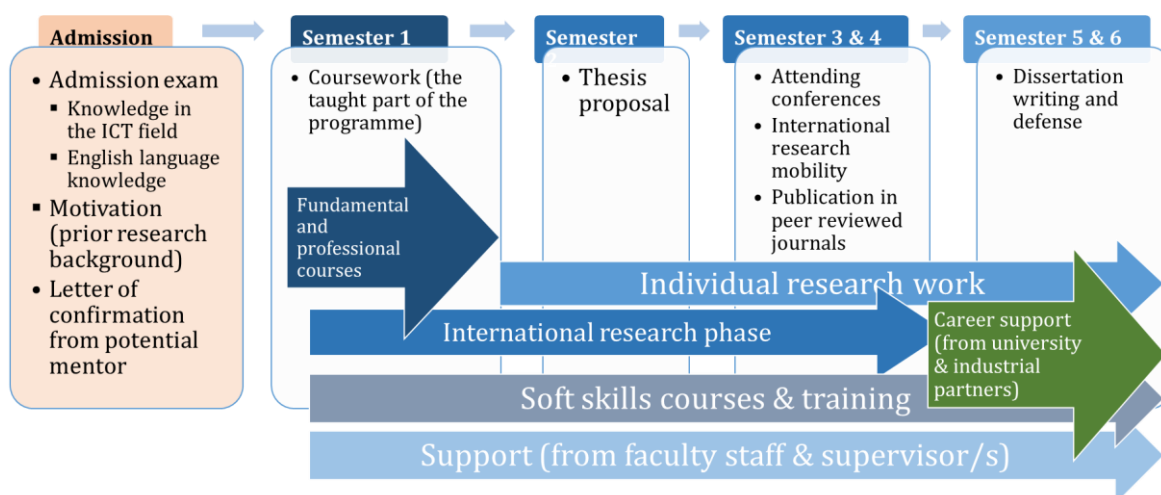


Figure 1 The structure of the PhD study program in ICT

Admission requirements

List of admission requirements for acceptance in the PhD programme:

1. Candidates should possess a master's degree (or should have gained at least 300 ECTS credits from BSc and MSc) in ICT or in a related field, which should be discussed within the admission committee and decided on individual basis regarding the related field,
2. Thesis proposal in English language, which must include a detailed statement that answers the following questions:
 - a. Why do you want to do a PhD in ICT? (State of the art of the research problem),
 - b. Why do you apply for this specific program? (References to be based on),
 - c. How does your background and qualifications make you an eligible match for studying in this program? (Research objectives).
3. Candidates should demonstrate fluency in English language (either via an examination test, worldwide recognized certifications like TOEFL, IELTS, iBT and PTE), or Bachelor/Master Degree Study in English or English as native language,
4. Average grade from previous studies (for both bachelor and master) should be at least 8 (out of maximum 10) from minimum passing grade 6 or equivalent if degrees are awarded from other international institutions,
5. Candidates should get a letter of recommendation from potential supervisor/supervisors (mandatory).

Coursework

The coursework component includes courses that are divided into three different categories, as presented in Figure 2 and listed below. Moreover, the syllabuses for all proposed courses are provided in a separate file.

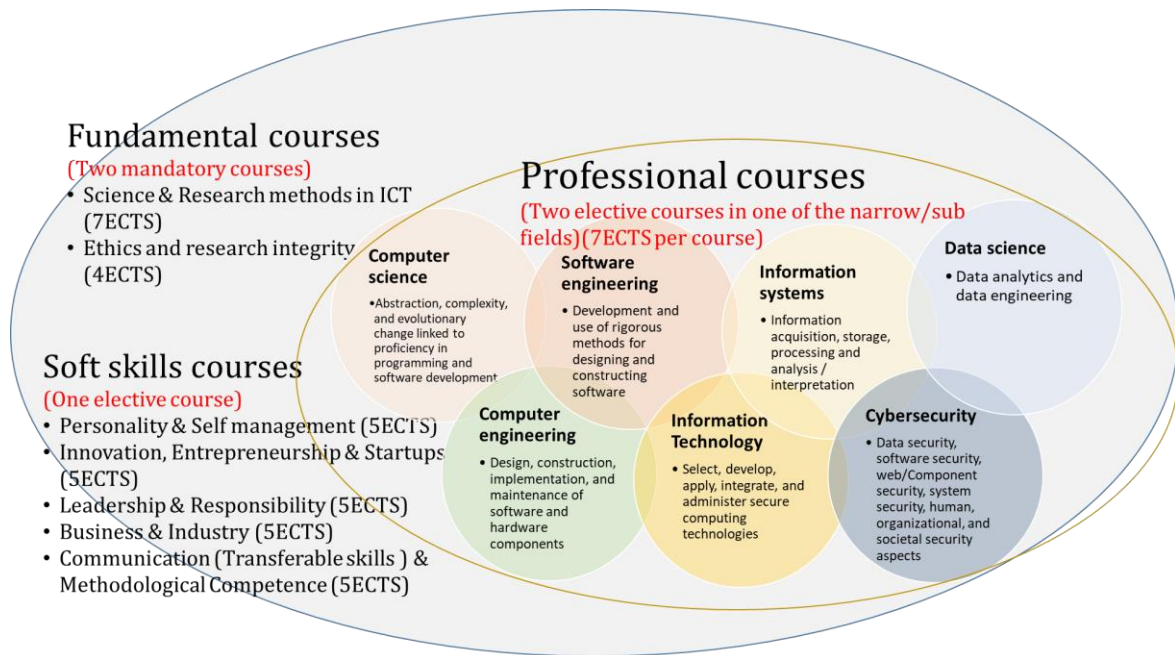


Figure 2 The structure of the course work in the PhD study program

The list of courses include the following:

- **Fundamental courses**, that contain two mandatory courses, each with different ECTS weight:
 - Science and Research methods in ICT (7 ECTS), and
 - Ethics and research integrity (4 ECTS).
- **Soft skills courses**, that contain five possible elective course, each with same 5 ECTS weight:
 - Personality and Self Management,
 - Innovation, Entrepreneurship and Startups,
 - Leadership and Responsibility,
 - Business and Industry,
 - Communication (transferable skills) and Methodological Competence.
- **Professional courses**, that are divided into seven non- exhausted¹ categories, where each has the weight of 7 ECTS credits:
 - *Computer science* courses:
 - Intelligent Systems (AI),
 - Graphics and Visualization,
 - Operating Systems,
 - Data Structures, Algorithms and Complexity,

¹ Additional categories in the field of Information and Communication Technologies may be included in the future.

- Programming Languages.
- *Computer engineering* courses:
 - Architecture and Organization,
 - Parallel and Distributed Computing,
 - Embedded Systems,
 - Internet of Things,
 - Digital Design,
 - Circuits and Electronics,
 - Signal Processing.
- *Software engineering* courses:
 - Requirements Analysis and Specification,
 - Software Quality, Verification and Validation,
 - Software Process,
 - Software Modeling and Analysis,
 - Software Design,
 - User Experience Design.
- *Information technology* courses:
 - Computer Networks,
 - Virtual Systems and Services,
 - Integrated Systems Technology,
 - Platform Technologies,
 - Platform-Based Development.
- *Information systems* courses:
 - Data and Information Management,
 - Systems Analysis and Design,
 - Computing Systems Fundamentals,
 - Project Management,
 - Enterprise Architecture,
 - IS Management and Leadership,
 - Social Issues and Professional Practice.
- *Data science* courses
 - Computing Fundamentals,
 - Data Acquisition and Governance,
 - Data Management, Storage, and Retrieval,

- Data Privacy, Security, and Integrity,
- Machine Learning,
- Data Mining,
- Big Data,
- Analysis and Presentation,
- Professionalism.
- *Cybersecurity* courses:
 - Data Security,
 - Software Security,
 - Web/Component Security,
 - System Security,
 - Human, Organizational, and Societal Security Aspects.

Thesis proposal

The thesis proposal and the PhD seminar (27+ 3 = 30ECTS credits):

- Thesis proposal could be reshaped within the first 12 months and the recent updates needs to be presented in front colleagues and/or the department staff, after they received and had time to review the proposal (2 weeks),
- The thesis proposal will be prepared under the supervision of a potential supervisor,
- It will be defended in front of the council of doctoral studies at the faculty level,
- It will be approved by the respective committees (council of doctoral studies and the faculty council) by the end of the second semester,
- The doctoral candidates, as long as they are students, must present at the fourth and sixth semester their achievements in the PhD seminar. In addition, they must attend every presentation that is given at the PhD seminar starting from their second semester.

Publications and international research mobility

Publications and international research mobility (60 ECTS credits):

- (30 ECTS) Doctoral candidates required to publish at least one paper as a first or corresponding author in a peer-reviewed journal relevant to the field that is indexed in one of the following platforms:
 - Web of Science (Science Citation Index Expanded – SCIE),
 - Scopus (Quartile 1 – Q1 or Quartile 2 – Q2),

- Norwegian Register for Scientific Journals, Series and Publishers (2-highest level, 1-minimum requirement).
- (20 ECTS) Presentation of the research results in at least one international conference which is indexed in the web portal called as “Computing Research and Education” abbreviated as CORE ranking (A*, A or B), where the presented papers are published in the form of book proceedings with allocated ISBN and ISSN numbers,
- (10 ECTS) Study or research visit or research collaboration from host institution in/with at least one international research institution or summer school and, upon the completion, presentation of the results in a domestic or international venue (at least 10*25=250 working hours ~ 31 working days ~ 6 working weeks) and providing results in at least a common research publication or obtaining proof of a successful completion of the summer school.

The PhD thesis

The PhD thesis, confirmed by the candidate to be his/her original work, can be written in one of the two forms:

- Research monograph,
- Compilation of at least four research papers that are related to their PhD topic, where the PhD student is the first author, and at least one of the papers is published in peer-reviewed journals relevant to the field (index in WoS or Scopus (Q1 and Q2), Norwegian Register for Scientific Journals, Series and Publishers (2-highest level, 1-minimum requirement) and at least one conference paper is published in conferences that are indexed in CORE ranking (A*, A or B):
 - In this case, besides including the four papers, the PhD thesis should contain a general first section which outlines the introduction, methodology and a conclusion with main findings
- In order to facilitate international assessment and transparency, the PhD thesis should be written in English (whereas the abstract in Albanian) and the final version be publicly available,
- Doctoral candidates have to submit their thesis to the doctoral committee and participate in the oral public defense,
- All the members of the doctoral committee must be established authorities in the research field. The committee must have at least one external member from a domestic or international institution,

- The supervisor/co-supervisor should not serve as a member of the doctoral committee.

Figure 3 presents the main components that need to be included into the PhD thesis in this study program, as in the following: (1) elaboration of the research topics and issues, (2) research design, (3) theoretical and empirical background, and (4) contribution to knowledge.

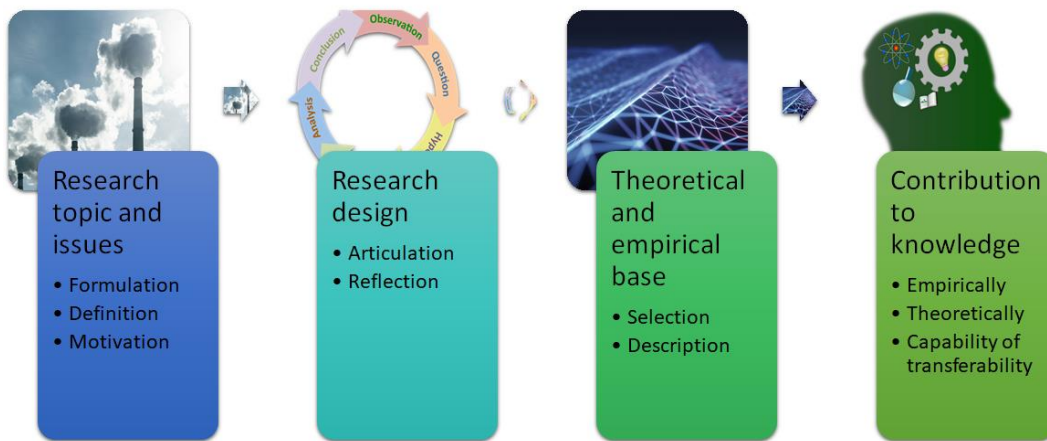


Figure 3 The main components of the PhD thesis

Supervising

This section outlines the main aspects about supervising, both from student and supervisor perspective, as given below:

- Supervisor should be appointed when the student gets admitted, one main supervisor and co-supervisors depending on the needs of the student. Supervisors should also support the student on which type of courses to be taken,
- The supervisor should not have more than three doctoral candidates at a given time,
- The supervisor must be a member of academic staff of the institution, hold a PhD and an approved academic title, be an active researcher in the field, with a minimum of three years' research experience following the award of his/her PhD; he/she must have at least 3 papers published in international relevant publications in the last 5 years (relevance of publications is defined according to international criteria for the particular field of science-indexed in WoS and/or SCOPUS),

- The supervisor must have experience in research projects and proven participation in international academic conferences and workshops relevant to the field,
- The co-supervisor can be from the host institution or external members from a domestic or international institution,
- The doctoral candidate will prepare her/his thesis proposal under the supervision of a potential supervisor and, if applicable, someone from industry can also be included to assure that the topic is current and applied,
- If the doctoral candidate is engaged in teaching, then:
 - The courses and/or supervisory task should be related to their research topic,
 - She/he must plan the teaching material under the supervision of the supervisor at least one semester before the course is taught, and
 - The doctoral candidate should get appropriate training for the teaching skills.
- The doctoral candidate and the supervisor must meet regularly (at least once in a month) and, if needed, more frequently in the beginning and at the end of the PhD study period,
- The Center for Career Development should be a facilitator between students, faculties and companies with the aim of strengthening collaboration and elevating the level of student readiness for the labor market.

Progress reports

This section summarizes the main aspects about progress reports on various levels (see Figure 4), as given below:

- The student makes a yearly report about her/his progress on the doctoral studies according to the defined templates,
- The supervisor makes a yearly report about the progress of the candidates she/he is supervising according to the defined templates,
- The council of doctoral studies at the faculty level, based on the reports of the students and the supervisors, makes a self-evaluation report on a yearly basis,
- The report of the council of doctoral studies is discussed by the council of the faculty and the central council of doctoral studies at the university level.

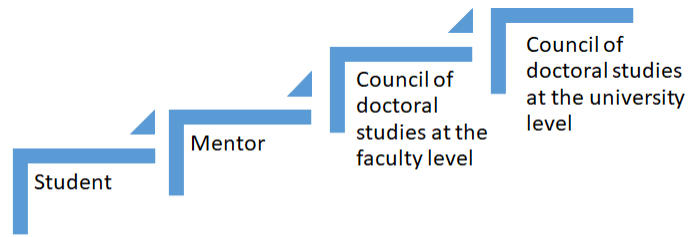


Figure 4 Different levels of reporting

Pausing studies

This section outlines the main details about pausing studies as given below:

- The doctoral candidates must submit their request for pausing the studies for a specific semester, which will have to be approved before it comes into effect,
- The maximal number of approvals for pausing the studies can be at most four semesters,
- During the pausing period there are no financial obligations, no supervision provided and the time period is not included in the overall study duration.

Methodology

The first draft of the PhD curricula in ICT was presented and discussed in the workshop organised on 29th of October 2021 by UP who are leading the Working Package 2. Within the DI-PhDICTKES project, the workshop is planned under the activity with the name “WP 2.3.3 Designing a three-year PhD curricula in ICT.

In this workshop, 17 attendees from all 6 consortium partner universities (University of Prishtina - UP, University of Prizren - UPZ, UBT college, Norwegian University of Science and Technology - NTNU, Linnaeus University - LNU and South-East European Research Centre - SEERC) with the objective to create a deliverable about the a three-year PhD curricula in ICT. In the group work session of the workshop, four different groups were created and assigned with a task of drafting the main components of the PhD curricula. All of the participants are presented with an initial draft of the PhD curricula, which could be commented and refined within a period of two months, as agreed among the participants.

Group name	Participants	Parts to be worked on
GROUP 1	<ul style="list-style-type: none"> ● Kadri Sylejmani (UP) ● Arianit Kurti (LNU) ● Arsim Susuri (UPZ) ● Faouzi Alaya Cheikh (NTNU) ● Edmond Jajaga (UBT) 	<ul style="list-style-type: none"> ● Vision and mission statement ● Learning outcomes/objectives of the PhD study program in ICT ● PhD study program structure
GROUP 2	<ul style="list-style-type: none"> ● Eliot Bytyçi (UP) ● Faton Maliqi (UBT) ● Kujtim Rahmani (PhD graduate from Universität der Bundeswehr München) 	<ul style="list-style-type: none"> ● Admission requirements ● Course work ● Thesis proposal
GROUP 3	<ul style="list-style-type: none"> ● Lule Ahmedi (UP) ● Ziriye Hasani (UPZ) ● Krenare Pireva(UBT) ● Sule Yayilgan (NTNU) 	<ul style="list-style-type: none"> ● Publications and international research mobility ● PhD thesis
GROUP 4	<ul style="list-style-type: none"> ● Ermir Rogova (UP) ● Muhamed Ali (NTNU) ● Yannis Spyridis (SEERC) ● Faton Berisha (UP) ● Anita Mirijamdotter (LNU) 	<ul style="list-style-type: none"> ● Supervising ● Progress reports ● Pausing studies