**State rigorous exam to obtain the postgraduate academic degree of PhDr. in the study program "Teacher Training in Computer Science for upper primary schools".**

**Examination board:**

Chairman: doc. PhDr. Milan Klement, Ph.D.

Members: doc. PhDr. PaedDr. Jiří Dostál, Ph.D.

doc. RNDr. Petr Šaloun, Ph.D.

doc. Ing. Čestmír Serafín, Dr.

Mgr. Jan Kubrický, Ph.D.

External member: doc. PaedDr. Ludvík Eger, CSc., FE, Západočeská univerzita v Plzni

**Parts of the state rigorous exam and their contents:**

At the state rigorous exam, the candidate shall demonstrate deeper theoretical knowledge in the particular field as well as in its broader scientific basis, the ability to acquire new scientific knowledge, evaluate it and use it in a creative way.

The candidate is allowed to register for the state doctoral exam after submitting the rigorous thesis and substantiating the required background materials.

The state rigorous exam comprises two areas:

- theoretical and methodological basis of the field, i.e. didactics of computer science,

- thematic focus of rigorous work.

The candidate shall submit at the exam a list of his / her publishing activities, presentations, an overview of his / her conference speeches and/or papers, and the theses of his / her rigorous thesis (the former must be submitted by the applicant together with the application for the state rigorous exam). The candidate shall briefly characterize the goals, theoretical background, methods, and preliminary results of his / her rigorous work at the examination board. The general content of the examination is determined by the appointed board after a discussion with the consultant.

**Rigorous exam topics outline:**

- Gifted student in computer science.

- Training in computer science as a part of career guidance for pupils.

- Typology of learning tasks in computer science and their influence on the development of computational thinking.

- E-learning - aided project teaching in computer science.

- New learning environments in computer science.

- Interactive simulations and new technologies in computer science.

- Inquiry approach to educational activities in computer science.

- Interdisciplinary relations in computer science.

- New knowledge in computer science and its influence on school curriculum innovation.

- Robotic systems in teaching computer science.

- Teacher of computer science at primary and secondary schools in the Czech Republic and abroad.

- Information and systems theories and the influence of their application in computer science didactics.

- Teaching computer science in European Union countries (computer science curriculum for primary and secondary schools, educational goals, key concepts, outputs, content and performance standard).

- Programming as a part of computer science teaching at primary schools.

- Computer animation and simulation models and their applications in teaching.

- Interactive electronic textbooks and educational materials in computer science.

- The influence of information and communication technologies on the learning of pupils and students.

- Research of professional competencies of ICT teachers in connection with the change of the educational paradigm.

- Connectivism as a determinant of the development of the secondary education system.

- The contribution of learning based on the concept of connectivism to the development of the pupil's personality.

- Bounds and limits of teachers` training in a virtual environment.

- Possibilities of evaluation of electronic educational materials.

- Multimedia and interactivity of educational materials - bounds and limits.

- Virtualization and possibilities of its use for building virtual educational environments.

- Virtualization as a tool for consolidation of the School Information System, and its hardware and software components.

**Rigorous exam questions – Computer science didactics:**

1. Didactics of computer science as a pedagogical discipline - basic concepts, action research as a tool of teaching optimization. Current requirements for the educational content / possibilities of education in the teaching of computer science. Integrated teaching, types of integration in computer science teaching, interdisciplinary relationships - classification.
2. Teaching objectives and teaching content - definition of the concept of computer science from this point of view, ICT, their characteristics and basic regularities, relation to general and professional education, computational thinking and computer literacy.
3. The concept of curriculum - starting points, transformation of selected contents into the curriculum (learning material vs. curriculum). Framework educational program, school educational program.
4. Non-traditional teaching methods - project teaching, research-oriented teaching, cooperative teaching, problem-based teaching, individualization, activation, nature and principles of pupil inquiry in computer science teaching, the concept of "research-oriented teaching / tuition / learning", the role of teacher and student in research -oriented teaching.
5. Suitable topics for pupil inquiry in teaching computer science - induction, management and evaluation of pupils` inquiry activities. Pupils' emotions related to inquiry, the use of such emotions for the motivation purposes, principles of pupil activation, use of digital technologies for pupil inquiry.
6. Project as a method emphasizing broader aspects of education supported by information technologies - approaches to assessing the quality, difficulty and adequacy of projects for primary school pupils.
7. Educational software applicable to touch didactic techniques - practical examples of possible uses of particular educational software in teaching, selection criteria, parameters, requirements.
8. Touch devices in education as a modern didactic tool (i.e. control interface in robotics, tool for the implementation of augmented reality, etc.).
9. Development of distance forms of education implemented in the form of e-learning - development of distance forms of education, basic principles of distance education (programmed learning), curriculum programming (linear and branched programs).
10. E-learning and its application in education - definition of the term e-learning, broader and narrower concept of e-learning, and their differences, components of e-learning, LMS system and its characteristics and functions, electronic study support and its components.
11. Activation of students in e-learning - the role of the teacher in e-learning, the educated individual and the possibilities of his / her activation, the use of modernization elements in e-learning (m-learning, virtual reality, simulation, etc.), communication channels in e-learning.
12. E-twinning - support for school partnerships for the purpose of technology-aided education, technology for the school agenda - pupil attendance, electronic pupil book, class register, report cards, etc.

**Recommended study literature on Computer science didactics:**

* BERTRAND, Y. *Soudobé teorie vzdělávání*. 1. vyd., Praha: Portál, 1998. 247 s. ISBN 80-7178-216-5.
* Botek, Z. *Základy informačních technologií*. Zlín: Univerzita Tomáše Bati ve Zlíně, 2013. 112 s. ISBN 978-80-7454-313-5.
* BURIANOVÁ, E. *Úvod do didaktiky informatiky*. Vyd. 1. Ostrava: Ostravská univerzita, 2003. 61 s. Systém celoživotního vzdělávání Moravskoslezska. ISBN 80-7042-873-2.
* BURIANOVÁ, E. Vybrané kapitoly z didaktiky informatiky. Vyd. 1. Ostrava: Ostravská univerzita, 2003. 56 s. Systém celoživotního vzdělávání Moravskoslezska. ISBN 80-7042-870-8.
* ČANDÍK, M. a CHUDÝ, Š. *Didaktika informatiky*. Vyd. 1. Zlín: Univerzita Tomáše Bati ve Zlíně, 2005. 133 s. Učební texty vysokých škol. ISBN 80-7318-285-8.
* DOSTÁL, J. *Badatelsky orientovaná výuka: Pojetí, podstata, význam a přínosy*. Olomouc: Univerzita Palackého, 2015. 151 s. ISBN 978-80-244-4393-5. DOI: 10.5507/pdf.15.24443935.
* HADJERROUIT, S. *Didactics* of ICT in Secondary Education: Conceptual Issues and Practical Perspectives. University of Agder, Kristiansand, Norwa. Issues in Informing Science and Information Technology. Vol.6 2009 Dostupné na <http://iisit.org/Vol6/IISITv6p153-178Hadjerrouit605.pdf>
* CHRÁSKA, M. a kol. Měnící se role učitele a žáka v nastupující informační společnosti ve vztahu k požadavkům státní koncepce informační politiky. Olomouc: Votobia, 2006. ISBN 80-7220-250-X.
* JANÍK, T. a I. STUCHLÍKOVÁ. Oborové didaktiky na vzestupu: přehled aktuálních vývojových tendencí. *Scientia in educatione.* 2010, roč. 1, č. 1, s. 5 – 32. ISSN 1804-7106.
* KLEMENT, M., DOSTÁL, J., BÁRTEK, K. Perception and Possibilities of ICT Tools in the Education from the Teachers’ Perspective. 1. vyd., Olomouc, Vydavatelství UP, 2017, 170 s. ISBN 978-80-244-5093-3. Accession Number (Web of Science): WOS:000419931900001.
* KLEMENT, M., DOSTÁL, J., KUBRICKÝ, J., BÁRTEK, K. ICT nástroje a učitelé: adorace, či rezistence? 1. vyd., Olomouc, Vydavatelství UP, 2017, 321 s. ISBN 978-80-244-5092-6.
* KLEMENT, M. et al. *E-learning: elektronické studijní opory a jejich hodnocení*. 1. vyd. Olomouc: Agentura Gevak, 2012. 341 s. ISBN 978-80-86768-38-0.
* KLEMENT, M., CHRÁSKA, M., DOSTÁL, J., MAREŠOVÁ, H. *E-learning: elektronické studijní opory a jejich hodnocení.* Olomouc: Ladislav Velfl, 2012. s. 112 – 165. ISBN 978-80-86768-38-0.
* Prášilová, M. *Tvorba vzdělávacího programu*. 1. vyd. Praha: Triton, 2006. První pomoc pro pedagogy; 3. ISBN 80-7254-712-7.
* PRŮCHA, J. A MÍKA, J. *Distanční studium v otázkách*. 1. vyd., Praha: Národní centrum distančního vzdělávání, 2000. 39 s. ISBN 80-86302-16-4.
* SAK, P. a kol. *Člověk a vzdělávání v informační společnosti.* Praha: Portál, 2007. ISBN 978-80-7367-230-0.
* STOFFOVÁ, V. et. al. *Informatika, informačné technológie a výpočtová technika* : Terminologický a výkladov slovník. 1. vyd. Nitra: Fakulta prírodných vied UKF v Nitre, 2001. 230 s. ISBN 80-8050-450-4.
* ZOUNEK, J. a SUDICKÝ, P. E-learning: učení (se) s online technologiemi. Vyd. 1. Praha: Wolters Kluwer Česká republika, 2012. xix, 226 s. ISBN 978-80-7357-903-6.

**Rigorous exam questions – Thematic focus of the rigorous thesis:**

1. Computer science and education - information and digital technologies, information and digital literacy, information society, education in the information society, information education.

2. School information system and approaches to its creation - the possibility of using the Internet in Education network, ICT in teaching, ICT support for teaching students, preparation for teaching using ICT.

3. Programming of complex applications in the development environment and versioning - creation of local and web applications, use of selected language resources and possible examples of typical constructions.

4. Selected constructions in the selected programming language - scripting, control of program operation, interconnection with the database, parallel or distributed program operation.

5. Modern didactic tools - interactive whiteboards, their types, possibilities of their use in teaching. Presentation technology (data projectors, visualizers, etc.), its classification and function.

6. Multimedia in teaching and possibilities of their use - Bloom's taxonomy in the digital world, non-traditional possibilities (ideas) for creating video in teaching, types of multimedia presentations.

7. Virtualization technologies and their use for the operation of the school information system - virtualization and its implementation, the classification of virtualization technologies, types of virtualization tools, the use of virtualization tools and the basic principles of creating virtual machines.

8. VMware vSphere virtualization software - use of VMware vSphere virtualization tool, structure of virtualization data centre built on VMware vSphere platform, work with virtual machines in VMware vSphere.

9. Teacher preparation for teaching in the laboratory - robotic kits and school practice, overview of robotic kits, principles of creating didactic material for working with robotic kits.

10. Application of LEGO Mindstorms Education kits (RCX, NXT, EV3) in education - development environment and programming software ROBOLAB, LEGO Mindstorms Education NXT software, LEGO Mindstorms Education EV3 software. Arduino kit concept, sensors.

11. System and application software - operating system architecture, types and classification of operating systems, BIOS, basic classification of application software, characteristics of individual types of programs, types of licenses, license validity, Microsoft licensing model, EULA, Microsoft licensing programs, Open Source licensing model.

12. Architecture of computer networks - types and topology of computer networks, types of communication media (cabling), characteristics of network protocols, ISO OSI protocol and its structure, TCP / IP protocol and its structure.

**Recommended study literature for Thematic focus of the rigorous thesis:**

* BENEŠ, P. a kol.  *Automatizace a automatizační technika: automatické řízení*. 1. vyd. Brno: Computer Press, 2012. ISBN 978-802-5141-069.
* BIERDSDORFER, J. D*. iPad : The missing manual.* 5th edition. USA: O’Reilly Media Inc., 2013. ISBN 978-1-449-32556-5.
* Brookshear, J. Glenn, Smith, David T., Brylow, Dennis. *Informatika*. Brno: Computer Press, 2013. 608 s. ISBN 978-80-251-3805-2.
* DALY, J. Alan. *Social network theory and educational change*. Cambridge, Mass.: Harvard Education Press, 2010. 330 p. ISBN 9781934742808.
* DOSTÁL, J. *Výukové programy*. Olomouc: PdF UP, 2011. ISBN 978-80-244-2804-8.
* GALBA, Alexander. *Moderní informatika*. 1. vyd. Praha: Professional Publishing, 2012. ISBN 978-807-4310-959.
* GLIKSMAN, S. *iPad in Education for Dummies.* 1st edition. Hoboken: John Wiley & Sons, Inc., 2013. 419 s. ISBN 978-1-118-37538-9.
* KABELOVÁ, Alena. *Velký průvodce protokoly TCP/IP a systémem DNS*. 3. aktualiz. vyd., Praha: Computer Press, 2002. 542 s. ISBN 80-7226-675-6.
* KALUŽA, Jindřich a Ludmila KALUŽOVÁ. *Informatika*. 1. vyd. Praha: Ekopress, 2012, 130 s. ISBN 978-80-86929-83-5.
* KLEMENT, M., BÁRTEK, K. Od digitální gramotnosti k informatickému myšlení – koncepce, obsah a realizace výuky informatiky z pohledu jejich aktérů. 1. vyd., Olomouc, Vydavatelství UP, 2019, 244 s. ISBN 978-80-244-5549-5. DOI: 10.5507/pdf.19.24455495.
* KLEMENT, M. a J., LAVRINČÍK. *Elektronická učebnice programování on-line*. 1. vyd., Olomouc: Jiří Dostál, 2011. 189 s. Dostupné na adrese: <http://www.pros.upol.cz/files/others/ucebnice-online-v3/index.htm>
* KLEMENT, M. *Pokročilé kreslení 3D výkresů v AutoCADu 2013*. 1. vyd., Olomouc: Jiří Dostál, 2013. 55 s. ISBN 978-80-87658-06-2
* KLEMENT, M. *Základy kreslení 3D výkresů v AutoCADu 2013*. 1. vyd., Olomouc: Jiří Dostál, 2013. 57 s. ISBN 978-80-87658-05-5**.**
* KLEMENT, Milan. *Principy a možnosti počítačových sítí*. 1. vyd., Olomouc: agentura GEVAK, 2013. 88 s. ISBN 978-80-86768-41-0.
* KLEMENT, Milan. *Virtualizace a instalace OS Windows*. 1. vyd., Olomouc: Vydavatelství UP, 2015. 58 s. ISBN 978-80-244-4568-7.
* KLEMENT, Milan. *Výpočetní technika - hardware a software*. 1. vyd., Olomouc: Vydavatelství UP, 2002. 178 s. ISBN 80-244-4012-6.
* PARK, E. J. *Lego Mindstorms EV3: stavíme a programujeme roboty*. 1. vyd. Brno: Computer Press, 2015. 373 s. ISBN 978-80-251-4385-8.
* PORTER, Sarah. *To MOOC or not to MOOC : how can online learning help to build the future of higher education?* Waltham, MA: Chandos Publishing is an imprint of Elsevier. 2015. 208 p. ISBN 9780081000618.
* UDEN Lorna (eds). *Learning technology for education in cloud : MOOC and big data : third International Workshop, LTEC 201*4, Santiago, Chile, September 2-5, 2014. Proceedings. Cham : Springer, 2014. 203 p. ISBN 9783319106717.