



**7th INTERNATIONAL DOCTORAL CONSORTIUM ON  
INFORMATICS ENGINEERING EDUCATION  
RESEARCH  
IEER**

**International annual event, organized since 2010 by the Vilnius  
University Institute of Mathematics and Informatics**

Organisers:  
Prof. dr. Valentina Dagiene, chair  
Dr. Anita Juškevičienė

November 30 – December 4, 2016  
Druskininkai, Lithuania

The 7th International Doctoral Consortium is organized by Vilnius University Institute of Mathematics and Informatics on November 30 – December 4, 2016 in Druskininkai, Lithuania.

**The aims of the Doctoral Consortium are:**

- To offer a friendly forum for doctoral students to discuss their research topics, research questions and design in the field of computing education / educational technology – informatics engineering and education.
- To receive constructive feedback from their peers and senior researchers, to help with choosing suitable methodology and strategies for research.
- To support networking with other researchers in the informatics engineering education research field.
- To discuss any relevant questions related to research and academic life.

**Participants**

The doctoral consortium is designed primarily for students who are currently enrolled in any stage of doctoral studies with a focus on informatics / informatics engineering / computing education research. Students, who are considering doctoral studies but not have yet a formal doctoral student researcher status, may participate as well.

Senior researchers in the field will provide feedback and suggestions for improvement of the research proposals.

**Requirements**

Each participant should submit a document, which includes the following information:

- a brief background of the applicant including information about prior studies, research topic, publications if any, and possible teaching experience;
- a summary of his/her research, including motivation, any relevant background, and main literature to contextualize the research, research questions, methodologies used or planned, and possible results obtained;
- questions related to the research that the applicant would like to discuss and get feedback on in the doctoral school.

The summary will be made available for other participants of the doctoral school to allow providing feedback and preparing questions on the research.

**AGENDA****Wednesday, November 30<sup>th</sup>**

- 14:30 Bus from Vilnius airport
- 18.30 Dinner - Welcome and discussion

**Thursday, December 1<sup>st</sup>**

- 08.00 – 09.00 Breakfast
- 09.00 – 09.30 Valentina Dagienė. Introduction. Welcome everybody
- 09.30 – 10.15 Arnold Pears (Uppsala university, Sweden). What characterises engineering education?
- 10.15 – 11.00 Erkki Sutinen (University of Turku, Finland). Co-design
- 11.00 – 11.30 Coffee break
- 11.30 – 13.00 Don Passey (Lancaster University, United Kingdom). Learning, data and methodological approaches – qualitative, quantitative or mixed methods dilemmas
- 13.00 – 14.00 Lunch
- 14.30 – 16.00 Work in small groups (2-3 students with a senior researcher): students present to senior researchers the research question, objectives/goals, current and expected contributions  
Coordinators: Lilia Georgieva, Don Passey, Arnold Pears, Erkki Sutinen
- 16.00 – 16.30 Coffee break
- 16.30 – 17.30 Continuation of the work in small groups
- 17.30 – 18.30 Dinner
- 18.30 – 20.00 Continuation of the work in small groups

**Friday, December 2<sup>nd</sup>**

- 08.00 – 09.00 Breakfast
- 09.00 – 10.30 Student's poster presentation: your BIG research idea (5 min. for each+ 5 min. questions): students present their BIG research idea: the clear formulation of the research question, the identified significant problems in the field of the research.
- 11.00 – 12.00 8th International Workshop „Data Analysis Methods for Software Systems“. Druskininkai, Lithuania, Hotel „Europa Royale“. Don Passey, Erkki Sutinen, Márton Visnovitz
- 13.00 – 14.00 Lunch
- 14.00 – 16.00 Reflection on students' posters: all participants will read posters and write down their questions and comments.
- 16.00 – 16.30 Coffee break
- 16.30 – 17.30 Individual work. Improve (re-write) your poster which summarizes your research: BIG research question, goal, subtasks, data collection and analysis methods, theoretical framework, scope, and use of results
- 17.30 – 18.30 Dinner

18.30 – 20.00 Work in small groups (2-3 students with a senior researcher)

Coordinators: Lilia Georgieva, Don Passey, Arnold Pears

**Saturday, December 3<sup>rd</sup>**

08.00 – 09.00 Breakfast

09.00 – 10.00 Arnold Pears (Uppsala university, Sweden). The rise and fall of MOOC: what can we learn about the education of the future?

10.00 – 11.00 Georgieva, Lilia (Herriot-Watt university, United Kingdom). Experiences with research, supervision, and involvement in activities promoting engagement of female computer scientists

11.00 – 11.30 Coffee break

11.30 – 13.00 Individual work. Improve your poster again

13.00 – 14.00 Lunch

14.00 – 16.00 Final presentation of your research work and discussion (10 min. for each student): students present the research to all participants

16.00 – 16.30 Coffee break

16.30 – 17.30 Final discussion and overview (all supervisors)

17.30 – 18.30 Dinner

**Sunday, December 4<sup>th</sup>**

07.30 – 09.00 Breakfast

9.00 Departure to Vilnius airport

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## SENIOR RESEARCHERS

### EXPERIENCES WITH RESEARCH, SUPERVISION, AND INVOLVEMENT IN ACTIVITIES PROMOTING ENGAGEMENT OF FEMALE COMPUTER SCIENTISTS

#### Lilia Georgieva



Dr. Lilia Georgieva has a PhD in Computer Science, University of Manchester.

Lialia's research interests include the area of applications of formal methods to program analysis, knowledge and data representation, and security.

**Program analysis.** Focused on establishing correctness of imperative programs that manipulate linked data structures. Linked data structures are ubiquitous in such programs, and can potentially lead to errors that are difficult to detect. We use logic to model, discover and verify properties of linked, dynamically allocated data structures and to verify high-level correctness properties of programs. Her research on program analysis uses formal languages like the description logics which capture the underlying data structures.

**Knowledge Representation.** Specific domain knowledge is required for many versatile applications such as modelling and reasoning about software systems, network modelling, modelling of cryptographic protocols, semantic web. Flexible ways for representing and encoding updatable knowledge are based on various extensions of classical logic: modal logic, agents logics, or description logics. They can be used to reason about the terminology of a domain or the behaviour of systems. Computer-based tools can then use this kind of reasoning to support the user. She has worked on novel approaches to representing semi-structured data, ontology verification, and data cleaning.

**Security.** Ubiquitous computing has led to development of new kinds of networks, including small operators, community networks, cellular operators in shared spectrum, mash networks, hybrid ad-hoc networks. New wireless communication technologies, e.g. cognitive radios, MIMO, directional antennas have also been developed. Security of the new wireless networks and technologies is a recognised challenge. Security threats to wireless networks such as node compromise or jamming have been identified. Her research provides a new perspective to establishing security of wireless networks.

**Data cleaning.** Data cleaning is the process of identifying and removing duplicate and/or inconsistent data on the web. Such data can be identified using a number of different techniques including using statistical approaches, Grammar based approaches, or description logics.

**Parallel programming.** She has worked on performance analysis of distributed-memory parallel functional languages, specifically on design, implementation and evaluation of parallel functional profilers.

**Research students:** five PhD students successfully completed in the areas of theorem proving, parallel programming and modelling and verification, and data cleaning between 2008-2016. One MPhil Student successfully completed: 2012.

Over 50 MSc students have successfully completed under my supervision.

#### **Her presentation session**

The experiences with research, supervision, and involvement in activities promoting engagement of female computer scientists (ACM and the European Commission)

## LEARNING, DATA AND METHODOLOGICAL APPROACHES – QUALITATIVE, QUANTITATIVE OR MIXED METHODS DILEMMAS

### Don Passey



Professor Dr. Don Passey is a full professor of technology enhanced learning in the Department of Educational Research, Lancaster University, UK. He is the Director of the Centre for Technology Enhanced Learning and the Director of Studies for the Doctoral Programme in e-Research and Technology Enhanced Learning, which recruits some 25 doctoral students annually, and is currently supporting some 100 students worldwide. Don's main concern is with learning, and how digital technologies can support learning and teaching. He has conducted over 60 studies in the past 12 years, identifying innovative as well as successful and effective practices, in classrooms, after-school activities, and home and community settings. Commissioned studies have informed policy and practice, for EU and UK government departments and agencies, national support agencies, regional and local authorities, corporations including the BBC, and a wide variety of companies. He has published widely; within his total output of currently 186 publications, he has singled authored and co-authored 16 peer-reviewed journal articles, 11 monographs, books or special issues, 47 book chapters, 78 reports to funders, and 14 articles in professional journals. He is a long-standing member of the International Federation for Information Processing, is vice-chair of their Technical Committee on Education, chair of their Working Group on Information Technology in Educational Management, and in 2014 received an Outstanding Services Award and in 2016 the Silver Core Award for his contribution to the field.

#### His research interests

- The development of blended and online learning approaches internationally, in higher and adult education.
- Teaching and learning outcomes arising from uses of leading edge technologies, from primary to adult learning.
- Implementation and management of leading edge technologies at national, regional, local authority and individual institution levels.
- Uses of data and development of data systems to support curriculum and educational practices.
- How home and out-of-school practices (formal and informal learning) can enhance and support learning at an individual learner level.
- How technologies support young people who are at risk of learning exclusion or who are 'hard to reach'.
- How evaluation and research can be undertaken to support policy and practice.

#### His presentation session

Educational outcomes, even at an individual learner level, are often now recorded or integrated through digital management systems, which collect increasing quantities and forms of background data. Arguments are made that these forms of data can be used to interpret features of use and of users that will inform better learning. Some previous research studies have explored learning features of the individual, using background data in qualitative ways (sometimes displaying outcomes through forms of imagery). Other previous studies have used much wider sets of data, gathered from across (sometimes very large) numbers of users; interpretations of those data are sometimes stated to say something about an individual's learning from a statistical or quantitative perspective. Increasingly, mixed methods are argued as an important alternative. However, the length of study also needs to be considered as a critical associated dilemma. This talk explores these different paradigms and perspectives, arguing that dilemmas in the choice of methodological approach when studying technologies used for learning are not the only or necessarily the key dilemmas that researchers face if their research findings are to be of value to the field of education

and learning. Different stakeholders – policy makers, educational advisers, head teachers or principals, teachers, parents, students, educational software developers – all need specific forms of data output if they are individually to be most effectively supported in terms of enhancing learning or teaching. A number of studies and their outcomes will be used to illustrate current and future implications and dilemmas we face in this field.

## WHAT CHARACTERISES ENGINEERING EDUCATION?

### Arnold Pears



Dr. Arnold Pears is Associate Professor, Deputy Head of Department and Head of Education at the IT Department of Uppsala University, SWEDEN. He leads the UpCERG research group in Computing and Engineering Education at Uppsala University. He is also a Director of the CeTUSS Swedish National

Center for Student and Societally Relevant Engineering Education, Chair of the Strategic Advisory Board of the Uppsala University Center for STEM Higher Education Research, and a member of the Uppsala University Academic Senate, and the pedagogical advisory board to the Faculty of Science and Technology at Uppsala University.

Arnold received his BSc(Hons) and PhD from La Trobe University, Melbourne, AUSTRALIA. Arnold is an IEEE Senior Member and has received the

Computer Society Golden Core Member award (2012) and the Schmitz Award (2012) for services to the Computer Society and its conferences. He has published more than 100 articles and papers in major conferences and journals in Computer Science, Computer Engineering and Computing and Engineering Education and has served as conference and program committee chair for many major conferences under the auspices of the IEEE and ACM.

#### **His presentation session 1. *What characterises engineering education?***

Research questions in STEM disciplines are frequently strongly contextualised in the teaching and learning practice of the researcher. In this paper we chart a number of possible paths a researcher can follow from a single research proposition, or fundamental research question, to results which can vary significantly in nature. In order to do this, we establish a theoretical framework for research activity and examine the meaning of “theory” as a cognitive and research tool that helps engineering education practitioners and researchers. The paper reflects on the nature and role of different types of theory at four distinct stages of engineering education research: disciplinary, methodological, analytical, and interpretive. We illustrate how theory applies to the framing and integration of study results, and assists in the process of relating theories of learner development and learning to results of empirical data analysis.

#### **His presentation session 2. *The Rise and Fall of MOOC: What Can we Learn About the Education of the Future?***

The first decade of the 21st century has been overshadowed by the MOOC phenomenon. Academics, policy makers, and think tanks world wide were caught up in a movement widely touted as a panacea to the educational challenges of the century, a paradigm shift, and major game changer in the higher education landscape. MOOC was predicted to threaten the future of traditional universities. MOOC would replace face to face teaching as the dominant paradigm of a new age of digital education without economic, geographical or socio-economic boundaries. Udacity founder Sebastian Thrun was quoted in an article in Wired magazine in March 2012, as follows.

” In 50 years, he [said], there will be only 10 institutions in the world delivering higher education and Udacity has a shot at being one of them. Thrun just has to plot the right course.” He was not alone in predicting the demise of the traditional University! The same year (2012) Ernst and Young Australia published a report on the MOOC phenomenon claiming, “[...] that the dominant university model in Australia — a broad-based teaching and research institution, supported by a large asset base and a



large, predominantly in-house back office — will prove unviable in all but a few cases over the next 10-15 years.” As 2016 draws to a close these bold predictions seem less likely to come to fruition, however, the bold foray into ubiquitous online education has ushered in a new flora of digital resources and delivery platforms for online learners. By reflecting on the MOOC experience we can draw some important lessons with which to fuel our continuing quest for a “Brave New World” of open education for all.

## CO-DESIGN

### Erkki Sutinen



Professor Erkki Sutinen received his PhD in Computer Science (string algorithms) from the University of Helsinki in 1998. Before joining the Department of Information Technology, University of Turku, where he leads Interaction Design, Sutinen established the edTechdelta research group at the then University of Joensuu in 1999. Sutinen’s research is oriented towards designing creative technologies for real-life challenges in a sustainable way, as a co-design process in the relevant cultural context. His current interest is in digital storytelling, applied in terminal care, tourism, and inter-faith dialogue. He has co-supervised almost 30 PhDs, and the portfolio of his externally funded projects is around 6M€.

## DOCTORAL STUDENT FACILITATORS

### Valentina Dagienė



Prof. Dr. Valentina Dagienė is principal researcher and head of Department of Mathematics and Informatics Institute at Vilnius University. She is supervising doctoral students in fields of informatics, informatics engineering and computer science education. The interests include computer science (informatics) teaching and learning strategies, puzzle-based learning, intelligent technologies for education, learning personalisation, semantic web applications. She published over 200 research papers and methodological works, wrote more than 50 textbooks in the field of informatics for schools. She has been working in various expert groups and work groups, organizing the Olympiads in Informatics among students, also engaged in e-learning and problem solving. She is an Executive Editor of international journals "Informatics in Education" and "Olympiads in Informatics". She got the Lithuanian Science Award for cycle of works (2008), the ETH (Zurich, Switzerland) honorary gold medal for contributions to school informatics in Europe (2011) and the Informatics Europe 2015 Best Practices in Education Award for the Bebras.

### Anita Juškevičienė



Dr. Anita Juškevičienė is researcher at the Vilnius University Institute of Mathematics and Informatics. During the period of 2009–2013, she was a PhD student at the Vilnius University Institute of Mathematics and Informatics (technological sciences, informatics engineering). The areas of her scientific interest are technology enhanced learning, intelligent and adaptive systems, recommender systems, semantics and ontology, evaluation of quality of learning software and learning process. She has been working very active on several national projects, helps to organize seminars and conferences. She has published a number of scientific papers and publications in popular magazines, participated in a number of large scale EU-funded R&D projects.

## SUMMARIES OF STUDENTS

### GAMIFICATION IN INFORMATICS ENGINEERING: THE MODEL OF CREATING INTERACTIVE TASKS

#### Gytautas Beresnevičius

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#### Brief Biography

#### Diplomas:

- Bachelor degree in Mathematics and Informatics Teaching at Vilnius University, Mathematics and Informatics faculty.
- Master degree in Mathematics and Informatics Didactics at Vilnius University, Mathematics and Informatics faculty.

#### Paper:

- S. Combéfis, G Beresnevičius, V. Dagienė (2016). Learning Programming through Games and Contests: Overview, Characterisation and Discussion. INTERNATIONAL OLYMPIAD IN INFORMATICS Vol. 10: 39–60. Vilnius: Vilniaus universiteto leidykla. ISSN 1822-7732.

#### Conferences:

1. From 2011-09-30 until 2011-10-02 “Geogebra” conference in Lithuania (Vilnius).
2. From 2012-09-14 until 2012-09-16 “Geogebra” conference in Estonia (Tartu).
3. 2015-07-01 – 2015-07-03 international conference IFIP TC3 Working Conference „*A New Culture of Learning: Computing and Next Generations*“, Vilnius.
4. 2015-12-08 – 2015-12-12 „*International Doctoral Consortium of Informatics Engineering Education Research*“, Druskininkai. My presentation: „*Gamification Methods to Teach Informatics Engineering*“;
5. 2016-05-19 International conference „*Advanced Learning Technologies and Applications – ALTA 2016*“, Kaunas university of technology. My presentation: „*Learning informatics through gamification*“.
6. 2016-09-02 – 2016-09-04 National seminar „*Bebras Lodge*“, Druskininkai.

#### Research area description

##### The problem of research

How to create a valid and useful model of gamification in informatics engineering as well as join technology of templates to create interactive tasks and frameworks of tasks’ components?

### **The aim of research**

When I do the analysis of application of gamification in informatics engineering, I will create the model of gamification in informatics engineering, which will join technology of templates to create interactive tasks as well as frameworks of tasks' components.

### **A presentation of preliminary ideas**

#### **The research questions**

1. How to find valid and useful models from scientific informatics engineering papers?
2. What kind of technologies of templates for creating interactive tasks exists and which of them are valid for joining such templates technology with frameworks of tasks' components?
3. How to create a better model for gamification of templates for creating interactive tasks in "Bebras Lodge" system and what kind of methods use to validate it?

#### **The research tasks**

1. To make the overview and analysis of scientific publications in the area of gamification in informatics engineering.
2. To explore the technology of templates as specification and application of method for creating interactive tasks.
3. To create the model of gamification for interactive tasks, which is based on technology of templates and frameworks of components of tasks.
4. To realize model of creating interactive tasks and validate it in "Bebras Lodge" system.

#### **What I plan to do**

- To improve analysis of publications in area of gamification in informatics engineering.
- To define and classify classes of informatics and informatics engineering interactive tasks; system them and create schema of improved templates to create such tasks.
- To expand "Bebras Lodge" system's possibilities of templates of creating interactive tasks.
- To make recommendations for making frameworks of components of interactive tasks.
- To create model of gamification of interactive tasks; validate it; try it and apply it into "Bebras Lodge" system.

I was interested in computer science, especially in some applications of programming languages that allows producing dynamic programs on the internet on browsers. I became interested in creating websites when I created my first website after I finished IT subject in 3 year of my bachelor studies.

Educational games are games, which educate skills or improve knowledge of one or more kind of science area (such as mathematics, computer science, and physics). Nowadays majority pupils and students use web browsers to entertain themselves on their free time. It is good thing not only to be entertained, but also at the same time learn some useful knowledge or acquire skills in computer science. One aspect of informatics engineering is that people apply computer science knowledge and skills to obtain some kind of science area.

Educational games improve cooperating, where players communicate with friends, who play the same game at the same time. It also improves logic thinking, helps to understand principles of the science, which game educates the student. (Andreas Schäfer, 2013).

There are many important factors for educational games to be successful. E. g., a feedback is an important and necessary part in education and educational games (Azmi et al., 2015; Cuba-Ricardo et al., 2015; Tillmann et al., 2013). The embedding of gamification in programming courses can be one of solutions for that: it can help to maximize student participation and learning, motivate and reduce dropout rates, especially for novices in programming (Azmi et al., 2015). The most successful factors are multiple modalities of games, players' collaboration, adaptive or personalized game components based on real world sensory data (Laamarti et al., 2014).

### **Expectations and motivation to attend Doctoral Consortium**

I want to participate in Doctoral Consortium, because I want to know about applications of computer science and teaching practice of other more experienced lecturers, assistant professors, professors, and PhD students' works, articles and plans what they intend to write, especially if it is concerned on computer science applications, or method about validation of models, or technologies of creating templates for interactive tasks.

I expect interesting discussions; work in small groups and useful lectures.

## Literature

1. Andreas Schäfer , Jan Holz , Thiemo Leonhardt , Ulrik Schroeder , Philipp Brauner & Martina Ziefle (2013). From boring to scoring – a collaborative serious game for learning and practicing mathematical logic for computer science education, *Computer Science Education*, 23:2, 87-111, DOI: [10.1080/08993408.2013.778040](https://doi.org/10.1080/08993408.2013.778040) , <http://dx.doi.org/10.1080/08993408.2013.778040> .
2. Azmi, S., Iahad, N. A., Ahmad, N. (2015). Gamification in Online Collaborative Learning for Programming Courses: a Literature review. In: *ARPN Journal of Engineering and Applied Sciences*, vol. 10, No. 23, 1–3.
3. S. Combéfis, G Beresnevičius, V. Dagienė (2016). Learning Programming through Games and Contests: Overview, Characterisation and Discussion. *INTERNATIONAL OLYMPIAD IN INFORMATICS Vol. 10: 39–60. Vilnius: Vilniaus universiteto leidykla. ISSN 1822-7732.*
4. Cuba-Ricardo, G., Serrano-Rodríguez, M. T., Leyva-Figueroa, P. A., Medoza-Tauler, L. L. (2015). Methodology for Characterization of Cognitive Activities when Solving Programming Problems of an Algorithmic Nature. *Olympiads in Informatics*, vol. 9, 27–30.
5. Laamarti, F., Eid, M., El Saddik, A.(2014).An Overview of Serious Games. In: *International Journal of Computer Games Technology*, Article ID 358152, vol. 2014, p. 1, 3–6, 11–12. Available on the internet: <http://dx.doi.org/10.1155/2014/358152>
6. Tillmann, N., Jonathan de Halleux, Xie, T., Sumit Gulwani, Bishop, J. (2013). Teaching and Learning Programming and Software Engineering via Interactive Gaming, In: *35th International Conference on Software Engineering (ICSE)*, IEEE, San Francisco, CA, 1117–1126.

## LEARNING OBJECTS PERSONALISATION APPLYING SEMANTIC WEB METHODS AND TECHNOLOGIES

### Andrius Berniukevičius

2nd year Phd studies

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### Your Brief Biography

Prior studies :

- Bachelor degree in Mathematics(2013), Vilnius Gediminas Technical University
- Master degree in Mathematics(2015), Vilnius Gediminas Technical University

Jevsikova, T.; Berniukevicius, A.; Kurilovas, E. (2016). Learning Personalisation Approach Based on Resource Description Framework. *Proceedings of the 15th European Conference on e-Learning (ECEL 2016)*. Prague, Czech Republic, October 27–28, 2016

### Research area description

- **The main problem you are trying to tackle and its relevance**

Learners have different learning styles and every learning object is not suitable to everyone. Personalisation of learning process is too hard job for teacher so we need recommender system which could help find suitable learning objects and activities for current learners according to their learning styles.

- **The aim of research**

Using semantic web technologies research and prepare tools and methods for learning objects identification in web that are suitable to different learning styles

### A presentation of any preliminary ideas

I have done systematic review of semantic web technologies using in learning personalisation process and find out that there is just several authors suggesting learning personalisation approach based on Web 3.0 tools. My approach is based on RDF (Resource Description Framework). According to this approach, RDF triples should interlink (1) LOs (“subject”) including metadata, (2) contextual information about particular learner (“object”), and (3) suitable learning methods, activities and tools (“predicate”). In this RDF triple, the “subject” denotes the resource, and the “predicate” denotes traits or aspects of the resource and expresses a relationship between the subject and the object.

Implementation of this approach consists of the following stages:

- Creating learners’ dynamic profiles/models according to their learning styles and other features.
- Creating interlinks and ontologies to establish suitability of learning components to particular learning styles.
- Creating recommender system to recommend suitable learning components to particular students.

### **Bibliographic References**

Kurilovas, E. (2015). "Application of Intelligent Technologies in Computer Engineering Education", Keynote paper read at IFIP WC3 Working Conference "A New Culture of Learning: Computing and Next Generations", Vilnius, Lithuania, 1–3 July, 2015, pp 15–26.

Kurilovas, E., Zilinskiene, I. and Dagiene, V. (2015) "Recommending Suitable Learning Paths According to Learners' Preferences: Experimental Research Results", *Computers in Human Behavior*, Vol 51, pp 945–951.

### **Expectations and motivation to attend Doctoral Consortium**

I expect to get new knowledge, critics and feedback from colleagues in order to improve my Phd. thesis theme.



## EDUCATIONAL DATA MINING / LEARNING ANALYTICS APPLICATION TRENDS TO PERSONALISE LEARNING

**Irina Krikun**

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### Research area description

In order to identify scientific methods, tools, techniques, and possible results on application of educational data mining / learning analytics to personalise learning, systematic literature review method devised by Kitchenham (2004) has been used. The following research question has been raised to perform systematic literature review: “What are existing educational data mining / learning analytics methods, tools, and techniques applied to personalise learning?”

After applying Kitchenham (2004) systematic review methodology, on the last stage 47 suitable articles were identified to further detailed analysis on the topic “learning analytics”, and 33 – on the topic “educational data mining”. After eliminating duplicating articles, 67 suitable articles left to further analysis.

The analysis results are as follow:

Williamson (2016) surveys and maps the landscape of digital policy instrumentation in education and provides two detailed case studies of new digital data systems. The author considers LA platforms that enable the tracking and predicting of students’ performances through their digital data traces.

The main objective of (Casquero et al., 2016) is to analyse the effect of the affordances of a virtual learning environment (VLE) and a personal learning environment (PLE) in the configuration of the students’ personal networks in a higher education context. The findings reflect the effectiveness of a PLE for facilitating student participation and for assisting students in the creation of larger and more balanced personal networks with richer social capital. From a methodological point of view, this paper serves as an illustration of the analysis of personal networks on digital data collected from technology-enhanced learning environments.

Experiment of Hung et al. (2016) demonstrated that a hybrid learning style identification can successfully cluster learning styles into three or four combinations based on learning performance, which suggests that the EDM technique can successfully explore multiple learning styles in problem-solving abilities.

Campagni et al. (2015) paper presents EDM methodology to analyse the careers of University graduated students. The authors present different approaches based on clustering and sequential patterns techniques in order to identify strategies for improving the performance of students and the scheduling of exams.

Pesare et al. (2015) argue that, in the latest years, LA are becoming the most popular methods to analyse the data collected in the learning environments in order to support teachers and learners in the complex process of learning. If they are properly integrated in learning activities, indeed, they can supply useful information to adapt the activities on the basis of student’s needs. In this context, the (Pesare et al., 2015) paper presents a solution for the digitally enhanced assessment. Two different learning dashboards have been designed in order to represent the most interesting LA aiming at providing teachers and learners with easy understandable view of learning data in VLEs.

According to van Leeuwen et al. (2015), because the amount of available learning information is high, teachers may be supported by LA. The (van Leeuwen et al., 2015) experimental study (n = 40) explored the effect of two LA tools (the Concept Trail and Progress Statistics) that give

information about students' cognitive activities. The results showed that when teachers had access to LA, they were not better at detecting problematic groups, but they did offer more support in general, and more specifically targeted groups that experienced problems. This could indicate that LA increase teachers' confidence to act, which in turn means students could benefit more from the teacher's presence.

Systematic review shows that, currently, there is an increasing interest in EDM / LA. In the latest years, EDM / LA are becoming the most popular methods to analyse the data collected in the learning environments (e.g. LMS / VLE) in order to support teachers and learners in the complex process of learning. EDM / LA seek to enhance the learning processes through systematic measurements of learning related data and to provide informative feedback to learners and teachers. EDM / LA researchers are addressing questions of cognition, metacognition, motivation, affect, language, social discourse, etc. using data from LMSs / VLEs, intelligent tutoring systems, massive open online courses, educational games and simulations, and discussion forums. EDM / LA are also used to develop the assessment of learners' skills. EDM / LA increase teachers' confidence to act, which in turn means students could benefit more from the teacher's presence. EDM / LA systems are used to support teachers in evaluating and monitoring individual progress within teamwork. EDM / LA dashboard is one of the popular applications to show students' online behaviour patterns in a LMS / VLE. EDM / LA could be also used to analyse data on students' informal conversations on social media (e. g., Twitter, Facebook) concerning their educational experiences-opinions, feelings, and concerns about the learning process. We can conclude that EDM / LA are useful tools to improve learning outcomes and the overall learning process in e-learning environments and computer-supported education.

Concerning learning personalisation, only some information could be found in scientific literature during last years. A hybrid learning style identification can successfully cluster learning styles into three or four combinations based on learning performance, which suggests that the EDM / LA technique can successfully explore multiple learning styles in problem-solving abilities. Most recently, new data analytics approaches are creating new ways of understanding trends and behaviours in students that can be used to improve learning design, strengthen student retention, provide early warning signals concerning individual students and help to personalise the learner's experience.

Thus, we could conclude that EDM / LA could be helpful to personalise learning, but future research is needed in the area, and, first of all, we should clearly identify the main trends concerning application of EDM / LA to personalise learning.

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## DESIGNING TECHNOLOGY-BASED LEARNING ENVIRONMENT: IMPROVING MONITORING IN LEARNING AND ACHIEVEMENTS

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Firs year of doctoral studies

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### Your Brief Biography

#### Education

2016 – Vytautas Magnus University, Doctoral of education.

2002 – Kaunas University of technology, Master of Information technology and Distance learning.

2010 – Siauliai university, Bachelor of Computer network administrator.

#### Work experience

2016 – Now. Working in Siauliai Vocational education and training center, ICT teacher.

2012 – 2015. Worked in Public Institution Northern Lithuania College, distance training coordinator.

2007 – Now. Working in Public Institution Northern Lithuania College, ICT lecturer.

#### Publications

2014 – Misiuliene, R. Lapinskaite, D. (2014). "Educational material development of multimedia tools".

Profesinio bakalauro studijos: Mokslo taikomieji tyrimai. ISSN 2029-1752.

2012 – Misiulienė, R. (2012). "Multiple ontologies usability in e. learning". From Studijos šiuolaikinėje visuomenėje: Scientific Works Studies in Modern Society: Academic Papers (No 3(1), 162-168). Šiauliai: Northern Lithuania College.

2011 – Misiulienė, R., Gelūnas, G. (2011). "E. education quality sociological survey of consumer attitudes". From Studijos šiuolaikinėje visuomenėje: Scientific Works=Studies in Modern Society: Academic Papers (No 2(1), 101-106). Šiauliai: Northern Lithuania College.

2011 – Misiulienė, R. (2011). "Ontologies for application to e. learning material presentation". Pažangios mokymosi technologijos Alta'2011: MW Sonet Project (103-109). Academy, Kaunas District: Aleksandras Stulginskis University.

2010 – Misiulienė, R. (2010). "Ontology-based test development system". From Studijos šiuolaikinėje visuomenėje: Scientific Works Studies in Modern Society: Academic Papers (No 1(1), 72-78). Šiauliai: Northern Lithuania College.

2009 – Misiulienė, R. (2009). "Comparative Analysis of Ontology Representation Language Possibilities". From Mokslas ir studijos 2009: teorija and praktika: studentų mokslinės konferencijos medžiaga [Electronic resource] (131-138). Šiauliai: Northern Lithuania College.

## Reports

- 2015-11-05 Misiulienė, R. "Quality of Distance Learning in Northern Lithuania College of Teachers Attitude". International conference "Open professional collaboration". VDU, LieDM association.
- 2014-12-12 Misiulienė, R. „ Video lectures system possibility in distance learning “, LieDM asociacija, Šiaulių S. Daukanto gimnazija.
- 2014-04-25 Misiulienė, R. „ Video system using in Northern Lithuania College“. Nuotolinio mokymo praktika Šiaurės Lietuvos švietimo institucijose. ŠU, ŠLK, ŠPRC, Šiaulių S. Daukanto gimnazija.
- 2013-06-(12-15) Misiulienė, R. "Women technology entrepreneurs". EDEN Annual conference 2013. Oslo.
- 2013-02-21 Misiulienė, R. „ Quality of Distance Learning in Northern Lithuania College of Students Attitude “. Mokslas ir studijos 2013: Teorija ir praktika. Šiaurės Lietuvos kolegija.
- 2012-04-20 Misiulienė, R. Research of Ontology Application in the Presentation of Training Materials: Republican Conference of Young Scientists "Fundamental Research and Innovations in the Interface of Sciences 2012"/Klaipėda University.
- 2011-03-01 Misiulienė, R. „Sociologinis tyrimas e. švietimo paslaugų vartotojų požiūriu“. Studijos šiuolaikinėje visuomenė. Šiaurės Lietuvos kolegija.
- 2010-02-25 Misiulienė, R. „ Ontology-based test development system “, Studijos šiuolaikinėje žinių visuomenėje. Šiaurės Lietuvos kolegija.
- 2010-05-13 Misiulienė, R. Comparative Analysis of Ontology Language Possibilities: national students' scientific-practical conference "Science and Studies 2012: Theory and Practice"/Northern Lithuania College.
- 2009-05-14 Misiulienė, R. Comparative Analysis of Ontology Representation Language Possibilities. Science and Studies 2009: Theory and Practice.

## Research area

The research problem - how to design TEL environment that responds to learners meta-cognitive learning characteristics, enabling learners to monitor and evaluate their learning achievements, learning progress, as well as to ensure quality training curriculum and the quality of studies.

## COLLABORATIVE LEARNING USING ICT CREATION, IMPLEMENTATION AND EVALUATION OF PEDAGOGICAL SCENARIOS IN SECONDARY SCHOOLS

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### Your Brief Biography

I am a PhD student in the Department of Education at the Vytautas Magnus University, Lithuania. I hold bachelors and master's degrees in psychology. My research interests focus on organizational change and behaviour, learning at work, and information technology (IT)–based and technology-enhanced learning.

Publications: Naujokaitienė, Justina; Teresevičienė, Margarita. Extension of Technology Acceptance Model while Integrating TEL into Business Organization. *Aukštųjų mokyklų vaidmuo visuomenėje: iššūkiai, tendencijos ir perspektyvos*. ISSN: 2029-9311. 2014, Vol. 1, No. 3. p. 152-157. [IndexCopernicus].

Abromavičienė, Daiva; Teresevičienė, Margarita; Naujokaitienė, Justina. Support System of Technology Enhanced Learning in an Educational Institution. *European Scientific Journal*. ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431 7431. May 2014 edition. Vol.10, No. 3, p. 142-155. [IndexCopernicus].

Naujokaitienė, Justina; Teresevičienė, Margarita.; Zydziunaite, Vilma. Organizational Support for Employee Engagement in Technology-Enhanced Learning. *SAGE Open*. ISSN: 2158-2440. 2015. Vol. 1 No. 9, p. 1-9. [SCOPUS].

### Research area description

#### The main problem you are trying to tackle and its relevance

Paradigm of traditional education is no longer suitable for nowadays secondary school. In order to achieve set goals, schools must keep up with the educational and technological innovation. Information and communication technologies (ICT) cannot simply supplement traditional teaching and learning activities, because the use of ICT exchanges teaching and learning objectives and techniques. After all, it is not possible to affirm that ICT changes teaching and learning process turning it more productive or improve students' achievements. The question is whether schools, looking to the educational goals, selects the proper training methods and properly complements them with ICT.

The main focus in this research is on teachers in Lithuania, and their experiences about engaging with collaborative learning enhanced with different information and communication technologies (ICT). This collaborative learning study, which takes account of the uses of technologies among teachers, is the first of its type in Lithuania. This state-of-the-art research gives an opportunity to see how collaborative learning is happening in practice from teachers' perspectives.

Collaborative learning combines constructionism with social learning — sometimes referred to as “social constructivism” (Vygotsky, 1978; Wertsch, 1985; Laurillard, 2009). Collaboration is one of the elements that is concerned with learning together, and can encourage individual cognitive processes. While learning, pupils take responsibility and make decisions on how they will work together, and make their contribution to the development and improvement of knowledge. ICT in the learning process are connected with positivistic pedagogy, which says that learner should be given needed tools and support in their learning experiences (McRobb et al., 2007). All this process should be developed by teacher. If positivism is based on realistic ontology, then constructivism says that reality is constructed. According to constructivists, the truth can be an agreement between those who are involved in to learning

construction and must be oriented to the process in which useful constructs are developed (McRobb et al., 2007). Ontologically collaborative learning and usage of ICT in educational process is analyzed basing on constructivistic perspective. According to Vygotsky (1978) pupils in collaboration, rather than learning individually, can make a higher intellectual level tasks. The reason is that the pupils are faced with different interpretations, explanations or answers, so it is needed to review taken learning decisions.

Collaborative learning can be used while working with students of different age groups, in various subjects; it can be long-term (over several lessons) or short-term (in 1-2 lessons) activities. Typically collaborative learning shifts away from teacher-centred or lecture-centred approaches, but principles of traditional learning do not disappear entirely as they play their part in other learning activities. Studies show that collaborative learning can lead to deeper level learning, critical thinking, shared understanding, and long-term retention of the learned material. Technologies can play a part in the change of the roles in the teaching-learning process, and support collaborative learning (Mercier and Higgins, 2015).

When talking with Lithuanian teachers, it is obvious that collaborative learning has been a success in Lithuania, as teachers are using collaborative learning in lessons practically and develop different methods of active learning. In the research field, the topic of collaborative learning is not very popular, but aspects have been analysed since early studies in 1996. Butkienė and Kepalaitė (1996) studied collaboration from an educational psychology perspective and suggested that there is a need for developing collaboration skills and producing different suggestions for teachers. Gaillienė et al. (1996) looked from the perspective of developmental psychology and argued that the process of socialisation would be better if the skill of collaboration would be developed as early as possible. Teresevičienė and Gedvilienė (2000) concentrated on a more educational perspective, suggesting different collaborative learning methods for teachers, and the positives and negatives of collaborative learning. Lipeikienė (2003) discussed virtual learning environments and the focus was on collaborative learning environments. Ozolaitė and Čiapas (2005) researched collaborative learning in special schools. Unfortunately there are very few researches analyzing integration of ICT using unconventional learning methods. The early 1990s was the start of the development of the current system of education in the Republic of Lithuania, and it is still undergoing change. When talking with Lithuanian teachers, it is obvious that collaborative learning has been a success in Lithuania, as teachers are using collaborative learning in lessons practically and develop different methods of active learning.

**Aim of the research** – To promote collaborative learning using ICT in secondary schools by creating a pedagogical scenario, implement and evaluate it.

Research questions:

1. What is the essence of collaborative learning using ICT?
2. What kind of learning scenarios are there?
3. How ICT are developed and implemented into the learning process?
4. Is the implementation of collaborative learning pedagogical scenario using ICT makes learning process more effective than traditional learning? An outline of the current knowledge of the problem domain (What is the state-of-the-art in relation to existing solutions to the problem)

## **A presentation of any preliminary ideas, the proposed approach and achieved results**

### **Current status of the research plan**

#### **Time table of the research implementation**

- 1<sup>st</sup> semester: review of recent studies on project topic.
- 2<sup>nd</sup> semester: deciding on research aim and main goals.
- 3<sup>rd</sup> semester: developing research methodology.
- 4<sup>th</sup> semester: quantitative research.

### **5<sup>th</sup> semester: design-based research.**

6<sup>th</sup> semester: summarizing results of the research.

7<sup>th</sup> semester: making conclusions.

8<sup>th</sup> semester: preparing summary of research project.

Currently collaborative learning with ICT integration lessons are planned, implemented and discussed.

### **A sketch of the applied research methodology (data collection and analyzing methods)**

Selected methodology for this research is design based approach. Research is held in several phases. The first thing was to answer the question *what is the essence of collaborative learning using ICT*, therefore an analysis of international, European Union and national documents, regulating education in schools, scientific works, other research dissertations and articles was made. This analysis also helped to answer the question *what kind of learning scenarios are there*, as it provided information about the development of different educational scenarios using ICT. In addition of analysis of various resources, a questionnaire was made and applied to teachers working in Lithuanian schools in order to answer the previous question as well as the new one *How ICT are being developed and implemented into the learning process?* This instrument will also helped to know if teachers are using ICT while pupils are involved in collaborative learning, what kind of learning scenarios there are. The last question is *how teachers develop scenarios and implement it into the learning process*. This question will be answered practically working with several teachers and implementing short term and long term collaborative learning scenarios. The last step of this research will be to analyze observation data of the lessons and data of teachers' reflection.

### **Expected achievements and possible evaluation metrics to establish the level of success of your results**

The research is focused on how teachers are involved in collaborative learning activities and how they use technologies implementing these activities. Results of the research will provide overview of the, covering different perspectives from the literature of how collaborative learning can be defined, a discussion of different collaborative practices in lessons, how technologies are used in collaborative learning lessons, and roles of individuals and groups in collaborative learning. Results from the survey that has gathered gave evidence from across Lithuania. The results offer evidence about collaborative learning practices of teachers nationwide, and explore when collaborative learning is used within lessons and projects, in which schools, by which teachers, and educational practices adopted within lessons and projects. These results already now draws out some important new evidence about forms of collaborative learning, and ways that technologies takes place are related to practices within collaborative learning lessons. Therefore, it is interesting to see what designed based research results will show us about implementation of collaborative learning and ICT.

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8. Teresevičienė M., Gedvilien G. (2000). *Mokymasis bendradarbiaujant*. Vilnius: Garnelis.
9. Vygotsky, L. (1978). Interaction between learning and development. In Vygotsky, L, *Mind in Society*, 79-91. Cambridge, MA: Harvard University Press.
10. Wegerif, R. (2006). A dialogic understanding of the relationship between CSCL and teaching skills. *International Journal of Computer Supported Collaborative Learning*, 1 (1), 143-157.

### **Expectations and motivation to attend Doctoral Consortium**

Doctoral Consortium is my opportunity to present my doctoral thesis and to get ideas from students working in the same field as I am. I hope that presenting and discussing my thesis during the doctoral consortium will help me to focus on what I need to improve in the research. My main motivation for attending the Doctoral Consortium is to discuss with senior researchers the contributions of my PhD and get feedback on my research. Furthermore I think that the possibility to exchange my ideas with the other doctoral consortium student participants will also provide me with insight in their interesting works.

## PREPARATION SYSTEM FOR IT TALENTS FROM PRIMARIES TO IOI

### Ágnes Erdősné Németh

5th semester of overall six semesters

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#### Brief Biography

I am a teacher of informatics and mathematics in a high school. I have taught children grade 5 till 12 and children grade 9 to 12 for ten years. I have built a system for pupils talented in IT and math during these years. This system is very efficient and unique not only in Hungary but - maybe - internationally as well. The uniqueness of the system is: I work at the same place and same time together with children who are at very different levels of informatics knowledge and who are of a wide range of ages. They work in small groups. Working such a various age and divers knowledge group creates a very inspiring environment for the members, but it needs very sophisticated preparing from the teacher and very strong cooperation between teacher and students. I use on-line preparation- and contest sites in this process.

#### Publications (in English)

1. Erdősné Németh Ágnes, dr. Zsakó László (2016): The Place of the Dynamic Programming Concept in the Progression of Contestants' Thinking *OLYMPIADS IN INFORMATICS 10*: pp. 61-72.  
[http://ioinformatics.org/oi/pdf/v10\\_2016\\_61\\_72.pdf](http://ioinformatics.org/oi/pdf/v10_2016_61_72.pdf)
2. Erdősné Németh Ágnes, dr. Zsakó László (2016): The Place of the Greedy Method Concept in the Progression of Contestants' Thinking *EDUKACJA TECHNIKA INFORMATYKA / EDUCATION TECHNOLOGY COMPUTER SCIENCE 2016*, 2: Paper 14. 6 p.  
[http://didmattech.inf.elte.hu/wp-content/uploads/2016/08/ENA\\_ZsL\\_The-place.pdf](http://didmattech.inf.elte.hu/wp-content/uploads/2016/08/ENA_ZsL_The-place.pdf)
3. Erdősné Németh Ágnes (2015): Introducing recursion with LOGO in upper primary school *The Proceedings of International Conference on Informatics in Schools: Situation, Evolution and Perspectives — ISSEP 2015.Ljubljana* pp. 121-129.  
<http://issep15.fri.uni-lj.si/files/issep2015-proceedings.pdf>
4. Erdősné Németh Ágnes, Dr. Zsakó László (2015): Online training and contests for informatics contestants of secondary school age *EDUKACJA TECHNIKA INFORMATYKA / EDUCATION TECHNOLOGY COMPUTER SCIENCE (ISSN: 2080-9069) 11: (1)* pp. 273-280.  
[http://eti.rzeszow.pl/docs/ETI\\_5\\_1.pdf](http://eti.rzeszow.pl/docs/ETI_5_1.pdf)
5. Nevena ACKOVSKA, Ágnes Erdősné Németh, Emil Stankov, Mile JOVANOVIĆ (2015) Report of the IOI Workshop "Creating an International Informatics Curriculum for Primary and High School Education" *OLYMPIADS IN INFORMATICS 9* pp. 205-212.  
[http://ioinformatics.org/oi/pdf/v9\\_2015\\_205\\_212.pdf](http://ioinformatics.org/oi/pdf/v9_2015_205_212.pdf)

#### Research area description

Future keypoints of my research:

- to make an overview of the national and international talent management in informatics: analysis, comparison.
- to find principles and methods of effective talent management (competitions, courses, camps, online courses, online bank of tasks, online competitions).
- To place an IT talent management system in public education, to examine international connections.
- To design a new curriculum for the talented with strong methodology.

#### A presentation of any preliminary ideas, the proposed approach and achieved results

Two years ago I began my doctoral studies at the Doctoral School of informatics Faculty of Eötvös Loránd University. I work at the Department of Media and Educational Informatics on my PhD.

In the first year I read a huge amount of papers about teaching informatics, especially selecting and teaching talented students preparing for IOI. I read articles about algorithms used in competitions and about different methodologies to teach programming:

- IOI Journal – Olympiads In Informatics, [http://www.ioinformatics.org/oi\\_index.shtml](http://www.ioinformatics.org/oi_index.shtml)
- Informatics in Education, [http://www.mii.lt/informatics\\_in\\_education/contents.htm](http://www.mii.lt/informatics_in_education/contents.htm)
- Acta Didactica Napocensia, <http://adn.teaching.ro/>
- Teaching Mathematics & Computer Sciences, <http://tmcs.math.klte.hu/>
- and proceedings of conferences, like ISSEP, WiPSCE, DIDMATTECH

In the next semesters I gathered information about the current state of IT talent programs and resources of Hungary: competitions, courses, summer courses, learning materials, selection processes, “best practices” of teachers. I made an overview about the mathematical talent programs too. I made an overview of international preparation and contest sites. It was examined the connection between public education and the courses for talented, especially the problem-solving and computational thinking part.

Last year I flashed a glance on the VU-DC for international IT talent management: I asked other participants about their national selection and preparation process for IOI.

I would like to develop a system with didactical comments on the base of my practice and other's experience.

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- Juraj Hromkovic *Algorithmic Adventures – From Knowledge to Magic* Springer, 2009.

### Expectations and motivation to attend Doctoral Consortium

On the consortium I hope to meet others who works on

- developing curricula for all,
- making talent selection
- preparing students for algorithmic contests.

I hope

- to be in a friendly environment on the consortium as last year,
- to receive new ideas for my research,
- to have strong motivation to keep on working.

## CONSTRUCTING A COMPOSITE INDICATOR FOR EDUCATION MONITORING

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### Your Brief Biography

Prior studies: Bachelor Degree in Informatics (2006), Vilnius University and Master Degree in Statistics (2008), Vilnius Gediminas Technical University.

Publications:

1. Zelvys R., Jakaitiene A., Stumbriene D. (2016). *Moving towards different educational models of the welfare state: changes in education systems of the Baltic countries (review process)*.
2. Stumbrienė D., Jakaitienė A. (2015). *Švietimo duomenų tyryba: apžvalga ir tyrimų kryptys*, Lithuanian Mathematical Journal, Vol. 56, p. 41–45, Vilnius.
3. Siurkute D., Jakaitiene A. (2009). *Forecasting inflation in short-term using factor models*, Lithuanian Mathematical Journal, Vol. 50, p. 230-234 IMI, Vilnius.

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**Background.** The socio-economic phenomena are complex and cannot be measured by a single descriptive indicator – it should be represented with multiple dimensions. This multiplicity implies a number of theoretical and statistical problems, especially when we need to make comparisons over

time or space. Phenomenon such as education can be measured and evaluated by applying methodologies known as composite indicators. In this way we can rank countries or periods, it is very useful for monitoring progress toward education goals.

The main task is how to assign weights to the components when combining them to Composite indicator. In literature we can find that there are used Statistical models such as Regression analysis, Factor analysis or Data envelopment analysis and Participatory methods such as Analytic hierarchy processes, Conjoint analysis, Budget allocation processes or Multiple criteria decision analysis for weighting. Sometimes there are combine two or more methods. For example, Factor analysis and Regression Analysis or Data envelopment analysis and Analytic hierarchy processes.

**Purpose.** The purpose of PhD thesis is to develop and suggest new method to construct composite indicator for education monitoring.

**Research methodology.** The education monitoring index is constructing following structural CIPO framework, which describes relationships between Input, Process and Output in education within a certain Context (*Figure 1*). Context indicators describe external conditions, Input indicators describe personnel and material resources, Process indicators describe process in educational system and Output indicators describe educational outcomes and results. This model includes comprehensive information of education system, while European Commission benchmarks include only output indicators. There are 7 context indicators, 11 input indicators, 11 process indicators and 17 output indicators. All data are for EUROSTAT and OECD databases.

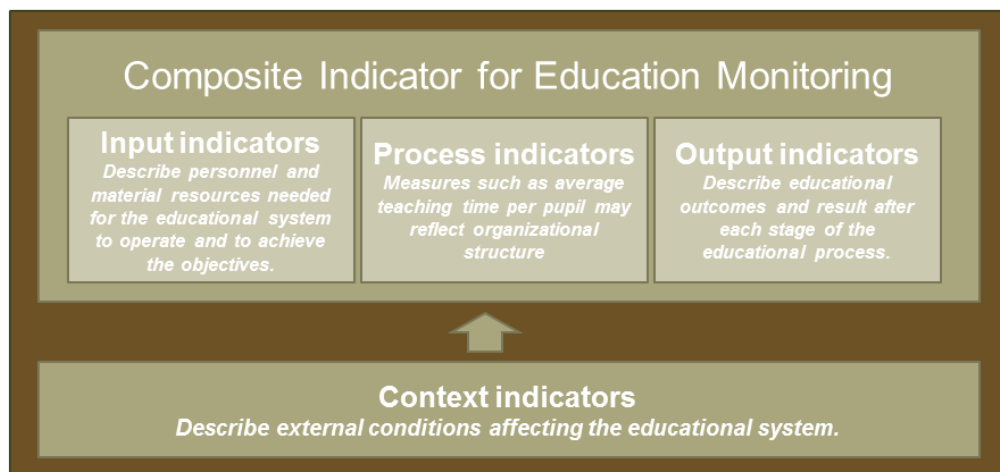


Figure 1. CIPO model

After literature review we pick out 5 stages for composite indicator constructing: data treatment, data normalisation, weighting, aggregation and comparing the indices (*Figure 2*). After literature review we pick out 5 stages for Composite Indices constructing. At the first stage we used single imputation for missing data. More over all indicators are treated as the profit type - "the larger the better". At the second stage we standardized data by subtracting the mean of the data and dividing by the standard deviation, so data have mean = 1, standard deviation = 0.

How to assign weights to the components when combining them to Composite index? In literature we can find that there are used Statistical models such as Regression analysis, Factor analysis or Data envelopment analysis and Participatory methods such as Analytic hierarchy processes, Conjoint analysis, Budget allocation processes or Multiple criteria decision analysis for weighting. Sometimes there are combine two or more methods. For example, Factor analysis and Regression Analysis or Data envelopment analysis and Analytic hierarchy processes.

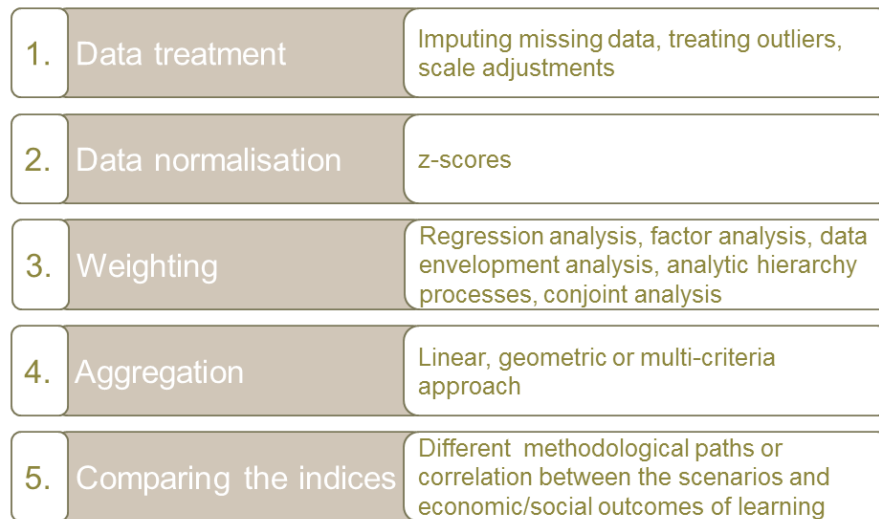


Figure 2. 5 STAGES for CI constructing

In order to compare the different methodologies, the education monitoring index will be calculate for Lithuania, Latvia, Estonia, United Kingdom, Finland and Germany over time.

#### Work plan for the next year:

- To apply principal components analysis and data envelopment analysis to construct a composite indicator for education monitoring.
- To compare correlation between the scenarios and context of education.
- To review methods to evaluate uncertainty related to model results.

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## RESEARCH OF TESTS GENERATION AND VALIDATION FOR INFORMATICS EDUCATION

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### Brief Biography

I studied a program of distance learning information technologies and got master degree in Vilnius Gediminas Technical University. I started my research in PhD studies in Vilnius University two years ago and started working in the Institute of Mathematics and Informatics this autumn.

I was interested in e-learning education, e-assessment, learning strategies and technologies during my studies and work, before PhD studies. Now I focus on my research about the validation of informatics education tests, assessment.

#### 1. Publications:

- Dagienė, V., Stupurienė, G., Vinikienė, L. Promoting Inclusive Informatics Education Through the Bebras Challenge to All K-12 Students. On CompSysTech '16 Proceedings of the 17th International Conference on Computer Systems and Technologies 2016, Pages 407-414
- Giordano, D., Maiorana, F., Csizmadia, A., Marsden, S., Riedesel, Ch., Mishra, Sh.; Vinikienė, L. New horizons in the assessment of computer science at school and beyond: leveraging on the ViVA platform in ITICSE-WGR '15 : Innovation and technology in computer science education conference : proceedings of the 2015 ITiCSE on working group reports, Vilnius, Lithuania, July 04-08, 2015. New York: ACM, 2015. ISBN: 9781450341462. 117-147
- Stupurienė, G.; Vinikienė, L.; Dagienė, V.. Students' success in the Bebras challenge in Lithuania: focus on a long-term participation in Informatics in Schools: Improvement of Informatics Knowledge and Perception : 9th International Conference on Informatics in Schools: Situation, Evolution, and Perspectives, ISSEP 2016, Münster, Germany, October 13-15, 2016, Proceedings / eds. : Andrej Brodnik, Françoise Tort . Series : Lecture Notes in Computer Science. Vol. 9973. ISSN 0302-9743. Cham: Springer International Publishing, 2016. ISBN: 9783319467467. p. 78-89.
- Vinikienė, L. Overview of the results of "Bebras 2015" competition in Advanced learning technologies : conference proceedings, 19th of May, 2016 / edited by Danguole Rutkauskiene, Daina Gudoniene. Kaunas: Kauno technologijos universitetas. ISSN: 2335-2140. 2016, 108-115.

### Research area description

In this research, I explore parameters that influence the validity of educational informatics test. The basic idea of my research are based on the test theory. I focus on methods that measure validity of test, test questions. This research should be developed in the area of informatics.

The difficulty of my research is finding method that could be improved and applied in educational assessment. There are very important to clarify concepts of an assessment, test, competences, the principle of test creation. Test creator should review and rethink criterion such as time taken to solve task, the total number of questions in the test, the concept's distribution, theme, sequence. In addition, test validity could be influenced by student's

interest, motivation, abilities to solve specific domain tasks, understanding theme, question, task difficulty, etc. All this criterion could be evaluated by using statistical data analysis, but this analysis will show the results after testing and we can guess that was the reason, which influenced test results. But we can't predict validity of future assessment, so we need methods, which allow to predict the difficulty of task before the assessment.

The second task of my research is to find methods to describe validity of interactive tasks. Solving interactive tasks students are able to communicate, reach better results, think deeper, concentrate on a specific task. In this way students are able to manage information and avoid information overload. Solving interactive tasks depends on knowledge and solution construction. Researchers claim that in this way the motivation and interest to get correct answer is growing, reflection on the solution is promoted, we can evaluate how student think, built their knowledge. But we have not enough research on interactive task analysis.

In addition, all research is based on the assessment of competences of informatics education. So, I should investigate the dependency between parameters which describe selected test theory or method and competences which should be evaluated using the tests.

**The aim of research** is to create recommendation lists of reliability assessment of informatics and suggest better methods for evaluation of test validity and reliability.

#### *The outline of the current knowledge of the problem domain*

Nowadays educational organization develop test system for the assessment of student knowledge. That systems have to fit the requirements of learning and teaching model or standard of tests. The main problem of this process is to identify correct assessment of the knowledge, especially competences, and describe item difficulty. Organization like the Test Commission emphasize the importance of validity (Abad, F. et al. 2013).

A calculation of the task difficulty value involves all participants' abilities to solve the task. The value of difficulty could be calculated as a ratio between the number of correct answers and the total number of answers (the number of tasks that students have not tried to solve at all). Lower values indicate more difficult tasks and higher values indicate easier tasks (Aesaert, Braak, 2015). The value of difficulty 1 indicates a very easy task and a task with the value of difficulty 0 indicates a very difficult task. The value of difficulty depends on the tasks and participants. It can be limited by the presentation on the screen, the number of attempts, etc. (Peerear, Petegem, 2012).

Methods used to measure test validity are complicated and require to measure dependency between cognitive inputs and cognitive attributes, goals of the testing (Lamb, R. et al. 2014). There exist classical test theory and item response theory.

In the classical test theory are not define how different person or group will answer the specific questions. The statistic of the test depends on selected items, item difficulty, item discrimination (Assert, K. at al., 2014). Assert (2014) investigate competences and skills of information communication technologies based on classical test theory. He represent the matrix of this competences and skills, but this theory is not sufficient to evaluate latent variable, which „can't be observed or determined by directed measurement“ (Fayers, P. M., 2007), or evaluate answer then the parameter of test attempt depends on validity. The classical test theory should be evaluated again then the second test results is different from the first. We can simulate item complexity, test statistic, which is not depending on student and his mark (Hambleton et al., 1991, Lamb, R. et al. 2014). Item Response Theory (IRT) are used in Computerized Adaptive Tests as a modern mental test theory (Fayers, P. M., 2007). IRT works when there is a need to determine a student's level of knowledge, but not measuring the student's knowledge in every concept or level in the course. For example, in the article “Measuring Student Competences” are mentioned that “the main goal of IRT analysis is the estimation of two parameters: the item difficulty ... and person parameters” (Hubwieser, P., et al., 2014). IRT is



used analyze test score and the impact of the proportion how „easy“ or hard“ is the task (Forišek, M., 2009). Forišek (2009) clarify that, this test theory could „work“ as the rating system. IRT model include latent variables and item parameters. So, the task is to find effective method for validity of the test. Some tools exist. Test generation system uses the ontology “to memorize pieces of knowledge of application” or has been used as a persistent level by test system (Bogdan, C. M., Ciobanu, G., 2013). Fan (1988) mentioned, that the invariance property of “IRT model parameters makes it theoretically possible to solve some important measurement problems that have been difficult to handle within the classical test theory framework.”

Interactive elements of the task (graphic, animation, etc.) support student understanding of a content and how they construct meaning from the presented content. The following goals of the interactive tasks benefit could be mentioned: greater validity, increased student engagement and motivation, measurement of higher order thinking skills, promoted students' reflection by solving tasks, better evaluating the cognitive and problem-solving skills (Dagiene, Stupuriene, Vinikiene, 2016).

Interactivity is very typical of computers, so it is clear that a computer oriented challenge should apply interactive elements to explain or solve tasks. These interactive elements attract student's attention quicker and make the problem statement better understandable. (Dagiene, Stupuriene, Vinikiene, 2016)

**The next preliminary step** is to define method how to measure interactive tasks validity and reliability.

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## ASPECTS FOR CHOOSING TEXTUAL PROGRAMMING LANGUAGES FOR HIGH SCHOOL EDUCATION

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### Your Brief Biography

My main interest is ICT supported education of natural sciences and also methodology of teaching programming.

My current research is about evaluation of textual programming languages used in Hungarian high school education and also about using informatics as a tool for multidisciplinary school activities. Another project of mine is about developing an interactive web application for presentations and education.

### Research area description

Implementing algorithms is an integral part of teaching programming and data modeling in high school. For this the teacher has to choose a programming language to use. Choosing the right language and development environment is of decisive importance for having an effective and useful teaching process. In this paper there is a list of aspects for textual programming languages that we have to take into consideration when choosing. For these aspects there is a system and for languages commonly used in Hungarian high school education I examined how well they do in terms of these aspects. Based on the results I listed the pros and cons for groups of languages. I also examined the latest changes in recent years and based on this I also examine the possibility of a new trend of using script languages for education. Among them I deal with the educational pros and cons of the Python and JavaScript, also the typed version of JavaScript, TypeScript.

### Studies

#### High School

Fazekas Mihály Primary and Secondary School and Teacher Training Centre  
Natural Sciences specialization

#### BSc

Eötvös Loránd University, Budapest, Hungary  
Computer Scientist, Teaching specialization with Environmental Sciences minor

#### MA (currently)

Eötvös Loránd University, Budapest, Hungary  
Informatics Teacher, Environmental Sciences Teacher  
Vilnius University, Vilnius, Lithuania  
Erasmus Studies

### Research/Interests

#### Programming languages and paradigms

Object-Oriented PHP Library for Valid HTML5 Application Development  
(OTDK Conference, Budapest, Hungary, 2013)

OOPS! PHP – HTML5 Application Development with Self-Developed Object-oriented PHP Library (BSc thesis, 2013)

“Perfect Babel” – How to Choose a Programming Language?

(InfoÉRA Conference, Zamárdi, Hungary, 2015)

Aspects for Choosing a Programming Language for Education

(MIDK Conference, Bratislava, Slovakia, 2016)

### **Learning environments**

Kozta – Interactive Presentational and Educational Platform

(InfoÉRA Conference, Zamárdi, Hungary, 2016)

### **Multidisciplinary education of informatics, IT supported education of natural sciences**

The Ball – “Thought experiment” in the Classroom

(InfoÉRA Conference, Zamárdi, Hungary, 2016)

Motivating questions:

- What the ideal textual programming language for education is like?
- What programming language should be used in education?
- What tools could make the learning process more effective?
- How is it possible to use computer science/programming to teach other subjects (primarily natural sciences)?
- How is it possible to use other subjects to teach computer science/programming?
- What is an effective approach to teach programming?

## **Teaching experience**

### **High School/Secondary School**

- informatics class and programming extracurricular programming classes (2007-2012)
- teaching practice informatics, environmental sciences (2015-2016)

### **University**

- Web-development practice (2013-2016)
- Web-programming practice (2015-2016)
- Application development practice (2015)