Preface

Special Issue on Digital Transformation Environment for Education in the Space of CogInfoCom

We are pleased to present our second special issue dedicated to a CogInfoCom theme to our readers. Our first thematic volume published at the beginning of 2020 contained the best studies and presentations from the proceedings of the 2018 conference. The present CogInfoCom-themed issue matches the thematic outlay of the previous CogInfoCom conference held in 2019. We hope that this periodical will help readers to learn about several professional research developments leading to further consideration of the given topics.

This special issue brings together papers in the field of digital education and CogInfoCom based LearnAbility including education through online collaborative systems, virtual reality solutions and project-based education. Further topics cover the digital transformation of education and investigating capabilities for learning through modern informatics based education. This is an interdisciplinary research field and fits well in the topic of Cognitive Infocommunication. The key concept behind CogInfoCom and its application in digital education and learnability is the various levels of entanglement between humans and ICT giving rise to new forms of blended cognitive learning capabilities. The studies of this special issue present the latest research results in this scientific discipline.

1) Uniform Dispersal of Cheap Flying Robots in the Presence of Obstacles

In previous solutions, the authors considered the uniform dispersal problem (or Filling problem) in which inexpensive robots had to disperse in order to cover an a priori not known area, as well as they also examined the possibilities of solving the Filling in two-dimensional regions. The swarm entities had to collectively solve a common task using the simplified cognitive abilities of the robots (i.e., their memory, visibility, and communication capabilities were restricted). In this paper, the authors investigate the possibilities to apply the method for three-dimensional regions. The need for such a solution emerged, as nowadays the number of low-priced flying robots, e.g., quadcopters, drones, has increased heavily. The main research direction is to minimize the hardware requirements of these robots, as doing so is crucial in order to maintain their cost-efficiency. The authors demonstrate that it is still possible to solve the Filling problem in three-dimensional space in the presence of obstacles, while the robots maintain the

following hardware requirements: they have a constant amount of memory, minimal visibility, as well as there is no communication between them, and the algorithm terminates in linear runtime. Finally, simulations were carried out to prove the theoretical results.

2) Advanced Assistive Technologies for Elderly People: A Psychological Perspective on Older Users' Needs and Preferences (part B)

This paper provides a general overview of the literature regarding advanced assistive technologies devoted to improve elders' life. Recent studies on assistive robots and embodied conversational agents are carefully examined in order to identify main seniors' preferences regarding their general design. While providing data on seniors' preferences about the design of assistive devices, main evidences on both robots and virtual agents appearance, abilities/functionalities, personalities and role features are summarized and commented.

3) Predictive Machine Learning Approach for Complex Problem Solving Process Data Mining

Problem solving is considered to be an essential everyday skill, in professional as well as in personal situations. In this paper we investigate whether a predictive model for a problem solving process based on data mining techniques can be derived from raw log-files recorded by a computer-based assessment system. Modern informatics-based education relies on electronic assessment systems for evaluating knowledge and skills. OECD's PISA 2012 computer-based assessment database was used, which contains a rich problem solving dataset. The dataset consists of detailed action logs and results for several problem solving tasks. Two feature sets were extracted from the selected PISA 2012 Climate Control problem solving task: a set of time-based features and a set of features indicating the employment of the VOTAT problem solving strategy. We evaluated both feature sets with six machine learning algorithms in order to predict the outcome of the problem solving process, compared their performance and analyzed which algorithms yield better results with respect to the observed feature set. The approach presented in this paper can be used as a potential tool for better understanding of problem solving patterns, and also for implementing interactive e-learning systems for training problem solving skills.

4) EEG-based Speech Activity Detection

The brain-computer interface is one of the most up-to-date communication options. The advances made in this area open up opportunities to help mentally or physically disadvantaged people. The brain-computer interface offers the possibility of re-acquiring communication skills by deaf individuals.

Electroencephalography (EEG) based speech recognition is, therefore, a novel research topic, which is an important component in communication technologies. In this article, we propose a speech activity detector algorithm, which, as expected, should improve the performance of the EEG based speech recognition system. EEG data uploaded while pronouncing 50 different phrases were classified using a feed-forward neural network. As a result of detection, a 0.82 F1 score was achieved.

5) Clean and Dirty Code Comprehension by Eye-Tracking-based Evaluation using GP3 Eye Tracker

During the observation, analysis and examination of cognitive processes, human-computer interfaces are increasingly becoming widespread. Programming could also be seen as such a complex cognitive process. This study aims to examine the efficiency of the clean code paradigm and compares to the dirty code produced without the principles formulated in this technique. In addition to the traditional knowledge level test and subjective judgment, the readability and comprehensibility of the implemented code was determined by analysing the heatmap and gaze route besides measuring and evaluating eye movement parameters. Based on the statistical evaluation, it can be stated that there is a significant difference in the average number of fixations, the average of fixation time and the average length of routes between fixations measured by studying two differently written source codes. This means that in the case of the clean code, significantly less and shorter information recording and processing were necessary to understand the code.

6) Experience of Self-Efficacy Learning among Vocational Secondary School Students

Self-study and self-efficacy are closely related concepts, and they are in connection even with lifelong learning. To develop real self-esteem in the learning process, it is important to be aware of one's abilities, weaknesses, and other characteristics that influence learning, which reinforces the foundations of learning motivation and lifelong learning. Self-efficacy and modern ICT solutions supporting self-directed learning become a more relevant role in self-learning outside the school context, ie in self-taught learning. This article examines self-efficacy in learning through a questionnaire survey for students at technical vocational secondary schools in Budapest (N = 1260) analyzing the answers to some of the self-efficacy statements based on the Motivated Strategies for Learning Questionnaire (MSLQ). The results can help to develop modern ICT solutions that effectively support learning.

7) Learner Experiences Related to Digital Education Schedules in Light of Empirical Data

In my essay I briefly introduce the theoretical foundations and main aspects of electronic learning in order to explore and evaluate the instruction schemes implemented as a result of the digital transformation. I base my findings on the analysis of a questionnaire-based survey administered to a sample of students. My research aims at examining the efficiency of the implementation of digital instruction and the accompanying challenges at various levels of the education sphere. I was interested in students' ICT preference and usage habits and whether they possess vital digital competences in their own view. The digitally scheduled education programs introduced in response to the COVID-19 pandemic could not fully reach a level required for effective learning according to research findings. The responses revealed several schools did not implement an uniform system, the educational materials were not suitable for independent learning, the given materials did not have a modular structure, the respective texts did not reflect a system oriented perspective, and it was proven that neither students nor teachers possessed digital literacy skills considered vital in the present. The most important result of this statistical analysis entails that those students were more successful in the digital home-based education who spent more time with ICT use, regularly played with or used experience-oriented software and relied on smart devices in most of their studie.

8) The Methods and IT-tools Used in Higher Education Assessed in the Characteristics and Attitude of Gen Z

In the era of digital transformation, some questions occur whether the teaching methods used in higher education are suitable for the students belonging to generation Z or these methods are appropriate enough to make them more attentive or motivated. The diverse methods of information technology have already spread into university education and a pedagogical paradigm shift can be perceived. The latest methodology, like project method, e-learning, BYOD, gamification, MOOC are available in higher education as well; however, it is a question to what extent teachers apply these methods in their teaching process. The new techniques not only make the students more motivated but also enhance them with those sorts of skills that are indispensable to be successful in the field of labor. The research was aimed to find answers about how much engineer students are satisfied with the training they are given in higher education in the 21st Century, what kind of attitude they have towards educational technology.

9) The Effectiveness of Different Sets of Learning Predictors in Moodle Machine Learning Models

Moodle is one of the world's most popular open source learning platforms with millions of users and widely used in online education. Although from its version 3.4 it is possible to create Machine Learning models within the system very few studies have been published so far about their successful applications. In this paper 16 different Moodle Machine Learning models for predicting the success of 57 full-time students enrolled in the Applied Statistics course at the University of Dunaújváros in Hungary have been developed and tested in terms of "goodness". The success can be affected by several factors. Here students' cognitive activities are examined. The type of the predictors used in the models are based on: number of view of Lecture Notes, number of views of Exercise Books, number of views of Lecture Videos, number of views of Minitab Videos (videos for problem solving with a statistical software), number of Quiz Attempts and Quiz Max Grades (best grades achieved by students on quizzes). The models differed in the number and in the types of predictors. Binary Logistic Regression was used for model training and evaluation. The target of the models indicates whether a student is at risk of not achieving the minimum grade to pass the course. The impact of cognitive predictors that are part of the Moodle core Analytics API on predictive power was also examined. Having evaluated the goodness of the different models, it was shown that students' success can be predicted purely from cognitive activities, but their predictive powers are very diverse. The predictors of quizzes have the largest impact on the success, however, supplementing the model with other even less effective predictors much better models can be made. Models built from purely Moodle core cognitive predictors give much less reliable results.

György Molnár

Guest Editor