Revolutionizing education: using computer simulation and cloud-based smart technology to facilitate successful open learning

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Abstract

The article presents the proceedings of two workshops: Cloud-based Smart Technologies for Open Education Workshop (CSTOE 2022) and Illia O. Teplytskyi Workshop on Computer Simulation in Education (CoSinE 2022) held in Kyiv, Ukraine, on December 22, 2022. The CoSinE workshop focuses on computer simulation in education, including topics such as computer simulation in STEM education, AI in education, and modeling systems in education. The CSTOE workshop deals with cloud-based learning resources, platforms, and infrastructures, with topics including personalized learning and research environment design, big data and smart data in open education and research, machine learning for open education and research, and more. The article includes a summary of successful cases and provides directions for future research in each workshop's respective topics of interest. The proceedings consist of several peer-reviewed papers that present a state-of-the-art overview and provide guidelines for future research. The joint program committee consisted of members from universities and research institutions worldwide.

Keywords

Computer Simulation in Education, Cloud-based Smart Technologies for Open Education

1. Introduction

1.1. CoSinE 2022

Figure 1: CoSinE 2022 logo.

CoSinE (**Co**mputer **S**imulation **in E**ducation) is a peer-reviewed international workshop focusing on theory and practice of computer simulation in education. Illia O. Teplytskyi (1941–2018), whose groundbreaking work in the area of computer simulation in education inspires us, founded this workshop.

CoSinE topics of interest since 2019 [1, 2, 3, 4] are:

- Computer simulation in STEM education
- AI in education
- Educational data mining and learning analytics
- Learning environments models
- Learning virtualization
- Modelling systems in education

The first part of this volume represents the proceedings of the 10th Illia O. Teplytskyi Workshop on Computer Simulation in Education (CoSinE 2022), held in Kyiv, Ukraine, on December 22, 2022. It comprises 4 contributed papers [5, 6, 7, 8] that were carefully peer-reviewed and selected from 5 submissions. Each submission was reviewed by at least 3 program

CoSinE 2022: 10th Illia O. Teplytskyi Workshop on Computer Simulation in Education, and
CSTOE 2022: Cloud-based Smart Technologies for Open Education, co-located with the
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🌐 https://ptpe.edc.uoc.gr/en/staff/32380/82 (S. Papadakis); https://ieeexplore.ieee.org/author/38339185000 (A. E. Kiv); http://www.kspu.edu/About/Faculty/FPhysMathemInformatics/ChairInformatics/Staff/Kravtsov.aspx (H. M. Kravtsov);
https://kubg.edu.ua/prouniversitet/vizytivka/rektorat/dyrektory/1175-osadchyi-viacheslav-volodymyrovych.html (V. V. Osadchyi); https://iitlt.gov.ua/eng/structure/departments/cloud/detail.php?ID=565 (M. V. Marienko); https://iitlt.gov.ua/eng/structure/detail.php?ID=442 (O. P. Pinchuk);
https://iitlt.gov.ua/eng/structure/departments/cloud/detail.php?ID=269 (M. P. Shyshkina);
https://iitlt.gov.ua/eng/structure/detail.php?ID=1139 (O. M. Sokolyuk); https://acnsci.org/mintii (I. S. Mintii); https://sites.google.com/view/neota/profile-vakaliuk-t (T. A. Vakaliuk);
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Figure 2: Joint workshop opening.

committee members. The accepted papers present the state-of-the-art overview of successful cases and provides guidelines for future research.

1.2. CSTOE 2022

CSTOE 2022: Cloud-based Smart Technologies for Open Education workshop is designed to consider the state of the art and potential benefit of new and emerging adaptive technologies application within the open systems of higher education. The aim is to explore the use of AI, smart data processing, cloud-based personalized open education and research tools, adaptive and intuitive learning environments for forming the creative and ICT competent person in view of European Research

Figure 3: CSTOE 2022 logo.

Area development. That have to meet the priorities of open science, open communication and open data access and delivery, the wide use of cloud-based learning resources, platforms and infrastructures to support learning and research within the open systems of higher education. The subject matter of the Workshop deals with Big data, Smart data, European Open Science Cloud (EOSC) data and resources, adaptive data processing and analytics, smart learning and research environment to provide breakthrough educational technologies and smart data processing.

CSTOE topics of interest are:

- Personalized Learning and Research Environment Design

- Smart Systems and Learning Robotics for Distance and Enhanced Learning
- Mobile Resources and Ubiquitous Computing in Open Education
- Virtual and Augmented Reality in Open Learning
- Knowledge Extraction, Engineering and Management
- Internet of Things for Open Learning
- Quality Assurance of ICT Education: Methods, Resources and Technologies
- Cloud-based Research Infrastructures for Open Learning and Research
- Language Technologies for Enhanced Learning
- Big Data and Smart Data in Open Education and Research etc.
- Machine Learning for Open Education and Research

The second part of this volume represents the proceedings of the Cloud-based Smart Technologies for Open Education Workshop (CSTOE 2022), held in Kyiv, Ukraine, on December 22, 2022. It comprises 1 contributed paper [9] that was carefully peer-reviewed and selected from 3 submissions. Each submission was reviewed by at least 3 program committee members. The accepted paper includes a current summary of successful cases as well as directions for future research.

1.3. CoSinE 2022 & CSTOE 2021 committees

1.3.1. Joint program committee

- *Marc Baaden*, CNRS, France [10]
- *Pablo Garcia Bringas*, University of Deusto, Spain [11]
- *Oleksandr Burov*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine & University of Vienna, Austria [12]
- *Nadire Cavus*, Near East University, North Cyprus [13]
- *El-Sayed El-Horbaty*, Ain Shams University, Egypt [14]
- *Ramón Fabregat*, University of Girona, Spain [15]
- *Irina Georgescu*, Bucharest University of Economics, Romania [16]
- *Mustansar Ali Ghazanfar*, University of East London, United Kingdom [17]
- *Anita Goel*, University of Delhi, India [18]
- *Carina Gonzalez*, Universidad de La Laguna, Spain [19]
- *Sven Hartmann*, Clausthal University of Technology, Germany [20]
- *Michail Kalogiannakis*, University of Crete, Greece [21]
- *Yuriy Kondratenko*, Petro Mohyla Black Sea State University, Ukraine [22]
- *Francesco Lelli*, Tilburg University, Netherlands [23]
- *Chung-Sheng Li*, PwC, United States [24]
- *Piotr Lipiński*, Technical University of Lodz, Poland [25]
- *Jinwei Liu*, Florida A&M University, United States [26]
- *Alessandra Lumini*, University of Bologna, Italy [27]
- *Rashid Mehmood*, King Abdulaziz University, Saudi Arabia [28]
- *Vincenzo Moscato*, University of Naples "Federico II", Italia [29]

- *Thomas Moser*, St. Pölten University of Applied Sciences, Austria [30]
- *Ranesh Kumar Naha*, University of Tasmania, Australia [31]
- *Stamatios Papadakis*, University of Crete, Greece [32]
- *Michael M. Resch*, HLRS, University of Stuttgart, Germany [33]
- *Nina Rizun*, Gdańsk University of Technology, Poland [34]
- *Abdel-Badeeh M. Salem*, Ain Shams University, Egypt [35]
- *Demetrios Sampson*, University of Piraeus, Greece [36]
- *Antonio Sarasa Cabezuelo*, Universidad Complutense de Madrid, Spain [37]
- *Prem Kumar Singh*, Gandhi Institute of Technology and Management, India [38]
- *Daniel Thalmann*, Swiss Federal Institute of Technology in Lausanne, Switzerland [39]
- *Longkai Wu*, National Institute of Education, Singapore [40]
- *Eftim Zdravevski*, University Ss Cyril and Methodius, Macedonia [41]

1.3.2. Organizing committee

- *Hennadiy Kravtsov*, Kherson State University, Ukraine [42]
- *Maiia Marienko*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine [43]
- *Iryna Mintii*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine [44]
- *Viacheslav Osadchyi*, Borys Grinchenko Kyiv University, Ukraine [45]
- *Olha Pinchuk*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine [46]
- *Serhiy Semerikov*, Kryvyi Rih State Pedagogical University, Ukraine [47]
- *Mariya Shyshkina*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine [48]
- *Oleksandra Sokolyuk*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine [49]
- *Andrii Striuk*, Kryvyi Rih National University, Ukraine [50]
- *Tetiana Vakaliuk*, Zhytomyr Polytechnic State University, Ukraine [51]

1.3.3. General chair

Dr. Stamatios Papadakis (figure 4) has been a postdoctoral researcher in Educational Technology, with an emphasis on mobile learning, at the Department of Preschool Education at the University of Crete, Greece, since 2016. He graduated from the Department of Informatics, Athens University of Economics and Business, Athens, Greece. In 2006 he completed a master's degree (M.Ed.) in Pre-school Education and Educational Design at the University of Aegean, Rhodes, Greece, at the School of Humanities, Department of Pre-school Education. In 2016, he completed a PhD at the University of Crete, Department of Education in Rethymnon, Greece. He has worked as an adjunct Lecturer in Education, teaching Didactics in Programming (2017-2018) at the Department of Computer Sciences, School of Sciences and Engineering at the University of Crete, Greece. Since 2017 he has worked as an adjunct Lecturer in Education teaching Informatics (2017-2018) at the Department of Preschool Education, School of Education, University of Crete, Greece.

He has worked in several international and national computational thinking and pedagogy projects for Pre-K to 16 Education. His scientific and research interests include the study of mobile learning, especially on using smart mobile devices and their accompanying mobile applications (apps) in Preschool and Primary Education, focusing on developing Computational Thinking and students' understanding of numbers. Furthermore, he currently investigates how a STEM learning approach influences learning achievement through a context-aware mobile learning environment in the preschool classroom and explain the effects on preschoolers' learning outcomes.

Languages: English (fluent), German.

He is an ambassador for Scientix – The Community for Science Education in Europe and EU Code Week. He is an ESERA member, CSTA, EAI, IGIP, and the Union for Science and Technology (ENEPHET).

Figure 4: Dr. Stamatios Papadakis, honorary editor of the CITEd 2022 workshop proceedings volumes.

He has published in scientific peer-reviewed journals and international conferences (including *Computers & Education*, *Education and Information Technologies*, *Early Childhood Education Journal*) and book chapters.

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Google Scholar: https://scholar.google.gr/citations?user=e3vLZegAAAAJ&hl=en

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Web of Science: https://www.webofscience.com/wos/author/record/S-1483-2016

AD Scientific Index: https://www.adscientificindex.com/scientist.php?id=1846783

Research website: http://moeads.edc.uoc.gr/

Selected works: Papadakis [52, 53, 54, 55, 56], Papadakis et al. [57, 58], Ampartzaki et al. [59], Vaiopoulou et al. [60], Dorouka et al. [61], Karakose et al. [62], Zourmpakis et al. [63], Drolia et al. [64], Chatzopoulos et al. [65], Lavidas et al. [66].

2. Articles overview

2.1. CoSinE 2022 overview

The article titled "Modelling of AGM-style doxastic operations in three-valued setting" [5] by Nadiia P. Kozachenko (figure 5) aims to identify controversial issues and areas for further research in the theoretical approach to modeling of reasoning. The study focuses on one of the primary modeling approaches based on the AGM concept of belief revision, which is considered classical due to its foundational concepts of belief, representation, cognitive actions,
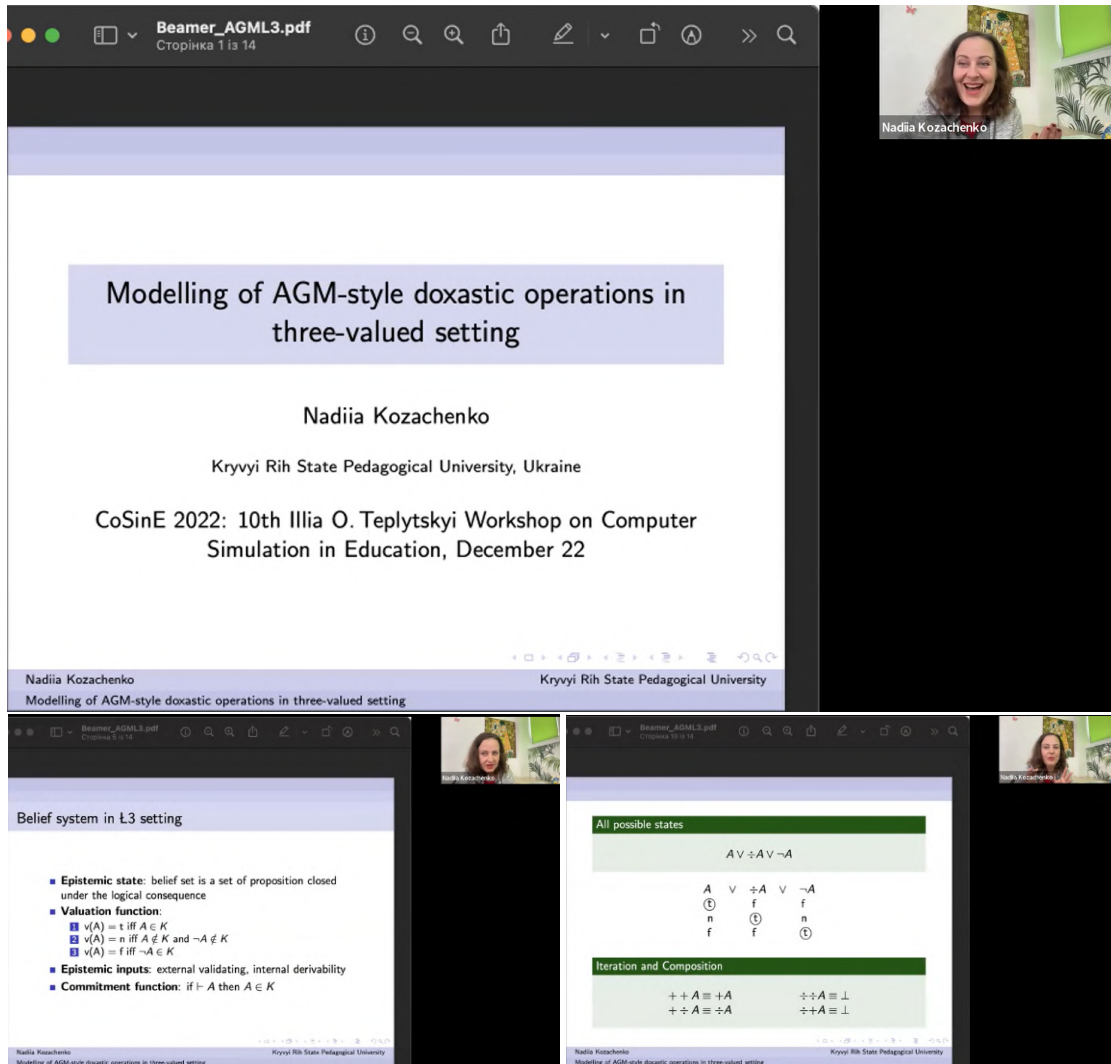
Figure 5: Presentation of paper [5].

and construction of epistemic systems. However, several controversial issues, such as the purity and primacy of doxastic operations and their connection, need further research to address.

To address these concerns, the study proposes modeling the AGM ideas within the framework of the consistent and complete logic of Ł3, using a three-valued logic formalism to constrain the functioning of doxastic operators. This approach will enable testing of the AGM postulates and finding possible solutions to the classical AGM problems. The study also explores the possibility of obtaining other doxastic operators and implementing the minimality criterion for the contraction operator by combining several theorems of three-valued logic.

The proposed method of translating an informal conceptual scheme into formal logic is useful in teaching the basics of modeling and demonstrating the limitations and relationships of modeled objects and processes. Overall, the study provides insights into controversial issues in

AGM-style doxastic operations and suggests potential avenues for further research. This article highlights further research by the authors, begun in [67, 68, 69].
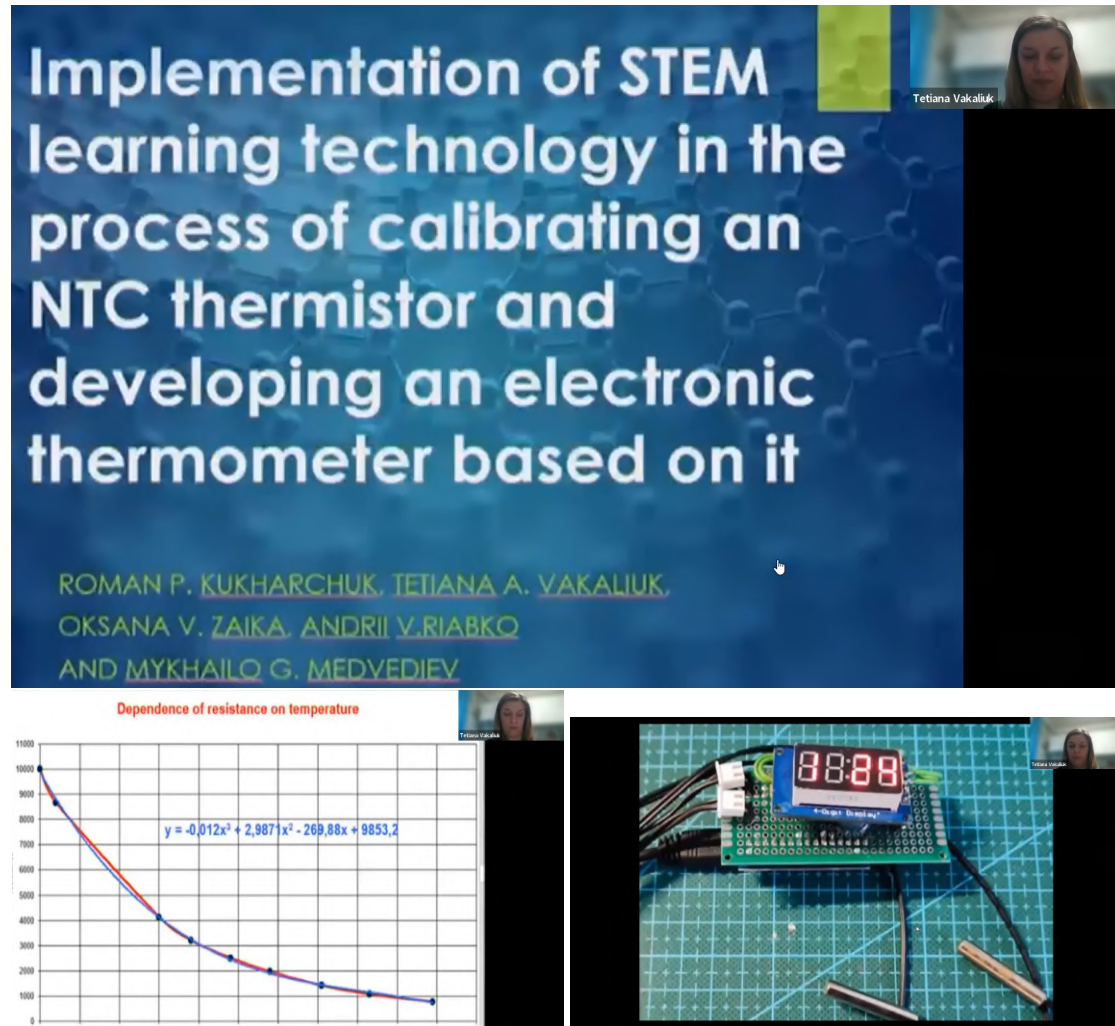

Figure 6: Presentation of paper [6].

The progress of information technology, robotics, nanotechnology, and biotechnology has resulted in a demand for highly skilled professionals who can adapt to new challenges and innovate creatively. To meet this need, there is an urgent requirement to reform education and prepare students for popular careers such as programming, engineering, biotechnology, nanotechnology, and IT. STEM education can integrate these fields into a comprehensive curriculum that can be applied to different age groups. The authors propose a method for calibrating an NTC thermistor using STEM technologies and demonstrate the development of an electronic thermometer using an Arduino microcontroller. The article "Implementation of STEM learning technology in the process of calibrating an NTC thermistor and developing an electronic thermometer based on it" [6] by Roman P. Kukharchuk, Tetiana A. Vakaliuk (figure 6),

Oksana V. Zaika, Andrii V. Riabko, and Mykhailo G. Medvediev describes this approach and builds upon the authors' previous work [70, 71, 72].
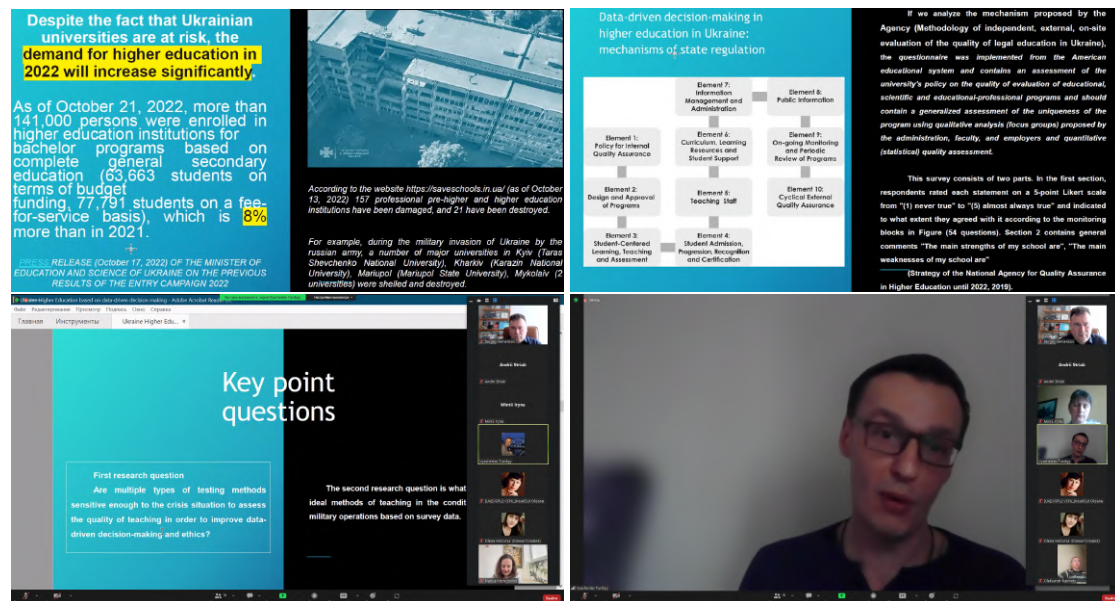

Figure 7: Presentation of paper [7].

The article "Ukraine Higher Education Based on Data-Driven Decision Making (DDDM)" [7] by Kateryna Bondar, Olena Shestopalova, Vita Hamaniuk, and Vyacheslav Tursky (figure 7) presents a study on the evaluation of the quality of online undergraduate and graduate education during the 2022 Russian military invasion of Ukraine. The authors conduct a qualitative theoretical analysis and empirical research, comparing higher education quality assessment data from across Ukraine during the war. They analyze the tools and structure of student feedback on the educational process and modify the programs based on the analysis of this data. The article also discusses the National Qualifications Framework, which has been under development since 2014 and requires universities to provide empirical evidence of students acquiring interdisciplinary competencies. The authors present baseline data on the assessment of online education quality during the war using the case study of Kriviy Rih State Pedagogical University. Finally, the authors propose modifications to the questionnaire for assessing the quality of teaching to enhance data-driven decision-making and testing ethics. This article builds upon the authors' previous research [73, 74, 75].

In their article titled "The recognition of speech defects using convolutional neural network" [8], Olha Pronina and Olena Piatykop (figure 8) present a solution to improve the recognition efficiency of speech defects in children by utilizing convolutional neural network models to process spectrogram-based sound data. The ability to communicate effectively through speech is crucial for successful integration into society, and speech development is an essential part of a child's normal growth. Speech defects can cause psychological complexes in children, making it important to identify and address them at an early age. The authors conduct a literature analysis and propose the use of CNN models for speech defect identification, with a focus on Ukrainian
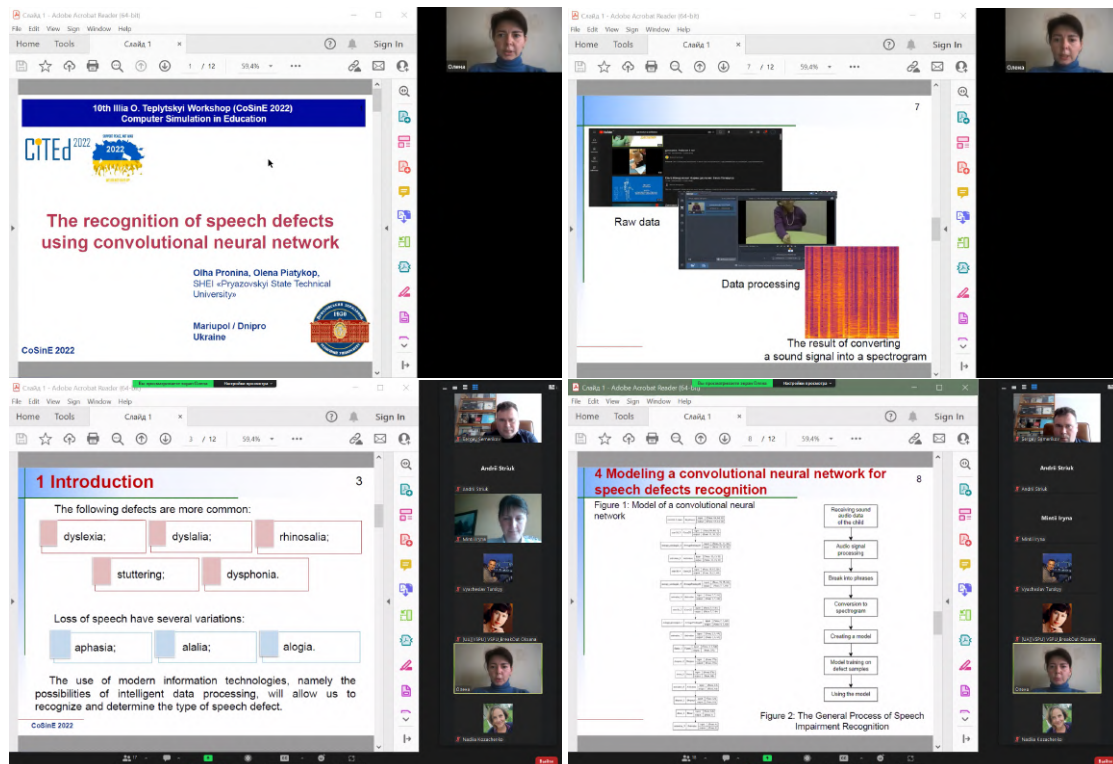
Figure 8: Presentation of paper [8].

language, which has not been studied in this context. The paper includes a mathematical model of oral speech disorders in children, a description of CNN structure, and experimental results. The results show that the proposed method can identify dyslexia, stuttering, difsonia, and dyslalia with a recognition accuracy of 77-79%. The authors' related works are referenced as [76, 77, 78].

2.2. CSTOE 2022 overview

The article "An IoT system based on open APIs and geolocation for human health data analysis" [9] by Oksana V. Klochko, Vasyl M. Fedorets (figure 9), Maksym V. Mazur and Yurii P. Liulko was the only paper accepted for presentation at CSTOE 2022. The authors highlight the growing popularity of open API-based applications, which offer new opportunities for real-time monitoring of human health using IoT, AI, and cloud computing technologies. The study describes the development of an application that uses smart gadgets and meteorological geographic information to generate alerts about potential health risks, such as high pollen concentrations or poor air quality. The authors believe that this application has significant potential to improve healthcare efficiency in extreme or sustainable conditions, particularly during and after the COVID-19 pandemic. They suggest that further research in this area could involve data processing in healthcare systems using machine learning and deep learning, and
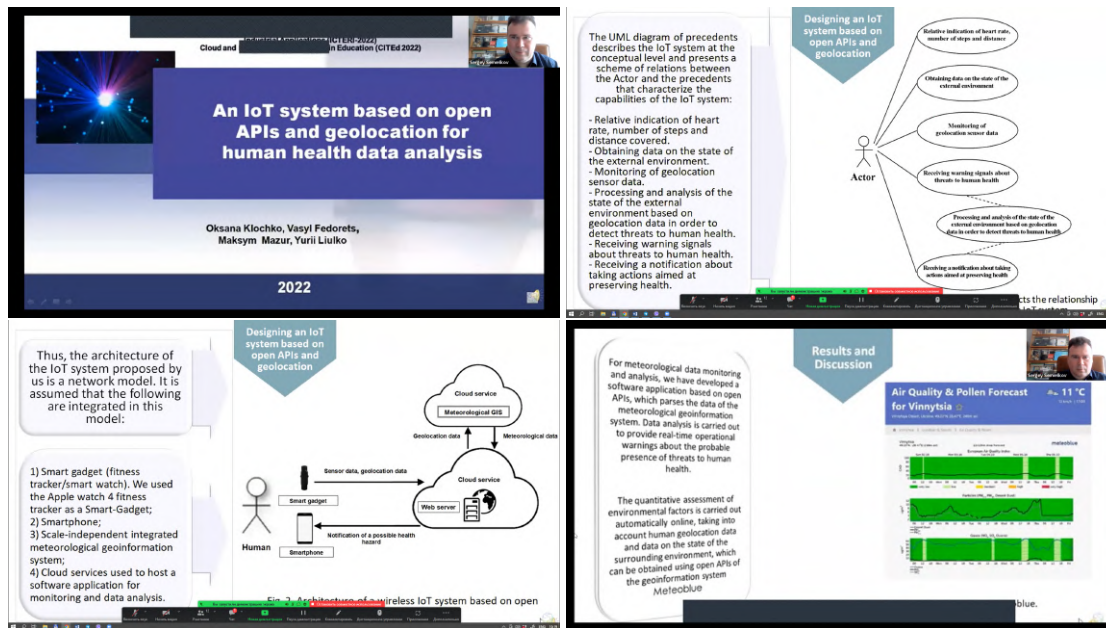
Figure 9: Presentation of paper [9].

that the developed IoT system could also be used for educational and scientific purposes. The authors' related works are referenced as [79, 80, 81].

3. Conclusion

Joint Workshop on Computer Simulation in Education and Cloud-based Smart Technologies for Open Education (CoSinE & CSTOE 2022) was organized by the Academy of Cognitive and Natural Sciences in collaboration with Institute for Digitalisation of Education of the NAES of Ukraine (with support of the deputy director for scientific experimental work Olha P. Pinchuk), Kryvyi Rih State Pedagogical University (with support of the vice-rector for research Vita A. Hamaniuk), Kryvyi Rih National University (with support of the rector Mykola I. Stupnik), Ben-Gurion University of the Negev (with support of the rector Chaim Hames), Zhytomyr Polytechnic State University (with support of the rector Viktor V. Ievdokymov) and Kherson State University (with support of the rector Aleksander V. Spivakovsky).

We are thankful to all the authors who submitted papers and the delegates for their participation and their interest in CITEd workshops as a platform to share their ideas and innovation. Also, we are also thankful to all the program committee members for providing continuous guidance and efforts taken by peer reviewers contributed to improve the quality of papers provided constructive critical comments, improvements and corrections to the authors are gratefully appreciated for their contribution to the success of the conference. Moreover, we would like to thank the developers and other professional staff of *Academy of Cognitive and Natural Sciences* (https://acnsci.org) and *Not So Easy Science Education* platform (https://notso.easyscience.education), who made it possible for us to use the resources of this

excellent and comprehensive conference management system, from the call of papers and inviting reviewers, to handling paper submissions, communicating with the authors etc.

We are looking forward to excellent presentations and fruitful discussions, which will broaden our professional horizons. We hope all participants enjoy this conference and meet again in more peaceful, hilarious, and happiness of further CITEd 2023.

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