

Advancing lifelong learning with AI-enhanced ICT: A review of 3L-Person 2024

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Abstract

The International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach (3L-Person 2024) brings together researchers and practitioners from Information/Communication Technologies (ICT) and Education/Training to explore the intersection of these fields. This paper introduces the 9th edition of the workshop, held on September 25, 2023, in Lviv, Ukraine, in conjunction with the 19th International Conference on ICT in Education, Research, and Industrial Applications (ICTERI 2024). 3L-Person 2024 received 23 submissions, with 14 papers accepted after rigorous peer review. The workshop covers a wide range of topics, including personal learning environment design, artificial intelligence in education, advanced ICT for professional retraining, blended and remote learning, educational robots and databases, ICT for special needs education, education safety and security, STEM education support, and synthetic learning environments.

Keywords

artificial intelligence, information and communication technology, lifelong learning, professional retraining, AI-driven personalization, adaptive learning, educational technology, 3L-Person 2024 workshop, data analytics, technology-enhanced learning

1. Introduction

The **International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach** (3L-Person) is a peer-reviewed workshop. The workshop's goal is to bring together researchers and practitioners from the areas of Information/Communication Technologies (ICT) and Education/Training (E/T), to support the bridging process between ICT opportunities and education/training needs. ICT have a profound impact on education and training, offering new opportunities and challenges for learners, educators, and researchers. However, there is a need for a better understanding of the potential and limitations of these technologies, as well as the best practices and methodologies for their design and implementation. The workshop is cover such topics as ICT tools' design for: remote learning, adaptive

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learning, day-to-day support for individual's learning, synthetic learning environment, life-long learning of individuals, learning in the workplace, learning/training process of individuals with special needs, teaching/learning safety and security, vocational training and carrier guiding, etc.

The workshop is also address the issues of time, space, and cultural differences of learners and teachers, and how ICT can help to overcome them. The specific goal of this activity is to facilitate a broader understanding of the promise and pitfalls of these technologies and working (learning/teaching) environments in global education/development settings, with special regard to the human as subject in the system and to the integration of humans with the technical, didactic, and organizational subsystems.



Figure 1: 3L-Person logo.

2. Workshop overview

2.1. Aims and scope

The workshop aims to achieve the following objectives:

1. Identification of needs and opportunities in which coordinated research efforts are required to expand and understand the emerging technologies in education (such as cloud computing, mobile tools and services, network infrastructures, systems of computer modeling, simulation, AR/VR/MR/ER, AI etc.), their effectiveness, the potential risks, and the potential benefits of new ways to educate, learn and collaborate.
2. Contribution of novel ICT in E/T.
3. Informing the educators about options for global education in near future.

2.2. Topics of interest

3L-Person topics of interest since 2019 [1, 2, 3, 4]:

- **Personal Learning Environment Design:** person-oriented tools, adaptive and intuitive learning, cloud-based learning environment, social networking, etc.
- **AR/VR/ER (Extended Reality):** Implementation of immersive learning technologies and personalization of education, augmented cognition, etc.
- **Artificial Intelligence in Education:** Development of educational materials, teaching methodologies, integration with educational practices, innovative teaching methods, ethics of usage.
- **Advanced ICT for Professional Retraining and Training in the Workplace:** cloud-based learning tools, mobile-based learning, learning networking tools, etc.
- **Blended and Remote Learning/Teaching with Emerging ICT:** remote learning and virtual classroom, flipped classroom, network-oriented collaborative learning, homeschooling, etc.
- **Educational Robots, Databases and Language Technologies for Open Learning and Research:** innovative and intelligence tools for data analysis; network labs, robotics learning tools; machine learning; open learning and research platforms etc.
- **ICT in Education of a Person with Special Needs:** openness and accessibility of education, e-inclusion; using ICT in educating gifted, underachieved, disabled individuals; ICT for a human development, etc.
- **ICT in Education Safety and Security:** human-system integration, human factors, quality evaluation of electronic learning resources, etc.

- **ICT-support of STEM Education and Professional Career:** network labs, robust intelligence, synthetic environment, 3D technology, systems of computer modeling and simulation, etc.
- **Synthetic learning environment:** AR/VR/MR, AI in education, computer modeling in teaching process etc.

This volume contains the papers presented at the IX International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach (3L-Person 2024) held on September 25, 2023 in Lviv, Ukraine. This year workshop co-located with the 19th International Conference on ICT in Education, Research, and Industrial Applications (ICTERI 2024).

The workshop received 23 submissions. Each submission was reviewed by at least 3 program committee members. Based on the reviews, 14 papers were accepted for this volume as regular papers.

2.3. Program committee

The workshop benefited from the expertise of a diverse and distinguished program committee, comprising leading researchers and practitioners in the fields of educational technology, computer science, psychology, and related disciplines. The committee members played a crucial role in reviewing submitted papers, providing constructive feedback to authors, and ensuring the overall quality of the workshop program.

- *Marc Baaden*, CNRS, France [5]
- *Nadire Cavus*, Near East University, North Cyprus [6]
- *Irina Georgescu*, Bucharest University of Economics, Romania [7]
- *Sven Hartmann*, Clausthal University of Technology, Germany [8]
- *Michail Kalogiannakis*, University of Thessaly, Greece [9]
- *Chung-Sheng Li*, PwC, United States [10]
- *Vincenzo Moscato*, University of Naples “Federico II”, Italia [11]
- *Thomas Moser*, St. Pölten University of Applied Sciences, Austria [12]
- *Stamatios Papadakis*, University of Crete, Greece [13]
- *Michael M. Resch*, HLRS, University of Stuttgart, Germany [14]
- *Antonio Sarasa-Cabezuelo*, Universidad Complutense de Madrid, Spain [15]
- *Prem Kumar Singh*, Gandhi Institute of Technology and Management, India [16]
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Additional reviewers

- *Oleksandr Burov*, Institute for Digitalisation of Education, Ukraine [19]
- *Oksana Klochko*, Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, Ukraine [20]
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- *Serhiy Semerikov*, Kryvyi Rih State Pedagogical University, Ukraine [24]

2.4. Organizer

The 9th edition of the International Workshop on Professional Retraining and Life-Long Learning using ICT: Person-oriented Approach (3L-Person) was meticulously coordinated by the Academy of Cognitive and Natural Sciences (ACNS), a non-governmental organization dedicated to nurturing the growth of researchers’ expertise in the cognitive and natural sciences arena. ACNS’s mission encompasses enhancing research, safeguarding rights and liberties, and catering to professional, scientific, social, and various other interests.

ACNS is engaged in a spectrum of activities, including:

- Spearheading research initiatives within the cognitive and natural sciences domain and fostering collaborative ties among researchers.
- Orchestrating conferences, workshops, training sessions, internships, and other platforms for the exchange and dissemination of knowledge in the realm of cognitive and natural sciences.
- Publishing scientific journals, conference proceedings, collections of scholarly works, and related materials (<https://acnsci.org/cms/journals/>).

3. Articles overview

Lytvynova et al. [25] explores the use of artificial intelligence (AI) in teaching students programming languages in higher education institutions. This paper highlights the positive impact AI can have on organizing the educational process and provides an overview of various AI platforms that can be used to support adaptive learning in programming education. The authors emphasize the need for teacher training and addressing technical and ethical challenges to effectively implement AI in this domain.

The paper “Using STACK to support adaptive mathematics learning in LMS Moodle” describes practices of using the STACK system in LMS Moodle to support adaptive mathematics learning at the university level. It showcases the potential of this technology to enable effective teaching and learning in mixed or distance environments. Astafieva et al. [26] provide examples demonstrating the advantages of interactive math tests using potential response trees and step-by-step tasks with prompts for self-study. Student feedback on the positive aspects of using STACK is also included.

Kharchenko and Babenko [27] examines the potential and limitations of large language models like ChatGPT, Gemini, and Copilot in chemistry education. The authors evaluate the LLMs’ performance on chemistry tasks at different knowledge levels compared to average Ukrainian students. While LLMs show promise in tasks not requiring deep reasoning, challenges are identified related to understanding nuances of chemistry, abstract concepts, formulas, and equations. Improving prompt engineering skills is noted as important for effectively using LLMs in this context.

In their study “Research on the feasibility of employing gamification technologies in the training process of IT specialization seekers”, Smotr et al. [28] test several hypotheses related to the effectiveness of gamification using data analytics methods. Visualizations like scatter plots and heat map correlations are used to depict relationships between participation levels, active time, task completion, and performance in gamified courses. Overall, the results indicate participation in gamified courses positively impacts learning effectiveness.

Ovcharuk and Soroko [29] focuses on monitoring the effectiveness of STEAM-oriented environments in general secondary education in Ukraine. The authors highlight approaches to defining criteria and indicators for implementation. Surveys reveal significant interest but also gaps and challenges in funding, equipment, and teacher training. Criteria proposed include academic achievement, resources, innovative teaching methods, and government attention. The authors emphasize the need for systematic monitoring and support to address problems in implementing STEAM education.

Sharyhin and Klochko [30] examines the automation of checking student assignments in IT-related subjects using AI systems. The authors compare AI-based approaches to traditional systems that use simulations for estimating the time complexity of algorithms. They found that AI systems like ChatGPT, Bard, TimeComplexity.ai and Chatsonic accurately determined algorithmic complexity for code fragments, taking much less time than simulation-based methods. An API was developed to partially automate teachers’ work in checking assignments. The paper discusses the potential of AI in providing prompt feedback and reducing resource costs in evaluating student solutions.

Bazhmina et al. [31] explores integrating formative assessment into the design of higher education learning environments. A pedagogical experiment conducted at a Ukrainian university focused on the graphic training of Industrial Engineering students. The study found that formative assessment fosters a culture of independent work among students. A pedagogical model was designed emphasizing a cyclical structure to enhance assessment skills. Key qualities developed include educational, personal, professional skills, and collaboration abilities. Digital technologies play a crucial role in the process. The

results demonstrate the positive impact of formative assessment on promoting independent learning, supported by digital tools.

Yurchyshyn et al. [32] analyzes the development of digital technologies in Ukraine and their impact on society and the economy. The authors highlight the country's significant potential for progress in this area, despite challenges. A survey assessed the readiness of Ukrainian SMEs to adopt digital technologies. To increase efficiency, the authors propose creating an innovation ecosystem integrating the interests of all stakeholders. The Digital Innovation Hub model based on a Ukrainian university demonstrates effective collaboration between researchers, educational institutions, SMEs and international partners. The systematic approach aims to enhance human potential and address economic issues through digital technologies.

Pokryshen [33] presents a study on Ukrainian teachers' satisfaction with the use of artificial intelligence (AI) in education. A survey conducted in December 2023 showed high interest and a positive attitude towards AI among teachers, with ChatGPT and Bard being the most popular services. Advantages noted include increased availability of materials, improved organization of the educational process, and automated creation of didactic content. However, technical limitations and risks associated with over-reliance on technology were identified as obstacles. The paper proposes a model for effectively integrating AI into the educational process while addressing challenges.

The article "Synergy of virtual learning environments in the context of implementing the principles of remote learning for higher education applicants: economic aspect" reveals the economic aspect of implementing educational websites and learning management systems in a remote learning environment. Kosovets et al. [34] analyze the synergistic combination of these components in improving the educational level of students and developing their creative potential. The teacher's website is highlighted as a crucial element for integrating technology into personalized learning strategies. Pedagogically balanced use of these tools contributes to individualized learning pace, differentiated tasks, and catering to students' interests. The efficiency of such training is enhanced by the integrated use of digital technologies. The study demonstrates the positive impact of virtual learning environments on accessibility, safety, and resource savings.

Kostetskyi et al. [35] describes the development of a computer system for distance learning with integrated artificial intelligence. The system introduces a unique functionality that enables the automatic generation of tests using AI, significantly reducing the time required by educators for test preparation. The Laravel framework, React library, and ChatGPT service were used for development. An experiment involving AI-assisted test creation confirmed the system's effectiveness and efficiency. The results indicate that the primary goal of developing a system that streamlines the educational process and reduces the burden on teachers has been successfully achieved.

Nazarenko et al. [36] presents a modern take on the potential usage of artificial intelligence and smart data-driven technologies in educational platforms. The study outlines the smart system design and provides in-depth data classifications for educational processes and methodologies. The Educational Assistant web-service software model consists of data-centered smart sub-systems, such as knowledge, recommendation, assessment, and expert feedback components. Platform-relevant data structures and algorithms were designed using educational assistant communication system architecture. The presented platform aims to help overcome obstacles in online education and assist both teachers and students in the process.

Burov et al. [37] analyzes the variation of students' intellectual and personality qualities necessary for the formation of ICT competences during vocational high school and university learning. The study revealed that the structure of intelligence can change at micro-age intervals over high school and university learning, despite the popular view of a relatively stable level of intelligence after age 15. The findings suggest adapting the educational process of IT learners to train specific professionally important psychological qualities, such as the ability to solve practical computational tasks and operate with spatial objects.

Semerikov et al. [38] substantiates the use of an immersive cloud-based educational environment (ICBEE) for developing digital competencies in higher education students. The authors propose a model for using ICBEE, define a system of digital competencies for future IT professionals and engineer-

educators, and present a methodology for developing digital competencies in pre-service teachers using immersive technologies. The implementation of the proposed approaches is expected to increase the level of digital competencies of graduates and promote their successful professional self-realization in the digital society.

4. Conclusion

The 3L-Person 2024 workshop provides a unique opportunity for researchers and practitioners from various fields and regions to exchange ideas and experiences on the use of ICT for lifelong learning and professional development. The goal of 3L-Person 2024 is to create a forum for presenting and discussing the latest research findings, innovative solutions, and best practices in this interdisciplinary field. The workshop also promotes collaboration and networking among participants, who will benefit from the exchange of knowledge and feedback.

We are grateful to all authors who submitted papers and to the delegates for their participation and interest in 3L-Person as a platform for sharing their ideas and innovations. We also thank all program committee members for their continuous guidance and the efforts of peer reviewers who helped improve the quality of papers. The constructive criticism, improvements, and corrections provided to authors are greatly appreciated for their contribution to the success of the conference.

We want to acknowledge the developers and professional staff of the *Academy of Cognitive and Natural Sciences* (<https://acnsci.org>) and the *Not So Easy Science Education* platform (<https://notso.easyscience.education>) for providing us with the excellent and comprehensive conference management system that facilitated the smooth running of the workshop.

Since 3L-Person 2016, our workshop is **sponsored** by the CEUR Workshop Proceedings (CEUR-WS.org), the world's best Diamond Open-Access proceedings publisher for Computer Science workshops.

Finally, we would like to acknowledge that Ukraine has been facing a difficult time due to the ongoing war in the country. Despite these challenges, the 3L-Person 2024 workshop serves as a testament to the resilience of Ukraine's scientific community.

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