Book of Abstracts
DIGIAI SOCIETY 2026

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2nd International Congress on Digitalization, Artificial Intelligence, and Society (DIGIAI SOCIETY)

Oludeniz, Turkey

April 6-8, 2026

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Andrew Peck	Loughborough University, UK
Hassan Kaya	University of KwaZulu-Natal, South Africa

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Alexandrina Mangau	Independent Expert, Romania
Karina Bogatyreva	Saint Petersburg State University, Russian Federation
Andrew Peck	Loughborough University, United Kingdom
Boris Mirkin	NRU Higher School of Economics, Russian Federation

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Michail Kalogiannakis	University of Thessaly, Greece
Omkar Singh Kushwaha	IIT Madras, India

2nd International Congress on Digitalization, Artificial Intelligence, and Society

PLENARY SPEAKER

Id-086

How Many Robots Could You Beat in a Fight?: Resisting the AI-Enabled Opponent

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Abstract: AI represents a revolutionary change in how we do business, healthcare, education and industry. But it will also be applied to warfare and policing in ways that point to a potentially dystopian future for the surveilled and those at a technological disadvantage. The talk imagines and considers the potential of AI enabled surveillance and battlefield technologies together with the autonomous vehicles or robotics that may form part of the big machine and imagines what form resistance and asymmetric opposition may look like, by exploring the limits of cybersecurity red-teaming practices. A survey of current legislation around AI-enabled surveillance and warfare is offered, and found lacking, with a proposal made that ethically as AI researchers we must build in safeguards in the "code as law" level of our creations to avoid future abuse.

Keywords: AI; Warfare; Surveillance; Smart Cities; Robotics; Decision Making; Red-teaming; Futurism; Ethics.

PLENARY SPEAKER

Id-113

Beyond the Frontier: Driving Global Resilience through Youth-Led Digital and Indigenous Innovation

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Abstract: The contemporary global landscape presents a paradox: unprecedented technological growth set against escalating existential crises. As we convene for DIGIAI 2026, we must pivot from viewing Artificial Intelligence as a mere tool for efficiency toward recognizing it as a catalyst for a deeper civilizational synthesis. Mitigating these global challenges requires an ontological shift that integrates Africa's ancient indigenous wisdom with the vanguard of the digital revolution. At the heart of this transition is a vibrant, youth-led digital revolution. Africa's burgeoning youth population is no longer composed of passive consumers; they are re-engineering technology to fit local realities. By grounding digital prowess in Indigenous Knowledge Systems (IKS), we empower a new cadre of "techno-indigenous" innovators. This generation is uniquely positioned to address the limitations of Western-centric AI, providing the localized, historical, and ecological context essential for sustainable environmental governance and climate resilience. Central to this synergy is the reclamation of indigenous languages as sophisticated cognitive frameworks. The nuances of satire and proverbs—historically used for social regulation—can be transformed into algorithmic logic and engagement strategies for climate, environmental energy and food security justice in just transitions and governance. Guiding this integration is the African philosophy of Ubuntu. Its "web of mutuality" offers a superior ethical blueprint for global governance, contrasting the individualistic models that have driven resource depletion. By marrying high-tech innovation with high-heritage wisdom, Africa provides a roadmap for a sustainable, peaceful, and inclusive global future.

Keywords: Global Resilience; Youth-Led Digital; Indigenous.

INVITED SPEAKER

Id-087

The Worst Case Workshop: AI Futures

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Abstract: In the "worst case workshop", participants are invited to explore a range of risks and harms resulting from improperly designed or deployed near-future AI capabilities, and generate the AI-risk register for a variety of scenarios that may be closer than we think (AI in healthcare, AI in dating apps, AI in self driving vehicles, battlefield AI, and AI in the financial sector). This is a fun workshop that will appeal to both the AI developer who wants to understand better what their work might mean in the real world, and the participant who's always dreamt of being a science-fiction author. Participants will leave ready to have the big conversations with senior stakeholders to ensure that the AI they develop and deploy comes with the right safeguards at the governance, policy and implementation level to mitigate risks that otherwise will make the headlines.

Keywords: Futurism; AI; Risk; Resilience; Cybersecurity; Red-teaming; Role Playing; Creativity.

INVITED SPEAKER

Id-092

Reporting AI to Environmental Issues (Climate Change Mitigation and Adaptation)

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Abstract: The state of the environment has suffered a considerable decline in recent decades, as a result of the disharmonious development of modern society. In the context of raising legitimate questions regarding the sustainability of life on Earth, the urgent need for intervention and action in the environmental field has been recognized. Concerns regarding environmental protection have gradually expanded from the European level to the global level, becoming priority directions of action for governments everywhere. Among the various instruments designed as appropriate for managing environmental issues, the application of emerging technologies such as artificial intelligence (AI) stands out. Performing a critical analysis of the specialized literature highlights the mostly positive perception of the application of AI in the field of climate change. The conclusions of the researched studies lead to the outline of a promising hypostasis of AI in relation to the environment as a whole, specifically aiming at the mitigation and adaptation to climate change. Artificial intelligence is attributed a crucial role in combating climate change from a dual perspective: improving the understanding of the phenomenon itself and through the provision of concrete solutions in the case of the climate crisis. In addition, AI seems to bring substantial changes to the way in which the effects of climate change are understood. A number of valuable possibilities offered by AI algorithms in the direction of supporting and substantiating climate decisions are stated. The application of AI in climate research can be extremely beneficial for the realization of weather forecasts, for example, being able to support decision-makers in taking preventive measures for certain limit situations. It is also worth noting the potential of AI to make a major contribution to reducing global emissions. In order to argue the position of AI in the context of environmental issues, the proposed study brings up for debate several dilemmatic aspects regarding: reporting the negative contribution of AI systems to climate change (by generating greenhouse gas emissions); the considerable energy consumption necessary to develop, operate and train AI algorithms; the hypothetical exacerbation of ethical issues and social challenges associated with the application of AI. In such a context, the research direction related to identifying the most optimal conditions that AI systems should meet is identified as pertinent so that the benefits targeted in the field of environmental issues prevail over the risks associated with the application. As a result of deepening the analysis topic- exploring the interaction between AI mechanisms and climate change- (through specific research methodology), a series of results were obtained regarding:

-Providing a synthetic framework of the current state of knowledge in the field associated with the interconnected application of AI technologies in the field of climate change;

-Identifying challenges (obstacles) to the application of AI in the environmental field;

-Sharing practical ways to implement new technologies (AI) towards obtaining benefits for preventing and mitigating environmental change.

Since the subject of the proposed study is one of topicality and major importance, we consider it useful to deepen it in future scientific research.

Keywords: Artificial Intelligence; Implementation; Benefits; Climate Change; Research.

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INVITED SPEAKER

Id-101

The "Less-is-More" Paradox of AI: How Capability Bundles Drive SMEs' Success in Emerging Market

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Abstract: This study challenges the direct link between AI usage intensity and performance in emerging-market SMEs. We argue that performance depends instead on how firms orchestrate internal capabilities under resource constraints. Using Resource Orchestration Theory and fsQCA analysis of 47 AI-using Russian SMEs, we identify configurational pathways to success. The results reveal an AI capability paradox: intensive AI use is not essential for high performance. Success is driven by core AI governance, combined with ethical readiness and either strong employee skills or active leadership. We shift the debate from adoption volume to capability orchestration. For managers, this means prioritizing governance and skills over mere technology adoption. For policymakers, it underscores the need to support organizational development alongside digital tools.

Keywords: AI, SMEs, Organizational Capabilities, Firm Performance, Resource Orchestration.

INVITED SPEAKER

Id-103

Bridging the Digital Divide through Culturally Grounded AI Literacy: A Case Study of the Smart Artificial Intelligence (SAIL©) Programme among the Aboriginal Community in Malaysia

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Abstract: While the rapid advancement of Artificial Intelligence (AI) presents opportunities for educational equity, it also poses significant challenges for marginalised rural communities. This study investigates the Smart Artificial Intelligence Literacy (SAIL) programme, an initiative designed to foster digital inclusion among indigenous (Orang Asli) students in Malaysia. Recognising the potential for a widening digital schism, the programme leveraged existing technological infrastructure to deliver a structured, four-module curriculum covering foundational AI concepts, generative AI applications, and digital content production. A distinguishing feature of the SAIL framework is the integration of 'local wisdom', wherein students synthesised traditional cultural narratives with AI tools to produce digital storybooks and AI-generated music. The research indicates that this culturally grounded approach not only enhanced students' technical competencies and confidence but also facilitated the preservation of intangible cultural heritage in a contemporary digital format. Furthermore, the inclusion of a Training of Trainers (ToT) component ensured pedagogical sustainability by equipping educators with the literacy required to integrate AI into the formal national syllabus. From a broader developmental perspective, the SAIL programme represents a multidisciplinary contribution to the United Nations Sustainable Development Goals (SDGs), specifically addressing Quality Education (SDG 4), Reduced Inequalities (SDG 10), Sustainable Cities and Communities (SDG 11), and Industry, Innovation, and Infrastructure (SDG 9). It is concluded that for AI literacy programmes to be truly transformative in resource-limited environments, they must move beyond technical instruction to incorporate local ontological perspectives and robust teacher-support mechanisms.

Keywords: Artificial Intelligence Literacy; Digital Divide; Indigenous Education; Sustainable Development Goals (SDGs); Cultural Preservation; Generative AI.

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INVITED SPEAKER

Id-108

Extending Chi-square Analysis of Contingency Tables to Local Associations

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Abstract: Two-way contingency tables, or cross-classifications, are one of the most popular data types. Indeed, the contingency table format is a rather straightforward way to summarize the data of associations between two sets of mutually exclusive categories, such as those in two features, over a possibly quite large data sample, in a most compact and demonstrative way. To date Pearson's chi-square independence test perhaps is the most popular approach for analyzing contingency tables. There is an issue inherent to this approach, though: it gives a "global" assessment of whether the hypothesis of "global" independence between features should be rejected or not. Whenever the independence hypothesis is rejected, which almost always happens if the sample size is in the thousands or millions, an open issue remains of investigating those "local" associations between categories that cause the rejection: «The Chi-square test is statistically significant: now what?" In our view, currently there are no adequate responses to this question for cases in which at least one of the features has more than two categories. We developed a novel approach based on an index for capturing "local associations" in contingency tables proposed by a founding father of statistics, Adolphe Quetelet, almost two hundred years ago. The Quetelet index between two categories shows the relative change of the probability of one of them when the other category becomes known. It turns out that the average value of Quetelet indices coincides with the Pearson's Chi-square index, normalized by the sample size. This gives both an operational meaning to the value of Chi-square and a decomposition of that in terms of Quetelet indices. Our scenario for Pearson-Quetelet analysis of contingency tables includes software with the following computations:

1. Relative contingency table.
2. Pearson Chi-square analysis.
3. Quetelet indices.
4. Pearson-Quetelet decomposition of Chi-Square.
5. Contrast: Positive and negative contributions.

The working of the scenario is illustrated at several real-world data tables of current interest.

Keywords: Contingency Table; Chi-squared; Quetelet Index; Local Association.

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INVITED SPEAKER

Id-111

Does AI Marketing Efforts Affect Brand Loyalty of Gen Z Consumers? Mediating Role of Brand Image and Brand Experience

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Abstract:

Keywords: AI Marketing Efforts; Brand Loyalty; Brand Image; Brand Experience; Repurchase Intention.

INVITED SPEAKER

Id-125

Citizens or Codes ? Back to Humanism

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Abstract: Technology is usually considered neutral, neither good nor bad it is the purpose and use that humans choose to make the difference. For a long time researchers in the technological sector didn't pose their attention on ethical and ontological aspects nor on the impacts of their discoveries on society. The different class of objects defined as "digital" have not raised potential concerns about their impact on society. Thus ownership, authenticity, integrity along with the revolutionary power to share messages and disseminate information have apparently not been considered in light of their social impact. At the same time ongoing digital transition or rather digital transformation has impacted society repeatedly without any prior assessment of its impact. The world summit on the information society in 2003 was one of the turning point to include ethics in the range of key guidelines to shape innovation. This contribution from humanities was soon extended to a mid a long term evaluation of digital technology impacts on society reversing the original approach considering citizens as pure "end users" to a citizens centred approach. The globalisation process played a relevant role in the digital transformation. The increasing full dependence of citizens from digital platforms in short showed its risks and drawbacks generating criticism on the roadmap to innovation. Mayor part of our daily life is based on digital, a technology that is intrinsically fragile, subject to malfunctions, hacking attacks and even top down decision to be selectively cut out from it some entities. Recently the two competing vision of transhumanism and the end of Anthropocene promoted the vision of a future based on cyborg or a "Planet of Apes". The recent resurgence of Artificial Intelligence as a technology accessible to all, coupled with the intention of investing enormous resources to achieve global supremacy in this strategic field, has paved the way for a debate among scientists and citizens on the impacts, benefits, and drawbacks of AI. Initially, concerns arose about potential bias, privacy violations, and the risk of losing cultural identity, jobs, and rights. Today, despite the trend toward deglobalization, we live in the era of IT moguls and transhumanism, coupled with declining trust in decision-makers and managers. The risk is that a generalized AI platform will dominate the digital pyramid of procedures, one that will rule the world. Today's digital technology can express a power unmatched in human history.

Keywords: Digital Trasformation; Ethics; Human Rights; Artificial Intelligence; Humanism.

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POSTER PRESENTATION

Id-102

Reshaping Operational Management with AI: A Systematic Literature Review

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Abstract: This systematic review objectively synthesises and clarifies how firms operationalise Artificial Intelligence (AI) for daily decision-making, addressing the 'why' of fragmented empirical evidence on AI's contextual integration amid rapid technological evolution (e.g., generative AI adoption post-2023). Drawing on 200 peer-reviewed studies (2020–2025) analysed using PRISMA, it maps seven key theoretical frameworks across sectors. Results indicate effective operational AI strategies depend not only on technical assets but on organisational adaptability, knowledge management, and user acceptance. Resource- and capability-based frameworks dominate public administration and research; knowledge integration and acceptance models prevail in healthcare, HRM, and hospitality; and disruption theory informs finance-sector dynamics. Originality stems from its theory-driven synthesis of fragmented literature, clarifying AI's operational impact across contexts and offering relevant, sector-tailored guidance for managers navigating adoption challenges. Limitations consist of the exclusion of non-English and grey literature. Practical recommendations are that managers should emphasise knowledge management, transparency, and organisational agility. The review provides a concise agenda for researchers and practitioners managing operational AI integration.

Keywords: Artificial Intelligence (O33); Operational Management (M11); Innovation Management (O31); Resource-Based View (L25); Dynamic Capabilities (M19); Disruptive Innovation (O30).

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POSTER PRESENTATION

Id-109

From Tool Use to Pedagogical Integration: A Structured Generative AI Strategy for Developing Primary Science Teachers' AI-TPACK

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Abstract: The rapid development of generative artificial intelligence (genAI) has begun transforming the way lesson was design. Although genAI models can produce meaningful outputs, there remains limited guidance on how such technologies can be pedagogically integrated into teachers' instructional planning. The objective of this study is to examine the effectiveness of the SIGMA (Set Up, Identify Context, Generate, Monitor and Apply) strategy, a structured genAI integration approach designed to instill teachers' Artificial Intelligence - Technological Pedagogical Content Knowledge (AI-TPACK) for planning science lesson. Early phases of the strategy, particularly 'Set-Up' and Identify Context' help in contextualised lesson before 'Generate' the lesson. While 'Monitor' assists teachers with critical evaluation of the AI-generated outputs before 'Apply' to the real science classroom. The study employed a pre-experimental with one group pre- and post-survey design among primary school science teachers. Teachers' AI-TPACK was measured across all the dimensions (AI-TK, AI-PK, AI-CK and integrated AI-TPACK). Results from the preliminary reflected positive shifts in teachers' AI-TPACK. These findings suggest that structured engagement with genAI can support a transition from surface-level tool use to pedagogically grounded integration. The study contributes empirical evidence to the emerging AI-TPACK literature and highlights the potential of structured strategies such as SIGMA to support responsible AI integration in primary science education. The findings hold significance for teachers' professional development and inform future investigations into GenAI-supported instructional planning. The authors would like to express their sincere gratitude to the supervisor for expert guidance, constructive feedback and continuous academic support throughout the development of this study. Appreciation is also extended to the participating science teachers for their time, commitment and valuable contributions to the preliminary phases of the research.

Keywords: Generative Artificial Intelligence; AI-TPACK; Science Lesson Planning; Primary School; Teaching and Learning.

2nd International Congress on Digitalization, Artificial Intelligence, and Society

POSTER PRESENTATION

Id-112

Bridging the Digital Divide: Culturally Relevant AI Literacy for Indigenous People

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Abstract: Artificial intelligence (AI) has become an integral part of everyday life, making AI literacy an essential competency for pupils from an early age. However, limited empirical evidence exists on the development of AI literacy among indigenous primary school pupils. This study aimed to examine the effectiveness of a contextualised AI literacy instructional intervention in improving AI literacy, based on the aspect understanding AI and data among indigenous primary school pupils. A pre-experimental one-group pre-test–post-test design was employed involving 32 pupils aged 10 to 11 years from three indigenous primary schools. The intervention focused on introducing fundamental AI concepts, the role of data, and the limitations of AI using age-appropriate and culturally relevant examples. Findings revealed an improvement in post-test scores compared to pre-test scores, indicating enhanced understanding of AI and data concepts. The results suggest that indigenous pupils are capable of developing foundational AI literacy when instruction is designed to be contextually meaningful and developmentally appropriate such culturally relevant. This study contributes to the growing body of research on inclusive AI education and highlights the importance of equitable access to AI literacy in primary education.

Keywords: Indigenous Pupils; Primary Education; Pre Experimental; Artificial Intelligence Literacies; Culturally Relevant Teaching.

2nd International Congress on Digitalization, Artificial Intelligence, and Society

POSTER PRESENTATION

Id-114

Beyond Gamification: Digital Badges as Structured Reflective Scaffolds in Teacher Professional Development

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Abstract: Digital badges are increasingly embedded in teacher professional development as instruments of gamification and micro-credentialing. However, their pedagogical function remains insufficiently theorised. Prevailing implementations privilege reward mechanics over structured cognitive engagement, thereby constraining their developmental impact. This study reconceptualises digital badges as metacognitive scaffolds that regulate staged reflective practice. Grounded in Reflective Practice theory, Self-Determination Theory (SDT) and Self-Regulated Learning (SRL), the study advance a four-stage reflective progression model comprising Cognitive Awareness, Pedagogical Transformation, Professional Consolidation and Sustained Meaningful Practice. The model was operationalised within a structured 90-minute digital professional development intervention involving 15 KAFA (Islamic primary religious education) teachers (n=15). Badge attainment was contingent upon completion of sequenced reflective tasks embedded in a learning management system, positioning badges as developmental checkpoints rather than extrinsic rewards. Data were drawn from interaction traces and a six-dimension reflective evaluation instrument capturing clarity, multimedia coherence, cognitive load, usability, engagement and contextual alignment. Findings provide preliminary support for the model's feasibility, with participants reporting high clarity, usability and motivational alignment. Evidence suggests that when structurally integrated with staged reflection, digital badges may reinforce perceived competence and autonomy while scaffolding metacognitive engagement. The study contributes a theoretically integrated framework for reflective micro-credential design and extends current discourse on badge-based professional learning beyond gamification. Implications are discussed for digitally mediated teacher development and context-sensitive innovation in Islamic education. The authors would like to express their sincere gratitude to the supervisor for expert guidance, constructive feedback and continuous academic support throughout the development of this study. Appreciation is also extended to the participating science teachers for their time, commitment and valuable contributions to the preliminary phases of the research.

Keywords: Digital Badges; Reflective Practice; Teacher Professional Development; Self-determination Theory; Micro-credential.

WORKSHOP

DIGITALIZING INDIGENOUS STI: YOUTH-LED INCLUSIVE AND SUSTAINABLE FUTURES IN SOUTH AFRICA AND TURKEY (DIGI-DIGI 2026)

Id-123

Digitalizing Indigenous STI: Youth-Led Inclusive and Sustainable Futures in South Africa and Turkey

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Abstract: This international workshop and exhibition, hosted at the 2nd International Congress on Digitalization, Artificial Intelligence, and Society (DIGIAI SOCIETY 2026) in Muğla, Turkey, highlights a transformative partnership between South Africa and Turkey. Led by the African Institute in Indigenous Knowledge Systems (AIIKS) at the University of KwaZulu-Natal, a UNESCO C2C, the program explores the synergy between frontier digital technologies and Indigenous Knowledge Systems (IKS) as a driver for the UN Sustainable Development Goals. The core of this initiative is the collaborative agency of African and Turkish youth working alongside local community knowledge holders and practitioners. The workshop demonstrates the practical integration of digital tools including AI, IoT, and mobile platforms into traditional sectors such as indigenous pottery, basketry, jewellery, and cuisines. Furthermore, it addresses critical global challenges by digitalizing indigenous farming and food systems, alongside indigenous weather and climate change early warning systems for disaster risk reduction (DRR). These indicators are vital for disaster risk reduction and enhancing community-led climate resilience. By showcasing these cross-cultural case studies, the exhibition provides empirical evidence on how the fusion of ancient wisdom and modern emerging digital technologies, fosters economic inclusivity and social equity. Ultimately, the South Africa-Turkey partnership serves as a global model for "giving back" to grassroots communities, ensuring that the digital revolution preserves, rather than erodes, the world's diverse cultural and scientific heritage.

Keywords: Digitalization; South Africa–Turkey Partnership; Digital Heritage Preservation.

WORKSHOP

Digital Intelligence, Resilience and Sustainable Transformation in Smart Societies

Digital Discrimination and Digital Devide Challenges in Modern Social Interactions

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Application of Geographic Information Systems in Formation of Effective Urban Transport Infrastructure for Sustainable Development Challenges

D. GROZEV
University of Ruse “Angel Kanchev”, Bulgaria

The Long-Term Resilience of Globally Dependent Critical Entities Generates the Prosperıty of Modern Societies

K. STOYCHEV
University of Ruse “Angel Kanchev”, Bulgaria

Towards the Psychology of the Artificial Intelligence and How It Affects The General Security of the People

R. BRATANOVA
University of Ruse “Angel Kanchev”, Bulgaria

New Business Models Enabling Digital Transformation in Society

I. VASILEVA KOSTADINOVA
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Emotional and Social Intelligence of Generative AI Models

A. TODOROVA
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Synergistic Applications of 3D Technologies: for Cultural Heritage Digitization and Reverse Engineering in Manufacturing

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2nd International Congress on Digitalization, Artificial Intelligence, and Society

Synergistic Applications of 3D Technologies for Cultural Heritage Digitization and Reverse

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WORKSHOP

Digital Intelligence, Resilience and Sustainable Transformation in Smart Societies (DIGI-RES 2026)

Mechatronic Applications for First Responders to Enable Fast Rescue

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AI-Driven Strategies for Carbon Footprint Reduction in Smart Grids and Industrial Energy Systems

T. TSVETOZAROVA STEFANOVA
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Modelling Processes to Improve Environmental Factors in Indoor Premises

S. LYUBOMIROVA ZAHARIEVA
University of Ruse “Angel Kanchev”, Bulgaria

Copper-Modified Titanium Implants: Functional Benefits, Manufacturing Strategies, and Biocompatibility Considerations

M. P. NIKOLOVA
University of Ruse “Angel Kanchev”, Bulgaria

Smart Economic Optimization of Transport and Logistics Processes

I. GEORGIEV
University of Ruse “Angel Kanchev”, Bulgaria

Mathematical Epidemic Modelling of COVID-19: A Case Study of Bulgaria

S. GEORGIEV
University of Ruse “Angel Kanchev”, Bulgaria

Application of Geographic Information Systems in Formation of Effective Urban Transport Infrastructure for Sustainable Development

D. E. TOPCHU
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WORKSHOP

Metaverse for Collaborative and Immersive Learning in Higher Education (DIGI-MTVS 2026)

Id 088 - Integrating XR into Engineering and Programming Education: Platforms and Adaptation Strategies

V. NEDEVA
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Id 089 - Application of Virtual Reality in Teaching Computer-Aided Manufacturing (CAM) to Engineering Students

N. GEORGIEVA, G. GEORGIEV
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Id 090 - Exploring the Potential of Immersive Technologies for the Study of Thermal Energy Processes

V. HRISTOV, N. GEORGIEVA
Trakia University, Bulgaria

Id 091 - Using a Virtual CAVE in Computer Networking Training

A. TODOROV
Trakia University, Bulgaria

Id 094 - Generative Artificial Intelligence in Engineering Education: Role, Student Use Patterns, and Pedagogical Challenges

T. PEHLİVANOVA-GOCHEVA
Trakia University, Bulgaria

Id 095 - The Transformative and Challenging Role of AI in University Education

S. DINEVA
Trakia University, Bulgaria

Id 096 - Immersive (VR/3D) Teaching of the Physical Layer and Network Infrastructure

V.STOYKOVA
Trakia University, Bulgaria

Id 097 - Using Gemini & NotebookLM for AI-Driven Collaborative Learning in Higher Education

A. MINCHEV
Trakia University, Bulgaria

WORKSHOP

Id-088

Integrating XR into Engineering and Programming Education: Platforms and Adaptation Strategies

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Abstract: Extended Reality (XR) encompassing Virtual, Augmented and Mixed Reality—has progressed from experimental visualisation into a practical educational medium within the wider metaverse ecosystem. In engineering education, XR not only renders abstract or "invisible" processes perceptually accessible (e.g., electrical current, voltage gradients, electromagnetic fields), but also enables safe and repeatable exploration of complex or hazardous systems that are difficult to reproduce in conventional laboratories. With the emergence of metaverse environments, these affordances extend beyond individual immersion to collaborative learning, where students and instructors can co-present, manipulate and discuss shared 3D artefacts and simulations in real time. Sustainable integration therefore depends on treating XR platforms as metaverse collaboration spaces for engineering learning and on addressing the technological adaptation required to embed them into existing course architectures. This abstract proposes a platform-centred, technology-driven pathway for XR integration in engineering curricula, illustrated through programming-based classroom examples. We begin with a concise framing of XR-enabled metaverse spaces as collaborative learning environments that support embodied interaction, spatial reasoning, simulation fidelity and social presence. From this perspective, platforms are evaluated primarily through their capacity to host engineering-relevant collaboration rather than as standalone visual tools. We outline three functional categories. **(i) Specialised VR simulators** provide shared laboratory contexts for safe circuit assembly, measurement, and fault exploration, allowing learners to jointly test design decisions and observe consequences without physical risk (e.g., Short Circuit VR, CRCT, Labster). **(ii) Metaverse collaboration and lecture platforms** offer multi-device or WebXR access to persistent 3D rooms for synchronous teaching, group inspection of machines or installations, and collaborative annotation of engineering models (e.g., Mozilla Hubs, ENGAGE XR). Their low threshold for entry makes them suitable for scalable deployment and for bridging participants with and without head-mounted displays. **(iii) Digital-twin pipelines** connect industrial-grade simulation with real-time 3D engines, enabling teams to co-develop and validate system-level models in immersive space (e.g., Simulink integrated with Unity or Unreal, and no-code XR authoring environments such as EON-XR). This category is positioned for advanced courses and capstone projects where authenticity and complex modelling are key learning outcomes. To translate platform affordances into curriculum-level practice, we propose a **technological adaptation pathway** synthesising established integration models. **SAMR** provides a staged view of increasing XR sophistication—from substitution (XR as enhanced representation) to redefinition (XR enabling tasks

impracticable in physical labs). **TPACK** specifies the required alignment between engineering/programming content, pedagogy, and XR technological knowledge, guiding educators to avoid tool-led design. **TAM** is used pragmatically to anticipate adoption constraints and to structure technical support. Building on these lenses, we outline adaptation strategies centred on technology readiness: selecting platforms by collaboration function and device accessibility, preparing reusable 3D learning objects, ensuring interoperability with existing learning management systems, providing scaffolded onboarding for both instructors and students, and progressing from browser-based metaverse rooms to higher-immersion VR and digital-twin workflows only when justified by learning outcomes. Finally, we present two XR implementations drawn from programming education using Python-based demonstrations. The first employs immersive code-to-behaviour visualisation to strengthen algorithm tracing, control-flow comprehension, and debugging literacy through spatial and embodied cues. The second uses collaborative VR problem-solving sessions in which learners manipulate shared data structures and observe execution consequences in real time, aligning novice programming with engineering-style teamwork and iterative design. These cases illustrate how programming activities can serve as flexible, low-risk entry points for XR adoption while also demonstrating transferable practices for engineering metaverse collaboration. Overall, the work argues that XR integration in engineering and programming is most effective when platforms are selected for their collaborative potential and when curricular embedding is supported by explicit technological adaptation strategies. The proposed pathway enables scalable, inclusive and instructionally meaningful XR deployment across technical education. This paper was funded under Research Project No. BG-RRP-2.004-0006-C02, “Development of Research and Innovation at Trakia University in Service of Health and Sustainable Well-being”.

Keywords: XR/VR; SAMR; TPACK; TAM; Programming Education.

2nd International Congress on Digitalization, Artificial Intelligence, and Society

WORKSHOP

Id-089

Application of Virtual Reality in Teaching Computer-Aided Manufacturing (CAM) to Engineering Students

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Abstract: This paper presents the results of the practical application of virtual reality as a supplementary tool in teaching the course Computer-Aided Manufacturing (CAM) to engineering students. The main objective of the study is to evaluate the effectiveness of immersive VR technologies in supporting the acquisition of knowledge and practical skills related to CNC programming, simulation, and analysis of manufacturing processes within a CAD/CAM environment. The study was conducted in a real educational setting involving students trained through a blended learning approach combining traditional lectures and laboratory exercises with immersive training in a virtual manufacturing environment implemented using a CAVE system. During the VR-based training, students performed specific practical tasks, including the creation and validation of CAM programs, selection of technological parameters, and visual monitoring of machining operations on digital models of CNC machines, tools, and workpieces. The effectiveness of the proposed approach was assessed through a comparative analysis of students' performance in ongoing assessments, practical assignments, and final evaluations, as well as by monitoring task completion time and the number of technological errors. The results indicate an improved understanding of technological process sequences, higher accuracy in CAM program development, and a reduction in errors during initial CNC programming attempts. Additionally, improved spatial perception and a more confident transition from the virtual environment to real manufacturing equipment were observed. The analysis confirms that integrating virtual reality into CAM education has a positive impact on the development of practice-oriented competencies and enhances the overall efficiency of the teaching and learning process. The presented results provide empirical evidence in support of the structured implementation of immersive technologies in CAD/CAM education and related engineering disciplines, as well as a foundation for future studies focused on the quantitative evaluation of digital technologies in engineering education. This paper was funded under Research Project No. BG-RRP-2.004-0006-C02, "Development of Research and Innovation at Trakia University in Service of Health and Sustainable Well-being"

Keywords: CAD/CAM; Industrial Engineering Education; Immersive VR; CAVE; CNC Programming.

WORKSHOP

Id-090

Investigation of the Possibilities for Using Immersive Technologies in the Study of Thermal-Energy Processes

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Abstract: Immersive technologies (virtual reality (VR), augmented reality (AR) and extended reality (XR)), are gaining increasing attention in the scientific literature as powerful tools for investigating thermal-energy processes. Contemporary publications demonstrate that the VR environments enable the development of highly realistic 3D models of heat exchangers, combustion chambers, turbines and heat-transfer systems, visualizing in real time parameters such as temperature, fluid velocity, heat fluxes and local losses. Numerous studies employ VR to simulate complex thermodynamical phenomena, including turbulence, fluid dynamics and phase transitions with the aim of achieving a more intuitive understanding of the processes and identifying critical operational points within the systems. The present study is a literature review of scientific publications in this emerging field covering the period from 1993 to the present, sourced from refereed databases. A total of 352 publications were examined and after applying a modified PRISMA methodology, 205 sources were retained for analysis. The literature review shows that despite the growing interest in immersive technologies, their applications remain constrained by several technical and methodological challenges. Key limitations include real-time performances issues, hardware dependency and high computational costs, all of which hinder scalability and the processing of large data volumes typical for CFD-based heat-transfer and thermodynamic models. The lack of standardization in the integration of CFD, BIM and VR/AR, as well as the use of incompatible data formats and platforms, results in fragmented solutions and impedes reproducibility in thermotechnical research. Most published studies rely on pilot experiments with small samples and insufficient empirical validation in real industrial environments. Usability and accessibility of immersive systems for thermal-process analysis are often undermined by complex interfaces, limited intuitiveness and inadequate support for multi-user interaction. Further limitations stem from simplified models, incomplete integration with digital twins and IoT systems and the absence of established educational frameworks and objective evaluation metrics. In conclusion, the main issues that could be focus of future research include performance, standardization, usability and empirical validation – factor that must be addressed to enable wider and more sustainable adoption of immersive technologies in the study of thermal-energy processes. This paper was funded under Research Project No. BG-RRP-2.004-0006-C02, "Development of Research and Innovation at Trakia University in Service of Health and Sustainable Well-being"

Keywords: Immersive Technologies; Thermal-energy Processes; PRISMA Method; Digital Twins, VR; CAVE.

2nd International Congress on Digitalization, Artificial Intelligence, and Society

WORKSHOP

Id-091

Using a Virtual CAVE in Computer Networking Training

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Abstract: Although computer networking is a foundational subject in computing and engineering education, it remains conceptually abstract for many students due to the invisible nature of network processes, the layered complexity of protocols, and the challenge of connecting theoretical knowledge with real-world network behavior. Traditional instructional approaches—lectures, static diagrams, and limited-access physical labs—are often insufficient to provide learners with a deep, experiential understanding of dynamic networking phenomena such as packet flow, routing decisions, fault propagation, and data center operations. Virtual reality (VR) technologies have emerged as viable tools for creating immersive, interactive learning environments. However, current VR-based solutions in networking education tend to focus on isolated visualizations or simplified simulations and do not fully utilize spatial immersion, collaborative interaction, and embodied cognition. The Cave Automatic Virtual Environment (CAVE), with its room-scale projection system and multi-user capabilities, presents an opportunity to create a shared virtual space where students can explore complex network topologies, visualize packet-level behavior, troubleshoot failures, and understand abstract concepts through physical interaction. Despite this potential, there is a lack of empirical research on how CAVE-based environments can be systematically designed to support computer networking learning outcomes, what instructional strategies are most effective in such environments, and how student performance and engagement compare with traditional or desktop-based simulations. Therefore, the central research problem is: *How can a CAVE-based virtual learning environment be designed and implemented to improve students' conceptual understanding, practical skills, and engagement in computer networking education, and how does its effectiveness compare to traditional instructional approaches?* This paper was funded under Research Project No. BG-RRP-2.004-0006-C02, "Development of Research and Innovation at Trakia University in Service of Health and Sustainable Well-being".

Keywords: Virtual Reality; Networking; CAVE; Interactive; Routing.

WORKSHOP

Id-094

Generative Artificial Intelligence in Engineering Education: Role, Student Use Patterns, and Pedagogical Challenges

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Abstract: The use of generative artificial intelligence (GAI) tools in higher engineering education is leading to a significant change in the way students are prepared. This change is especially noticeable for abstract theoretical disciplines, where mastering complex circuits and mathematical models and concepts often creates significant difficulties. The objective of the work is to explore the opportunities and challenges of applying generative artificial intelligence in engineering education. The research focuses on three questions that are key to developing future pedagogical strategies: 1. What are the pedagogical benefits of systematically using artificial intelligence tools as part of the learning process?; 2. What GAI use patterns do students prefer in the learning process? The following main GAI use patterns in engineering education are considered: Calculator; Virtual Textbook; Step-by-Step Tutor; Simulation/Verification Tool; Case Study Generator; Jargon Interpreter; Soft Skills Development; 3. What are the pedagogical challenges in integrating artificial intelligence tools into engineering education? A study is presented that examines the impact of GAI on the teaching of the subject "Theoretical Electrical Engineering". This course covers the analysis of DC and AC electrical circuits. The study is based on empirical data from an exam test conducted in 2025, including 630 attempts by students. The large volume of data allows for precise analysis and identification of specific cognitive and conceptual gaps. The analysis clearly defines problem areas where the success rate is below 40%. These are topics with a high degree of abstraction, such as the analysis of RLC circuits, working with phasors and complex impedances, three-phase power supply and resonance in electrical circuits. In contrast, in other topics, such as the analysis of DC circuits and the application of Ohm's and Kirchhoff's laws, a success rate of over 70% was reported. On the identified problem topics, students are further prepared using GAI tools, applying various GAI use patterns. The research methodology is mixed. It combines quantitative analysis of test results with qualitative analysis of student practices. Preliminary findings highlight the dual role of generative artificial intelligence. On the one hand, it has significant potential to support understanding of the most challenging, abstract topics to build deeper knowledge (through personalized learning, rapid feedback, etc.). Students who use GAI show higher engagement and better results in difficult areas. On the other hand, serious risks include: generating inaccurate or wrong answers; promoting surface learning and circumventing the need for independent problem-solving, which undermines the development of critical thinking and problem-solving skills, academic dishonesty, changing the role of the teacher, etc. On this basis, the article offers specific recommendations for pedagogical scenarios and institutional policies. The final conclusion is that effective

integration of GAI requires a rethinking of the curriculum and assessment, shifting the focus from the reproduction of solutions to the application and synthesis of knowledge. This paper was funded under Research Project No. BG-RRP-2.004-0006-C02, “Development of Research and Innovation at Trakia University in Service of Health and Sustainable Well-being”.

Keywords: Generative Artificial Intelligence; Engineering Education; Theoretical Electrical Engineering; AI Use Patterns; AI-supported Learning.

WORKSHOP

Id-095

The Transformative and Challenging Role of AI in University Education

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Abstract: The paper discusses various aspects of implementing AI in university education. While AI has the potential to accelerate research and enhance students' understanding and learning, it may also diminish individuals' ability to form independent opinions and draw conclusions. New digital technologies have become integral to human life, leading to concepts such as Industries 5.0, Agriculture 5.0, Forestry 5.0, and Education 5.0, which represent the incoming digital transformation and its impact on human well-being. The integration of Artificial Intelligence (AI) within the framework of Education 5.0 is transforming higher education systems by promoting personalized and adaptive learning environments. This change focuses on student-centered approaches, which enhance engagement and improve educational outcomes. The paper aims to summarize the evolution of education and highlight the key characteristics of the upcoming digital transformation in higher education systems. The paper is part of the results from the research project: "The Post-Pandemic Learning Trends, Digital Online Teaching". The research was supported and funded by Trakia University, grant number 113/01.09.2023.

Keywords: Higher Education; AI; Education 5.0; Evolution of Education; Digital Transformation.

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2nd International Congress on Digitalization, Artificial Intelligence, and Society

WORKSHOP

Id-096

Immersive (VR/3D) Teaching of the Physical Layer and Network Infrastructure

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Abstract: The Physical Layer of computer networks is fundamental to infrastructure design, yet it remains one of the most challenging domains to teach due to its inherently concealed nature. Students often struggle to conceptualize cabling systems, rack organization, patch panel design, and physical topologies because these elements are typically inaccessible within traditional classroom environments. This paper investigates the role of immersive technologies—specifically Virtual Reality (VR) and 3D simulation platforms—in addressing this “invisible lab” problem and enhancing student comprehension of Layer 1 concepts. Through an analysis of immersive tools, including Cisco Packet Tracer’s Physical Mode and virtual datacenter environments, the study examines how spatially accurate, interactive simulations enable learners to practice cable installation, device placement, and hardware troubleshooting in a risk-free setting. The findings highlight how these environments foster a deeper integration of physical and logical topology understanding, support the development of essential OSI Layer 1 competencies, and contribute to improved workforce readiness in network infrastructure roles. Additionally, the paper discusses pedagogical design considerations, implementation challenges, and implications for curriculum development in networking education. This work argues that immersive VR/3D environments constitute a significant advancement in bridging theoretical instruction with real-world hardware practice, thereby strengthening both technical proficiency and employability. Central Research Problem: Traditional networking instruction struggles to effectively teach Physical Layer concepts because students have limited access to real cabling infrastructure, device racks, and physical topologies, raising the question of how immersive VR/3D environments can overcome this “invisible lab” barrier and improve conceptual understanding, practical skills acquisition, and readiness for professional networking roles. This paper was funded under Research Project No. BG-RRP-2.004-0006-C02, “Development of Research and Innovation at Trakia University in Service of Health and Sustainable Well-being”.

Keywords: VR/3D; Physical Layer; Networking; Topologies; Immersive.

WORKSHOP

Id-097

Using Gemini & NotebookLM for AI-Driven Collaborative Learning in Higher Education

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Abstract: Artificial Intelligence is rapidly transforming higher education—not only as a productivity tool, but as a cognitive partner in learning, research, and collaboration. This workshop presents a practical, hands-on exploration of Gemini and NotebookLM as AI-powered environments for knowledge synthesis, academic sensemaking, and immersive collaborative learning. The session demonstrates how higher education educators and researchers can move beyond traditional content delivery toward AI-supported cognitive processes: critical reading, comparison of sources, generation of conceptual frameworks, and collaborative knowledge construction. Through real-time demonstrations, participants will observe how NotebookLM enables structured interaction with academic texts, policy documents, lecture materials, and research data, while Gemini supports ideation, explanation, multimodal reasoning, and adaptive learning scenarios. The workshop aligns with the concept of AI-enhanced studying, where learning processes are supported by intelligent agents that facilitate reflection, inquiry, and knowledge co-creation. The session provides a practical demonstration of how Gemini and NotebookLM can be used as cognitive tools to analyze academic materials, structure information, generate explanations, and support collaborative knowledge work. Practical use cases include AI-supported seminars, research supervision, interdisciplinary project development, and the design of AI-assisted learning scenarios in higher education. The participation in DIGIAI SOCIETY Congress 2026 was financed under program No BG-RRP-2.004-0006-C02

Keywords: Artificial Intelligence in Higher Education; AI-Enhanced Learning; Cognitive Tools for Education; Collaborative Knowledge Construction; Academic Sensemaking.

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All Submissions & Topics

Digitalization in Business and Economy	Id 101 - The “Less-is-More” Paradox of AI: How Capability Bundles Drive SMEs’ Success in Emerging Market
	Id 111 - Does AI Marketing Efforts Affect Brand Loyalty of Gen Z Consumers? Mediating Role of Brand Image and Brand Experience
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	Id 125 - Citizens or Codes ? Back to Humanism
AI and Sustainable Development	Id 92 - Reporting AI to Environmental Issues
	Id 123 - Digitalizing Indigenous Stı: Youth-Led Inclusive and Sustainable Futures in South Africa and Turkey
The Future of AI: Opportunities and Challenges	Id 86 - How Many Robots Could You Beat in a Fight?: Resisting the AI-enabled Opponent
Workshop	Id 87 - Resilience in the AI Shaped Future
	Id 88 - Integrating XR into Engineering and Programming Education: Platforms and Adaptation Strategies
	Id 89 - Application of Virtual Reality in Teaching Computer-Aided Manufacturing (CAM) to Engineering Students
	Id 90 - Investigation of the Possibilities for Using Immersive Technologies in the Study of Thermal-Energy Processes
	Id 91 - Using a Virtual CAVE in Computer Networking Training
	Id 94 - Generative Artificial Intelligence in Engineering Education: Role, Student Use Patterns, and Pedagogical Challenges

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