AI-EMPOWERED LEARNING MODELS IN ECONOMY 5.0: FOSTERING MEANING CREATION BEYOND LITERACY

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ABSTRACT

Economy 5.0 signifies a transformative era with profound implications for human development and education. This article examines emerging learning models underpinning Economy 5.0, exploring their impact on politics, personal growth, and global education ecosystems. The paradigm shift in economic evolution prompts a reevaluation of the nexus between politics and personal development, with learning acting as a catalyst for societal and individual transformation. A global perspective on AI in education policies underscores the geopolitical significance of AI-related technologies, reshaping knowledge dissemination through innovative learning platforms and Learning DAOs. Blockchain-based Agile Learning DAOs (BALD) are introduced as a mechanism that revolutionizes content creation with transparency and ethical considerations. Ethical learning, privacy, and addressing information bias emerge as central themes, with AI enhancing personhood. The roles of educators as guides remain pivotal. The future of learning in Economy 5.0 necessitates a balanced partnership between humanity and technology, grounded in ethics and human potential.

KEYWORDS

Economy 5.0, Learning models, Machine learning, Ethical learning, Technology in education

1. INTRODUCTION

Advocating a paradigm shift, this paper explores integrating technology in education to enhance human capabilities and ethical awareness, preparing learners for Economy 5.0.

1.1. The Role of AI in Economy 5.0 and Education

In the dynamic landscape of Economy 5.0, where traditional paradigms of literacy and economic production undergo profound shifts, the role of artificial intelligence (AI) in shaping the future of learning cannot be understated. This article conducts a comprehensive examination of the transformative potential inherent in AI-empowered learning models within the context of Economy 5.0, transcending conventional notions of literacy-centered education. Within this exploration, the intricate relationship between AI and learning is guided by the hermeneutic circle, seamlessly integrating principles from Scrum and Lean methodologies [1],[2]. This approach finds practical application in the development of Blockchain-based Agile Learning DAOs (BALD) [3].

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1.2. Stakeholders and Technologies in AI-Driven Education

The examination extends to the roles of various stakeholders, ranging from program directors to content designers, as they become integral to the educational process. Additionally, AI technologies, including Natural Language Processing (NLP), Generative Adversarial Networks(GANs), and decision trees, play a pivotal role in automating and optimizing diverse aspects of the educational landscape [4]. However, beyond the realms of automation lies a crucial dimension: ethics. AI-empowered learning models inherently integrate ethical considerations into the learning process, emphasizing the imperative to keep the code behind AI transparent and open to revision, including feedback from learners.

1.3. Human Teachers and Learners in the AI-Empowered Landscape

In this evolving landscape, human teachers are liberated from the burden of administrative organizational tasks, enabling them to assume a renewed role as mediators of wisdom in society [5]. They engage learners in profound and meaningful discourse, fostering a deeper understanding of complex subjects and guiding them towards critical thinking and profound insight. Moreover, the profound impact of AI on learners themselves is uncovered. The interaction between learners and AI technologies, such as chatbots, transcends mere convenience; it shapes the very nature of engagement. From formulating questions to fostering deep reflection, AI serves as an assistant philosopher or personal mentor, guiding learners toward critical thinking and profound understanding [6].

1.4. Blurring Boundaries: Education, Workplace, and Information Warfare

This transformative shift not only reshapes education but also blurs the boundaries between education and the workplace, academia and industry/businesses. Furthermore, within the context of the emerging information warfare landscape, the influence of policymakers, developers, and educators in redefining education, transcending the confines of literacy, and nurturing a new generation of learners can potentially open doors to new and subtle forms of disinformation [7], [8, pp. 253–259]. This underscores the vital importance of fostering a symbiotic relationship between these realms to prepare learners for the challenges of Economy 5.0 and to contribute to a more peaceful and secure world.

1.5. Redefining Human Self-Understanding and Value in the Work Environment

This paradigm shift necessitates a thorough reevaluation of traditional models and practices, heralding a future where learning transcends formal institutions to become a lifelong, integrated aspect of our evolving economic and technological reality [9]. This era is marked by the synergy of AI with human educators, where AI not only augments teaching but also redefines our understanding of personal worth and contribution in the workplace. AI, serving as an assistant philosopher and personal mentor, becomes an inseparable ally in our journey towards a new dimension of education and knowledge acquisition, one that places a renewed emphasis on the intrinsic value and potential of every individual in the context of Economy 5.0.

The subsequent sections of this paper delve deeper into the transformative role of AI in the realm of education, particularly within the ambit of Economy 5.0 and are organized as follows. Section 2 discusses the paradigm shift in learning models, motivated by the evolution ofEconomy 5.0, and reflects on the consequent changes in economic and human self- understanding. Section 3 provides a background on the current state of AI in education, offeringa global outlook on AI in educational policies. In Section 4, the focus shifts to the Blockchain- based Agile Learning DAOs

(BALD) ecosystem, exploring its operational framework andsignificance. Section 5 explores how AI leverages the reintegration of the ethical dimension into learning, underlining its role as a complement to human educators in this process. Section 6 introduces a practical use case of BALD in the context of educational content creation, illustrating the application of this technology in a dynamic, educational setting. Finally, Section 7 addresses the broader implications of these developments, concluding with insights on how Economy 5.0 radically reshapes society, positioning learning as pivotal in shaping the future. Overall, the paper's structure emphasizes the interplay between technology, policies, and human development, highlighting that the encounter with AI is key in fostering an awareness of ethics as the tool through which societies gain control over the uncertainties of an ever-changing world. It calls for an education that transcends mere knowledge acquisition, advocating for ethical, holistic human growth.

2. NEW LEARNING MODELS FOR ECONOMY 5.0

The paradigm shift in the economic context impacts learning models in three key ways: a) affecting methods of human self-understanding and learner identity building, b) accentuating the political relevance of learning beyond mere economic demands, and c) introducing new methods of transferring knowledge through AI-driven technologies.

2.1. Paradigm Shift in Economic Evolution and Human Self-Understanding

Economy 5.0 represents a transformative shift from traditional industrial models to a cyber-physical framework, integrating digital innovation, environmental sustainability, and a new understanding of human capabilities. Utilising technologies like AI, blockchain, and IoT, it aims for operational efficiency and responsible resource management [10]. The concept of "God makers" aptly encapsulates this shift, highlighting humanity's aspiration to transcend limitations and engage in meaning-making, thereby bridging the gap between theoretical understanding and practical application [11]. This new economic paradigm adapts to current global challenges, advocating for ethical business practices, decentralised structures, and consumer-driven demands for sustainability. The COVID-19 pandemic has further accelerated this shift towards remote work and ethical consumerism. Overall, Economy 5.0 necessitates a reevaluation of our worldview and business practices, marking a significant evolution in human capabilities and self-conception.

2.2. Learning at the Crossroads Between Politics and Personal Development

Economic transitions, such as the move to Economy 5.0, are collective learning processes that involve societal adaptation to new technologies and challenges. This shift impacts how individuals and communities understand their role in the world, making learning a holistic and inherently political act [12, p. 11]. While AI is advancing, it's crucial to distinguish between human learning and machine learning. Human cognition and personal development are ethical and discursive phenomena, deeply interconnected with societal construction [14, pp. 5–6, 10; 15, pp. 37–38, 67–68, 252–253]. The relationship between technological advancements in AI and human pedagogical models is mutually influential, shaping our collective future and individual identities [13, pp. 224–225, 269].

2.3. New learning ecosystems for Economy 5.0

In the era of digital transformation, learning paradigms have evolved into comprehensive and discursive systems that integrate various facets of knowledge creation, meaning-making, value generation, production, and reproduction. This shift represents a departure from traditional learning models, often pejoratively referred to as the "fabric model," where individuals enter educational institutions to receive isolated knowledge and specific skills training, emerging as certified professionals [14]. Today, the learning process exhibits a remarkable fluidity, blurring the boundaries between early childhood development and lifelong adult learning. The demarcation between educational institutions and the labor market has become less distinct, thanks to the integration of project- and task-based learning methodologies that seamlessly incorporate microtasking and complex projects. In this evolving landscape, the traditional notion of secular education is being redefined. Society now acknowledges that achieving secularism in schools involves more than superficial changes, such as removing religioussymbols or regulating attire. Successful education in contemporary society relies on shared values that underpin the learning process. While the aspiration for value-free education remains unattainable, the quest for the right values in education is just beginning. Trends set by Economy 5.0 underscore the need to align education with principles of digital and sustainable transformation, a human-centric approach, global collaboration, ethical business practices, continuous learning, decentralization, innovation ecosystems, consumer empowerment, and hybrid work models. Responding to these imperatives, the ideal learning system should incorporate characteristics such as decentralization, agility, collaborative governance, transparent record-keeping, security, adaptability, knowledge sharing, and innovation-driven approaches [15]. To address the contemporary challenges and evolving educational needs, it is proposed here to pioneer a groundbreaking concept: Blockchain-based Agile Learning DAOs (BALD) [16]. This innovative approach represents a novel paradigm in education, blending decentralized and autonomous models to meet the demands of our ever-changing digital and sustainable world. The subsequent sections will provide an in-depth exploration of this entirely new concept introduced here for the first time.

3. BACKGROUND AND CURRENT STATE OF THE ART

The impact of artificial intelligence on education varies globally, influenced by divergent trends such as the shift towards holistic learner development, the strategic use of information, the rise of new economic actors, and the transition from supply-chain models to modular networks.

3.1. Global Outlook on AI in Educational Policies

International organisations like the OECD [17] are assessing the impact of AI on education, focusing on adult proficiency in essential skills such as digital literacy and problem-solving. The study also explores the qualifications of adults in relation to their skills. This work provides insights into the effectiveness of AI in education. Meanwhile, countries exhibit varied approaches to AI in education. China aims for AI leadership in its educational system , India focuses on personalised learning and skill development [18], and Russia employs AI for assessments and inclusion [19]. Europe is cautious due to ethical concerns and digital disparities[20], while North America aims to foster AI literacy [21]. These approaches reflect each country's unique challenges, opportunities, and strategic priorities.

3.2. Geopolitical implications of AI in Education

AI in education intersects with broader geopolitical and information landscapes, revealing its dual role as both a resource and a battleground [7]. While it has the potential to democratise learning,

it can also propagate biases, especially in the U.S., where tech companies may inadvertently spread cultural biases globally [20], [21]. Russia's use of AI for assessments and targeted messaging highlights the technology's adaptability but also its potential for indoctrination [19], [22]. China's investment in AI-based education raises questions about intent and impact, especially given its use of surveillance and censorship technologies [23]. The challenge is to ensure that AI fosters unbiased, balanced, and informed learning, particularly in a world where information is deeply political. This complexity has accelerated the development of AI literacy and its smart use in education, requiring nations and institutions to navigate intricate challenges [7].

3.3. Ecosystem of AI related Technologies

An extensive heuristic review analysed 198 projects across 15 AI technology fields, cautioning that the study lacks a systematic approach to mitigate bias. Geographically, while the U.S. continues to lead in many areas, Europe and Asia, particularly Russia, China, and India, are rapidly closing the innovation gap, challenging U.S. dominance and shifting global technological leadership with implications for education and information geopolitics.

In the European context, key AI contributors are Russia, the UK, Germany, and Switzerland, with Germany leading within the EU, followed by Greece, Ireland, and Spain. Globally, Deep Learning and Computer Vision are most prevalent. Lesser-represented regions like Latin America, Africa, and Oceania are making significant contributions in niche AI sectors, thereby diversifying the global AI landscape and its implications for education and geopolitics.

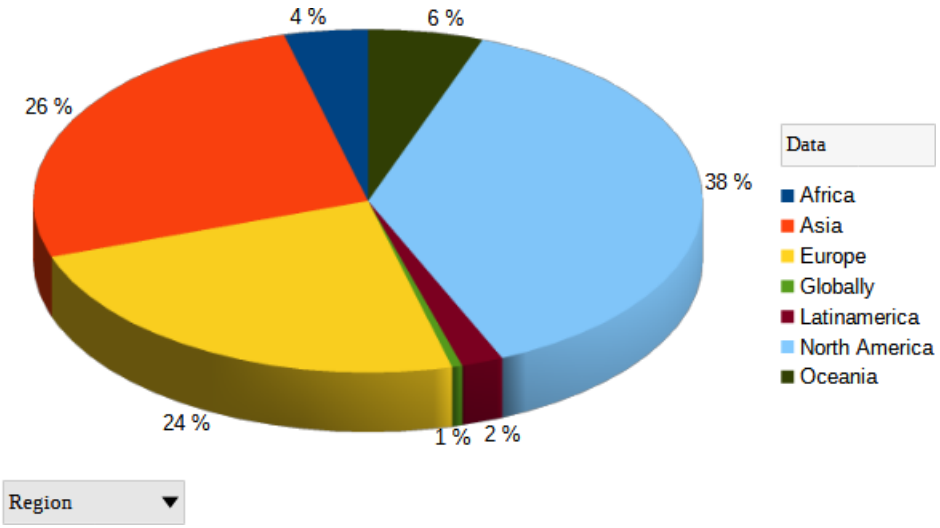

Figure 1: Pie chart based on own sources displaying the distribution of ongoing projects acrossdifferent regions. The data percentages are as follows: Asia (38%), Europe (26%), Latin America (24%), Africa (6%), North America (4%), Oceania (2%), and Globally (1%). Data Source: Own elaboration.

Shifting focus from regional players to technological fields, it's essential to consider a broader array of technologies that underpin AI innovations. An analysis of 260 technologies across 13 critical research fields was conducted. While not an exhaustive market study, the aim is to outline the landscape of key stakeholders in AI's educational applications. Notably, key technologies are increasingly developed through global cooperation networks and open-source platforms, often making it unclear where the developers are based. This trend underscores the diminishing relevance of geographical boundaries in the development and application of AI technologies. The table below provides a comprehensive overview, categorising these technologies into specific

research fields, from Blockchain and Smart Contracts to User Interface and Interaction. Each field is further delineated by the number of technologies analysed, offering a snapshot of the current technological diversity and focus in AI's role in education. Table 1. Distribution of 260 Analyzed Technologies Across 13 Research Fields in AIApplications for Education.

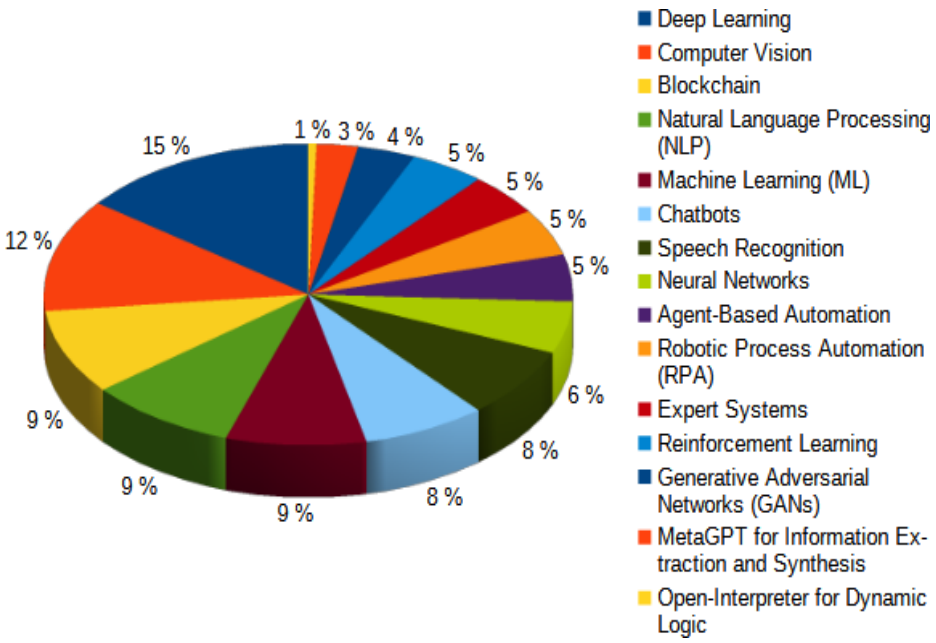

Figure 2: Distribution of global AI-related project types, highlighting the prominence of various technologies and methodologies. Data Source: Ownelaboration.

Research field	**Technology**	
Blockchain and SmartContracts	Programming Language used in Smart Contracts	7
	Smart Contracts	7
Data and KnowledgeManagement	Framework for Knowledge Structuring	8
	Semantic Web and Knowledge Structuring MetaOntology	10
Documentation and Training Dynamic Logic andDecision-Making	Documentation and Training	16
	Dynamic Logic and Decision-Making	16
Financial Projections andRisk Mitigation	Financial Projections and Risk Mitigation	14
Fundraising and MilestoneTracking	Fundraising and Milestone Tracking	15
Information Extraction and Synthesis	MetaGPT for Information Extraction and Synthesis	13
Legal Compliance andReporting	Legal Compliance and Reporting	15
Market Research andAnalysis	Financial Projections and Risk Mitigation	7
	Fundraising and Milestone Tracking	8
	Market Research and Analysis	10
	Market Research and Data Analysis	9
	Risk Mitigation	7
Operational Efficiency	Operational Efficiency	12

Programming andDevelopment	A high-level programming language	16
	Managing and manipulating semantic data	8
	Orchestration Scripts	11
	Tokenomics implementation	11
Security and Privacy	Security and Privacy	20
User Interface and Interaction	User Interface and Interaction	20
Total		260

Data source: Own elaboration.

3.4. Existing examples Learning Platforms and Learning DAOs

In the changing development trends of AI in education, the focus is shifting towards two primary approaches: learning platforms and Decentralised Autonomous Organisations (DAOs). These technologies are prevalent in sectors such as business, fintech, and holistic education. They employ strategies like conditional progression, immersive bootcamps, and AI-driven personalisation. Gamification is also a key feature, with both traditional and modern elements incorporated.

As we move towards Economy 5.0, there is an increasing emphasis on automated content generation. DAOs like Aragon, MolochDAO, and others are pioneering in this space, offering innovative governance and financial mechanisms that align decentralized education with contemporary economic needs [3]. To further elucidate this trend, the table below categorises various DAOs into distinct groups based on their primary functionalities [24]. These range from governance and decision-making to financial mechanisms and work management, thereby providing a comprehensive overview of the diverse roles DAOs are playing in shaping the future of education and the economy.

Table 2. Classification of DAOs Based on Primary Functionalities and Focus Areas

Primary Functionalities and Focus	**Brand Name**
Incentive-Based Learning and Development	DAOStack, Harmony
Work and Task Management	Dework, Colony
Dynamic Talent Allocation and DecentralizedTalent Pools	McKinsey, Harmony
Automated Recruitment Processes	Workable, Gohire, Harmony, Robotic Process Automation (RPA)
Peer-to-Peer Job Recommendations	Harmony, 0x DAO (formerly 0x Protocol)
Freelancer and Gig Economy Platforms	Upwork, Gitcoin, Harmony
Skill and Credential Verification	Hyland (former Learning Machine), Harmony, Associations and Certification Bodies
Financial	Compound, MakerDAO, Harmony
Governance and Decision-making	Aragon, Decred, Moloch v2/DAO, Polkadot
List and Directory Management	Token-Curated Registries (TCRs)
Prediction and Market-focused	Gnosis, OpenDAO, GalaxyDAO

Data source: Own elaboration.

3.5. Automating Educational Content Creation

In this evolving landscape, key stakeholders extend from learners to policy-makers, educational institutions, and both commercial and community-based tech developers. These entities wield significant influence in areas like Deep Learning, Computer Vision, Natural Language Processing

(NLP), and Machine Learning (ML). Employers and recruitment agencies also have a pivotal role in shaping the trajectory and applications of artificial intelligence (AI) in education.

The following section introduces a case study that explores the transformation of an existing learning platform into a Blockchain-based Agile Learning DAO (BALD). Developed over a decade and initially based on the Modular Object-Oriented Dynamic Learning Environment (Moodle), BALD incorporates microtasking and psychometrics to better align with the dynamic requirements of the job market. The standardisation of lesson planning, led by European Schoolnet's Novigado system [25], has been instrumental in automating educational workflows.
In conclusion, a 2022 partnership with United Nations Educational, Scientific and Cultural Organization (UNESCO) heritage sites highlighted the need to refine workflows in educational content creation. This was driven by the challenges of international teamwork and the complexity of Science, Technology, Engineering, Arts, and Mathematics (STEAM) educational tasks. These insights have catalysed the transition from structured workflows to more streamlined automation, opening up promising avenues for advancements in educational technology (edtech).

4. BLOCKCHAIN-BASED AGILE LEARNING DAOS (BALD)

Blockchain-based Agile Learning DAOs (BALD) are decentralized autonomous organizations (DAOs) that leverage blockchain technology to facilitate agile and collaborative learning initiatives. These organizations are characterized by their decentralized decision-making processes, which empower participants to contribute to the development and governance of educational programs, content, and strategies in a dynamic and adaptive manner. By utilizing blockchain technology, BALDs ensure transparency, security, and traceability in managing educational resources and achievements. These DAOs promote continuous learning, knowledge sharing, and innovation in a decentralized and self-directed manner, enabling participants to shape their educational experiences and adapt to rapidly changing educational landscapes.

4.1. Roles in Automated Content Creation

Within the intricate ecosystem of the BALD, a diverse array of stakeholders and elements coalesce to shape a dynamic and responsive learning environment. Roles such as the Programme Director (PD), Pedagogical Team (PT), Financial Director (FD), and Human Resources (HR) work in tandem with elements like Governance Forums (GF), Collaboration Platforms (CP), and Financial Dashboards (FDB).

The Programme Director (PD) sets the overarching vision and is closely aligned with Governance Forums (GF) to ensure that policy aligns with strategy. The Pedagogical Team (PT) collaborates with Teachers and Pedagogues (T&P) to sculpt the curriculum, and their work is often materialised through Educational Resources (ER). The Financial Director (FD) maintains the platform's financial health and liaises with Private and Public Investors (PPI), often using Financial Dashboards (FDB) for real-time insights. Human Resources (HR) provide psychological support and are usually connected to Virtual Meeting Rooms (VMR) for remote consultations [26].

Content Designers (CD) ensure the course materials are relevant and often collaborate with NFT Galleries or Virtual Worlds (NGVW) for interactive learning experiences. The Community Manager (CM) nurtures the platform's user base and is active on Social Media Platforms (SMP). Tutors and Course Monitors (TCM) offer on-the-ground support to Learners (L), ensuring content comprehension and addressing queries. The Business Advocate (BA) promotes the platform's interests in broader marketplaces (MP) and networks. The Quality Manager (QM) ensures all

content adheres to set standards and benchmarks, often liaising with the Ministry of Education (MoE) and using Smart Contracts (SC) to enforce quality measures.

Central to this ecosystem are the Learners (L), who actively shape its evolution through feedback, engagement, financial support, and commercial ventures like NFTs. They often interact with Marketplaces (MP) for trading educational resources. Private and Public Investors (PPI) also play a fundamental role, not just in funding but also in decision-making processes, often facilitated through Governance Forums (GF).

Within BALD, roles are defined less by affiliation and more by levels of engagement, reflectinga fluid approach to platform management [4]. To provide a comprehensive understanding of these complex interrelationships, a network graph will follow this section, visually representing how each role and element, identified by their acronyms, interacts within the BALD ecosystem.

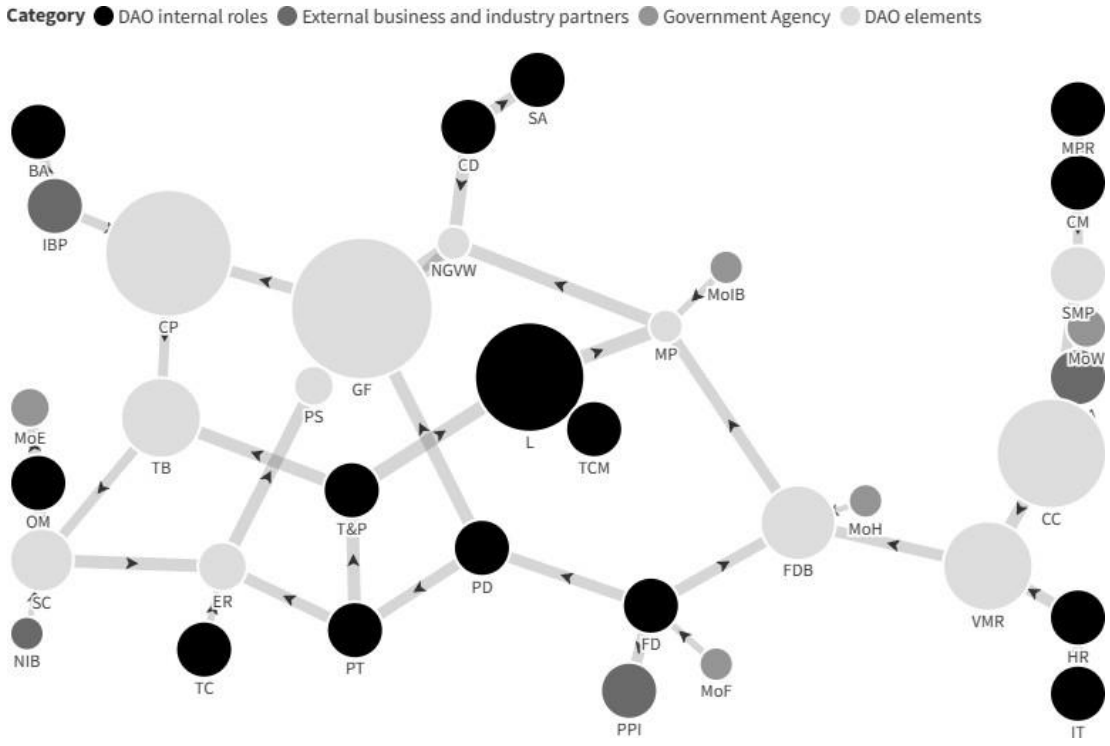

Figure 3. Table 1: Roles and Elements in the Blockchain-based Agile Learning DAOs (BALD)Ecosystem - A Comprehensive Overview of Stakeholders and Their Interconnections [45]

4.2. BALD Workflow as Hermeneutic Circle

In the transition to Economy 5.0, the focus is shifting from supply chains to value networks, a change that echoes the network-centric logic of IT since the UNIX era [27]. This paper argues that a hermeneutic circle approach, informed by game design and social constructionist theories,is more suited for managing contemporary DAOs. Fallman and Stolterman's methodology [1] offers a four-stage, iterative framework: conjunctural analysis (ways of acting), integrational analysis (ways of relating), categorical analysis (ways of being), and empirical analysis (ways ofdoing).

In the political-educational context, this framework encompasses traditional literacy skills,critical thinking, ethical development, and practical application [13, p. 139 ff.]. When applied to Blockchain-based Agile Learning DAOs (BALD), the framework operationalizes into fourlevels:

Level A: Data definition, including libraries, goals, and methodologies.Level B: Narrative elements and logical connections in learning.
Level C: Activities requiring approval, such as learner interactions.
Level D: Aesthetic and logical aspects of learning content, including validation.
Each level is iterative, with no fixed starting or ending point, aligning with the fluid nature of educational needs and technological advancements.
The BALD workflow, as illustrated in the following figure, has been meticulously developed over a span of a decade, drawing upon the foundations of CLIL (content and language integrated learning), STEAM, the 21st Century classroom, and the Novigado learning scenario tool [25]. This represents a profound shift in educational process management, transitioning from a direct chronological sequence to a more intricate and interrelated system. Currently employed at Learning4Tech [28], the workflow has evolved to encapsulate a vast array of elements and roles. Such evolution not only underscores the complexity of process management but also emphasises the pressing ethical considerations.

The workflow initiates with *Activity Creation*, focusing on 'Scenario Writing.' This phase is crucial for defining the tasks' sequence and combination for educational units such as lessons or workshops. Automation plays a significant role in this stage, with tools like H5P enabling quick scenario development. In this regard, Dework, as utilized in DIA DAO, stands as a model demonstrating the effective integration of task management in the educational process [29]. It showcases the potential of AI, particularly through neural networks and big data, to augment automation capabilities. AI excels in data gathering and analysis, surpassing traditional feedback collection methods in education. Text Generation Algorithms, in particular, are instrumental in formulating these learning scenarios, providing a blend of efficiency and adaptability to suit diverse educational needs.

The next significant phase is *Content Development*, and one of the key components here is "Content Design." This pertains mostly to digital content, encompassing the creation, writing, and editing of such content. The challenge is integrating diverse mediums, such as text with audio or video, ensuring seamless learning experiences. Knowledge Graphs play a pivotal role at this stage, offering an understanding of the interrelations between various educational methods and theories.

The Content Development phase further delves into the standardization of educational content, focusing on elements like 'Educational Standard Frameworks' and 'Sustainable Development Goals (SDGs).' Knowledge Graphs aid in mapping relationships between educational standards and content, whereas Text Classification is employed to automatically link course content with pertinent competencies or SDGs. In this context, systems like Hyland play a crucial role in skill and credential verification, ensuring that the educational content not only aligns with established standards but also accurately reflects the verified competencies and qualifications of learners [30].

Another nuanced component of Content Development is "Ethical Orientation," which is paramount given the evolving complexities of modern education. This segment centers on the narrative, noetic tension, and the concept of Goffmanian footing [13, p. 139 ff.]. Ethical AI Algorithms are integral here, ensuring content adheres to ethical guidelines. They assist in maintaining standards, especially concerning noetic tension, and uphold the ethics underpinning interactions and narratives within the course content.

In essence, the BALD workflow represents a sophisticated interplay of traditional educational methods and cutting-edge technological innovations. While it aids in streamlining and enhancing the educational process, it also brings to light the ethical challenges intrinsic to integrating AI in

education. This evolution from a simple chronological sequence to a more multifaceted approach has broad implications, warranting continuous reflection and scrutiny, especially as technology becomes increasingly integrated into education.

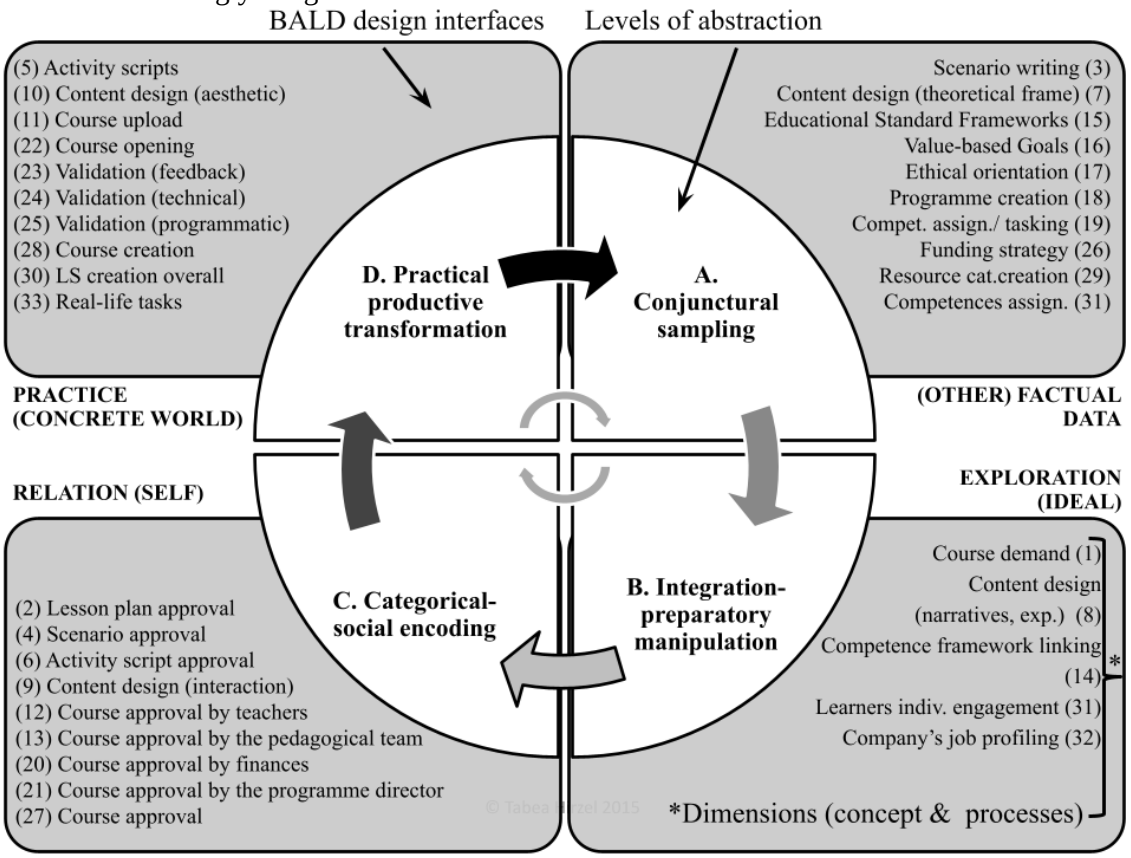

Figure 4: The hermeneutic circle of the BALD ecosystem.

4.3. Technological integration

The BALD development process harnesses a range of advanced technologies to streamline educational content creation, ensuring relevance, quality, and alignment with learners' needs [31]. Predictive Analytics plays a pivotal role in the Course Demand phase, situated at the Integrational Preparatory Level. By utilizing historical course demand data, the system can predict future demands for courses. This allows the BALD to proactively respond to the needsof educational institutions and learners, aligning its offerings with anticipated demand.

Natural Language Processing (NLP) comes into play during Programme Creation at the Conjunctural Data Level. NLP helps automate the creation of coherent programs by parsing and processing course descriptions and requirements. This technology streamlines the alignment of educational programs with industry requirements and learner competencies.

Machine Learning (ML) is applied in the Funding Strategy phase, which also takes place at the Conjunctural Data Level. ML aids in creating predictive models to forecast potential Return on Investment (ROI) for courses. This enables the BALD to make data-driven decisions regarding funding sources and strategies, ensuring the sustainability of the education system.

Decision Trees are employed in the Course Approval process, situated at the Categorical(Social) Encoding Level. Automation plays a pivotal role in streamlining the course approval process

based on predefined standards. Decision Trees automate the decision-making process, ensuring that courses meet predetermined criteria regarding content quality, feasibility, and relevance. Generative Adversarial Networks (GANs) are introduced in the Course Creation phase, occurring at the Practical Productive Level. GANs facilitate the generation of course materials and content, helping educators rapidly create engaging and relevant learning resources. This ensures that courses are rich and varied in content, meeting the diverse needs of learners.

Recommendation Systems play a crucial role in Resource Catalogue Creation, situated at the Conjunctural Data Level. These systems suggest resources based on course topics, historical success, and user reviews, providing learners with valuable materials to enhance their educational experience.

Simulation Software comes into play during Learning Scenario Creation, which takes place at the Practical Productive Level. This technology is instrumental in creating virtual learning scenarios to test and refine learning paths. Educators and developers can experiment with different scenarios, ensuring that the BALD offers engaging and effective learning experiences.

Semantic Analysis is applied during Competences Assignment, situated at the Conjunctural Data Level. It helps assign competencies based on course descriptions, objectives, and outcomes. Semantic Analysis ensures that the competencies align effectively with the educational content, promoting comprehensive learning experiences for students.

Sentiment Analysis plays a dual role in the Lesson Plan Approval and Activity Script Approval phases, both at the Categorical (Social) Encoding Level. It automatically gauges reactions and approvals from stakeholders based on feedback, ensuring that learning scenarios and activities meet quality standards and learner expectations.

Text Generation Algorithms come into play during Scenario Writing, occurring at the Conjunctural Data Level. These algorithms facilitate the drafting of learning scenarios, allowing for the efficient creation of engaging and structured educational content.

These technologies contribute to the automation and efficiency of the BALD development process, ensuring that educational content is of high quality, aligned with learner needs, and responsive to demand. They enable the BALD to provide engaging and relevant learning experiences for a wide range of learners.

5. MACHINE-HUMAN INTERACTION FOR ETHICAL LEARNING

In the context of BALD, personalization and adaptation are foundational rather than mere embellishments. Interaction with AI-driven technologies and the automation of key processes guide learners through essential components: learning tokens, internal noetic tension via manipulation and simulation, community negotiation dynamics, real-world knowledge application, and the intrinsic structure of a DAO. Ethical considerations become an inherent aspect of this learning framework, making them inseparable from the overall experience, internal noetic tension through manipulation and simulation, the dynamics of the learning community driven by negotiation, the application of knowledge in real-world contexts, and the organizational structure itself as a DAO.

5.1. Personalization and Adaptation

In digital learning environments, including gaming, personalisation and adaptation serve dual functions. These elements not only enhance the quality of the learning experience but also contribute to the economic sustainability of the system by attracting paid users [4]. The Balanced Adaptive Learning Design (BALD) framework incorporates psychometrics, competencies, and a comprehensive analysis of learner behaviour. Initially aimed at integrating noetic elements, advancements in AI technology have enabled the identification of distinct learning traits [32].

In the proposed BALD approach, learners are categorised based on their mental traits and learning approaches into three groups: specialists, generalists, and polymaths.

Specialists excel in environments with a controlled flow of information, tailored to their cognitive abilities and personal preferences. This approach is particularly effective in precision- demanding contexts. Conversely, generalists are inclined towards a diverse spectrum of learning content and require adaptable learning paths. Automated systems must identify frequent task- switching behaviours and evaluate their impact on learning efficiency. Psychological support from both AI and human coaches is indispensable [33].

Polymaths distinguish themselves by not merely combining depth and breadth but also by adding a dimension of integration and new meaning creation to learning contents and tasks. This unique approach to problem-solving is not readily apparent through choice-making along the learning path but manifests in their innovative solutions to complex challenges. AI-driven personalisation is instrumental in accommodating their unique inquiries and is particularly effective for peer-based and community-driven tasks [32], see also recent discussions by Samoylova [34].

The BALD framework further incorporates task-oriented and project-based learning approaches. Assessment methodologies transcend automated scoring systems to include direct evaluations in the job market, thereby facilitating a seamless transition into the workforce [35].

5.2. Privacy and Technology Related Issues

Privacy and Data Ethics represent a multifaceted challenge concerning the responsible use of learner data. Striking a delicate equilibrium between collecting data for personalization purposes and safeguarding learner privacy necessitates the development of meticulous policies. On the technical front, several challenges loom large. A robust technological infrastructure is imperative to unlock the full potential of AI in education, yet many regions, particularly remote or underdeveloped areas, may lack the requisite connectivity and hardware for effective AI- driven learning. Furthermore, the extensive data generated in AI-enhanced education mandates stringent data security measures, ensuring protection against cyber threats and breaches to maintain learner trust. While AI can assist in content creation, ensuring the quality of AI- generated educational materials remains a considerable hurdle, underscoring the need for continuous human oversight to align content with educational standards. Lastly, given the rapid evolution of AI, keeping educational systems abreast of the latest AI technologies and practices is an ongoing challenge, demanding educators' continuous professional development [36].

5.3. Information Bias in times of Information War

In Level A, the conventional or conjunctural analysis, the tokenization of learning into discrete units intensifies the segmentation of learning into distinct disciplines. Although this aligns with the global approach adopted by UNESCO in framing competencies, a pressing challenge is the very definition of "tokenizing learning". The notions of "competence" and the evidence of its

acquisition by learners remain contested. Recently, criticisms against learning "silos" have been on the rise. However, inherent to the learning process is a phase of rationalizing and idealizing the world by establishing classifications and categories. To dismiss this would risk discarding valuable insights. The primary concern with such silos is their intrinsic nature as idealized representations, not the incontrovertible truth. Different contexts or groups may perceive or break down these "tokens" differently [37].

The BALD system's advantage lies in its potential use of AI to provide learners with broader insights than what a human educator might offer. For this to be effective, the underlying code of the AI needs to be transparent and open to revision based on feedback from learners. A fascinating trend with AI interactions, for instance through chatbots, is the increased necessity for learners to pose well-constructed questions. In traditional settings, students are often tasked with forming opinions on specific subjects. However, when learners employ chatbots for similar tasks, the dynamics shift significantly. With easy access to data and instant arguments, learners need only understand their convictions. If educators are not cognizant of this dynamic, they might misinterpret chatbot outputs as authentic student contributions. However, in a system like BALD where integrated AI would scrutinize learners' responses, assessment criteria would evolve. Engaged learners might challenge chatbots with critical questions, deepening their understanding, and even probe meta-level questions, allowing them to reflect on personal beliefs and feelings.

In essence, when correctly implemented, AI serves as a philosophical assistant or a personal mentor. For this potential to be realized, it is imperative that policymakers, developers, and educators consider these nuances and intricacies.

5.4. Ethics of design in education

The use of Artificial Intelligence (AI) in the Decentralised Autonomous Organisation (DAO) for Blockchain-based Agile Learning Design (BALD) presents a range of ethical considerations. These span across various learner demographics and institutional beneficiaries and include the Diffuse Role of Learners and Stakeholders, Profiling and Bias, Persuasive Design Elements, and AI-Enhanced Scoring and Measurement.

BALD caters to a diverse audience, from school children and adult learners to businesses and governments. While these entities benefit from real-life tasking activities and integrated tools for learner profiling, they also influence the learning process. Policies and business demands often dictate the metrics used for evaluation, thereby shaping the learning paths and potentially introducing biases.

The encoding of learners into types such as polymaths, generalists, and specialists, often based on psychometric evaluations, is fraught with ethical concerns. The validity of these methods is often questionable, and their use can have a lasting impact on learners' self-perception and opportunities, especially when used for recruitment filtering.

The use of audiovisual elements and spatial design is intrinsically part of educational and political persuasion, as evidenced by the didactic role of propaganda in instructional design [13, pp. 166–167]. This is further supported by the concept of 'awareness as propaganda' in educational genres [13, pp. 158–159] and the ethical considerations between didactics and propaganda in Dramatica theory [13, p. 238]. While BALD encourages diverse learning environments, the manipulation of story elements to impact audience perception [13, p. 163] and the cultural context of rhetorical effects [13, pp. 236–237] highlight that the availability of such resources can exacerbate existing inequalities among learning communities.

The use of AI for scoring and measurement, as learned from the Chinese educational system's experimentation with attention-tracking headbands [38], [39], raises concerns about data privacy, consent, and the potential for reinforcing stereotypes or biases. The ethical implications of using AI to measure 'attention' or other psychological traits are still not fully understood and require careful scrutiny [40].

In summary, while AI technologies offer promising avenues for personalised and efficient learning, their ethical implications, particularly in a DAO setup like BALD, cannot be overlooked. These range from issues of bias and profiling to the potential for increasing educational inequalities. Therefore, a balanced and ethically sound approach is essential for the responsible deployment of these technologies.

5.5. AI as a tool That Enhances Personhood

The interaction with artificial intelligence and related technologies gives rise to a profound dichotomy, encompassing the challenges of reification and fetishism on one end of the spectrum and technophobia and conspiratorial beliefs on the other. This dialectical tension has been a matter of concern, and its historical antecedents, as illustrated in Cervantes' Don Quixote, underline the age-old recognition that an excess of imagination can potentially lead individuals astray. However, the lessons derived from this literary classic are twofold. They not only caution against the perils of unrestrained imagination but also emphasize the pivotal role of imagination in shaping our future. When contemplating how AI influences our cognitive processes and emotional responses, it becomes evident that the technology's potential for promoting holistic humanist education hinges on its openness and transparency. This transparency extends beyond the mere disclosure of AI's output to encompass the revelation of its underlying philosophy, structure, and operational processes. When AI adheres to theseprinciples, it presents a genuine opportunity to democratize access to comprehensive humanist education, benefiting a broad and diverse population. In this evolving landscape, the role of educators as custodians, facilitators, and mentors assumes an unprecedented level of significance, signifying that their guidance and support will be more indispensable than ever in the shaping of future generations [41].

6. USE CASE: BALD IN EDUCATIONAL CONTENT CREATION

The following presents a use case of Blockchain-based Agile Learning DAOs (BALD) in action, currently being tested by Learning4Tech [28], demonstrating its application in a dynamic, educational setting and its seamless integration in a job providers process in content creation. It's important to note that the specific technical details of specific software or coding decisions are beyond the scope of this paper, due to their context-dependent nature and the dynamic state of ongoing implementation.

6.1. Learner Classification and Certification

Learning4Tech employs BALD to categorize and certify learners based on their unique competencies, personality traits, psychological profile, and mental traits through tokens – as specialists, generalists, and polymaths. This approach mirrors the automated recruitment processes seen in platforms like GoHire, which streamline the matching of job roles with suitable candidates based on their specific skills and traits [42]. However, it transcends mere functionality by embracing the diversity of profiles, ensuring that each individual's talents are not only utilized but also celebrated. This inclusive strategy aims to leave no one behind, recognizing the value of varied perspectives and skills. In the context of BALD, these tokens are then utilized to grant access to specific microtasks, aligning with the learner's abilities and traits, thereby creating a

dynamic, responsive, and inclusive learning environment that caters to the unique needs of each student and fosters a holistic educational experience [43].

6.2. Job Allocation and Efficiency

Educational content creators, through BALD, can access and allocate microtasks to workers. This allocation is not limited to specific skills or organizational values but also considers the approach to a task, thereby enhancing efficiency. In the collaborative creation of a science textbook, BALD strategically leverages the distinct expertise of specialists, the multidisciplinary acumen of generalists, and the integrative approach of polymaths at various stages of the workflow. McKinsey's approach to dynamic talent allocation serves as a real-world parallel, demonstrating the effective harnessing of diverse expertise in complex projects [44]. While their system is aligned with principles of maximizing efficiency and impact through optimal participant contribution, BALD takes a step further by valuing the unique contributions of diverse skill sets. This approach not only leverages human creativity but also extends beyond the capabilities of AI, emphasizing the irreplaceable value of human insight and innovation in the learning process.

Specialists' Expertise: They provide detailed, current knowledge in their scientific fields for content accuracy.
Generalists' Managerial Dynamics: They manage the project's multidisciplinary scope, workflow, and team coordination, aligning with educational goals.
Polymaths' Interdisciplinary Insight: They integrate diverse content areas with innovative methods, ensuring textbook cohesion and continuity.

This collaborative approach, facilitated by BALD, leverages the deep knowledge of specialists, the overarching vision of generalists, and the integrative capabilities of polymaths, resulting in a comprehensive, well-rounded, and engaging science textbook. To illustrate this process in a practical context, let's consider the example of using BALD in the collaborative creation of a science textbook, where the unique capabilities of each group are optimally utilized.

6.3. Implementation Process

Moving into the details of the implementation process, this section outlines the distinct contributions of specialists, generalists, and polymaths in the various stages of educational content creation.

Planning and Conceptualization: This phase values the precision of specialists in ensuring scientific accuracy, while generalists' broad oversight ensures the project aligns with educational goals. Polymaths bring a unique perspective by proposing interdisciplinary connections and defining overarching themes, showcasing the importance of diverse intellectual approaches.

Content Integration: Here, the detailed, subject-specific contributions of specialists are crucial. Generalists play a key role in weaving these contributions into a coherent whole, ensuring a consistent flow. Polymaths, with their broad vision, review the content for alignment and cohesion, linking concepts across disciplines, highlighting the synergy of varied expertise.

Language and Clarity: Specialists' focus on technical accuracy is invaluable, ensuring content integrity. Generalists maintain the consistency of language across the project, while polymaths enhance the content's accessibility and engagement, applying their expertise in British English, demonstrating the blend of precision, consistency, and accessibility.

Multilingual Adaptation: Specialists' accurate translations of technical terms are essential for

content integrity in different languages. Generalists ensure these translations align with educational objectives, while polymaths adapt the content into languages like German, French, and Spanish, ensuring cultural accuracy and broadening the content's appeal and relevance.

Visual and Graphic Enhancement: The accurate visuals suggested by specialists enhance content authenticity. Generalists coordinate these efforts with designers to align with educational goals, while polymaths contribute innovative ideas for diagrams and graphics, showcasing the blend of accuracy, alignment, and creativity.

Final Review and Quality Control: Specialists' role in verifying scientific accuracy is critical, ensuring content reliability. Generalists' focus on educational alignment guarantees the content's relevance, while polymaths' final review for international standards, educational objectives, and cultural sensitivity underscores the importance of a comprehensive, inclusive approach.

6.4. Outcome and Impact

This strategic integration of mental traits masterfully leverages the interdisciplinary knowledge, language proficiency, and meticulous attention to detail of the workforce. The outcome is twofold: firstly, a high-quality textbook that is not only informative and cohesive but also accessible and culturally resonant for a global audience. Secondly, it fosters a shared knowledge base within the work community. This approach celebrates diversity as a catalyst for unlocking creative potential and unparalleled expertise, thereby shifting the focus from isolated individuals to dynamic, collaborative teams. This shift not only enhances the product but also enriches the work environment, fostering a culture of respect and synergy. Particularly in the production of STEAM content, this approach proves invaluable. It also excels in managing complex, large-scale projects with numerous subcontracted and outsourced parties, ensuring coherence and quality across diverse contributions [44].

7. CONCLUSIONS

In summary, the emergence of Economy 5.0 marks a transformative phase that extends beyond economic frameworks to encompass human development and educational paradigms. This new era necessitates an educational landscape that integrates political, technological, and individual growth aspects. Foremost, it demands a reevaluation of human value, recognizing individuals not just as workforce components but as unique creative sources pivotal in shaping the future and navigating life's uncertainties.

The global role of AI in shaping educational policies is significant and comes with geopolitical implications. The expansive technological ecosystem of AI has led to the development of innovative learning platforms and Decentralised Autonomous Learning Organisations (DAOs), revolutionising the methods of knowledge dissemination and acquisition. While automation in content creation offers efficiency, it also calls for stringent quality assurance and ethical governance.

Within this evolving landscape, Blockchain-based Agile Learning DAOs (BALD) offer a promising model, acting as a connector between learning platforms, learners' personal development, and recruiters' demands. This structure facilitates a dynamic interaction between learners and educational content, allowing job seekers to seamlessly earn money and credentials. The effectiveness of BALD hinges on integrating technology, particularly AI, while upholding ethical transparency.

Ethical considerations are crucial in machine-human interactions, particularly in safeguarding privacy and addressing information bias in an era marked by information manipulation. AI evolves from being a mere tool to an entity that not only enhances human capabilities but also fosters awareness of the essence of personhood, reshaping the educational sphere.

Navigating these multifaceted challenges and opportunities underscores the pivotal role of educators as custodians, facilitators, and mentors. The future of learning in Economy 5.0 calls for a balanced partnership between humans and technology, rooted in ethical transparency and a holistic understanding of human potential. Thus, striking a balanced approach between technological innovation and the preservation of human values is imperative.

7.1. Limitations

This study is subject to certain limitations, including the absence of a validated methodological framework for sampling AI-related technologies and key stakeholders. Additionally, the research is based on an ongoing project that is not publicly accessible. Future work would benefit from more systematic research in these areas.

7.2. Declarations

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request. No competing interests are declared.

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