From Assignment to Authorship: Review Paper Writing as a Pedagogical Approach in a Blockchain Course

Jeyamala Chandrasekaran
Associate Professor, Department of Information Technology. Thiagarajar College of Engineering. Madurai
jeyamala@tce.edu

Abstract— **This paper presents a pedagogical approach adopted in a Blockchain Technologies course offered to undergraduate engineering students in Information Technology. As part of the course, students were engaged in collaborative review writing on diverse applications of blockchain across domains such as healthcare, agriculture, and finance. The initiative was designed to foster analytical thinking, communication, teamwork, and presentation skills, while simultaneously deepening students' conceptual understanding of blockchain. Students received structured guidance on topic selection, academic writing practices, and the effective use of AI tools to support content development. The outcomes indicate that, in addition to acquiring technical knowledge, students enhanced a range of 21st-century skills considered essential for engineering graduates. This paper discusses the pedagogical design, implementation process, outcomes, and broader implications for engineering education research. The approach underscores the significance of experiential learning, wherein students actively contribute to content creation, thereby bridging the gap between theoretical instruction and practical application. The outcomes demonstrate significant improvement in both technical learning and 21st-century skills: 80% of students scored above 85% in CO6-mapped assessments, and the experimental group achieved 77% higher-order grades (S/A/B) compared to 45% in the control group. The initiative also resulted in 26 scholarly outputs. The findings suggest that integrating collaborative writing projects not only enriched students' understanding of blockchain technologies but also better equipped them to address real-world challenges in their future professional practice.**

Keywords— **Active Learning; Blockchain Education; Review paper Writing; Collaborative Learning; Experiential Learning; Undergraduate Pedagogy**

ICTIEE* Track— *Innovative Pedagogies and Active Learning
ICTIEE Sub-Track: Inquiry-Based Learning in Fostering Curiosity and Critical Thinking among (GenZ)

I. INTRODUCTION

THE introduction of emerging technologies such as blockchain requires pedagogical approaches that move beyond traditional lecture-based formats, coding exercises, and mini-projects. Conventional teaching practices often restrict students to programming tasks or written assignments, providing limited opportunities to develop essential soft skills such as teamwork, communication, and academic writing. Moreover, the outcomes of these activities generally remain confined within the classroom, with little visibility in broader academic or professional circles.

Understanding the complexity of emerging technologies like blockchain also demands proficiency in literature review and critical analysis—skills that are rarely emphasized in standard courses and are usually reserved for project-based learning. To address this gap, the proposed pedagogical approach integrates a structured literary analysis exercise into the core course, with the objective of producing work of publishable quality. By engaging in scholarly review and synthesizing research findings into a coherent academic paper, students not only strengthen their conceptual understanding but also acquire research-oriented competencies.

Recognizing the time-intensive nature of academic writing, the activity was designed as a collaborative task. Students worked in teams to distribute responsibilities, thereby enabling the completion of a full-length review paper within the course duration. This collaborative process fostered active learning, peer support, and constructive feedback, while also developing critical 21st-century skills such as analytical thinking, communication, and coordination. Beyond meeting course requirements, the initiative offered students the opportunity to cultivate academic authorship, practice research dissemination, and develop a sense of professional ownership in their work.

This paper discusses the pedagogical rationale for this approach, the process of implementation, the outcomes observed, and its broader implications for engineering education. The initiative aligns with the principles of Outcome-Based Education (OBE) and resonates with the Washington Accord's emphasis on lifelong learning, critical thinking, and strong communication skills. By combining technical learning with scholarly authorship, the approach not only deepens students' understanding of blockchain but also enhances their preparedness to address the challenges of an evolving professional landscape.

II. LITERATURE STUDY

Teaching blockchain requires fresh approaches. Traditional lectures and coding tasks often limit student learning. They rarely help students build teamwork, communication, or writing skills. Yet blockchain is becoming central to IT, business, and software engineering. Bringing it into the classroom is now essential.

Researchers have proposed many strategies. A constructivist framework by Leung et al. (2024) combines theory with practice. It has proven flexible and effective for IT professionals. Project-based learning (Faruk et al., 2024; Mentzer et al., 2020) helps students design real-world blockchain tools, such as software repositories. Students report that such projects make the subject easier to understand and more meaningful.

For business students, scenarios work well. Negash and Thomas (2019) show that scenario-based teaching helps learners connect blockchain with business transformation. The "Four-Level Guidance" model (Xu et al., 2021) gradually moves students from basic practice to research and development. Industry partnerships and flexible assessments strengthen this method.

Gamification has also been tested. Games make abstract blockchain ideas accessible. They improve motivation and satisfaction (Choi & Jung, n.d.; Latifah & Fauziah, 2022). Tools like Bloxxgame allow learners to experiment with transactions and consensus mechanisms (Dettling & Schneider, 2020). The ASSURE program (Choi et al., 2022) blends gamification and blended learning to raise awareness of blockchain among school children.

Although the reviewed literature spans diverse strategies, three dominant pedagogical themes emerge:

Constructivist Learning

Students build knowledge by actively creating, experimenting, and engaging with real-world blockchain problems.

Experiential and Project-Based Engagement

Designing blockchain prototypes, simulations, or scenario-driven case studies deepens conceptual understanding and improves problem-solving skills.

Collaborative and Communication-Centered Instruction

Team-based projects, discussions, and peer-supported activities enhance communication, critical thinking, and shared responsibility.

Synthesizing insights from the literature, this study proposes a Blockchain Learning Integration Framework (BLIF**)** with three interconnected layers as follows:

Foundational Understanding

1. Core blockchain concepts, cryptographic principles, and consensus mechanisms
2. Typically delivered through lectures, simulations, or guided scenarios

Applied Exploration

- Hands-on tools, coding exercises, prototype development, and case analysis

3. Encourages experimentation and contextual knowledge application

Knowledge Creation and Collaboration

4. Activities such as collaborative writing, research synthesis, presentations, and peer review
5. Fosters higher-order cognitive skills, communication, teamwork, and scholarly practice

This framework positions collaborative academic writing—the focus of the present stud as part of the highest layer, where learners transition from content consumers to content creators. Despite the robust literature on project-based and gamified learning, only a few works explore the role of collaborative authorship in blockchain education. This study addresses that gap by evaluating how review paper writing enhances both conceptual knowledge and 21st-century skills.

III. RESEARCH QUESTIONS

The research questions for the proposed work are formulated as follows:

A. How does collaborative review paper writing enhance students' understanding of blockchain technology and its applications across various domains?

B. In what ways does engaging in collaborative authorship contribute to the development of 21st-century skills, such as analytical thinking, communication, teamwork, and presentation skills, among undergraduate students in a blockchain course?

C. What are the long-term impacts of collaborative writing projects on students' preparedness for real-world challenges and their future careers in technology-related fields?

IV. METHODOLOGY

A. Course Context

The course on Blockchain Technologies is offered as a programme elective for the sixth semester students of B.Tech Information Technology in the academic year 2024-25 with a class strength of 74. The prerequisites of the course include the completion of core courses on programming, data structures and Cryptography. The course outcomes have been formulated as follows:

CO1: Demonstrate the need and usage of cryptographic algorithms in blockchain

CO2: Explain the significance of blocks, proof-of-work, and consensus building in blockchain.

CO3: Explain the functional/operational aspects of trading and mining using crypto currencies.

CO4: Develop smart contracts to code business logic in Solidity.

CO5: Develop decentralized applications for web 3.0 using Ethereum blockchain with node services like metamask, alchemy and frontend technologies like node.js

CO6: Analyze the impact and challenges in Blockchain implementation in various domains like finance, Health care etc.

The proposed pedagogical approach on collaborative authoring is to meet the requirements of CO6 designed at the "Analyze" level in Blooms taxonomy.

B. Design of Assignments

As an initial step, the instructor designed a series of lectures to provide students with both conceptual knowledge and practical insights into the diverse applications of blockchain technology. The lectures were structured around key domains where blockchain has demonstrated significant potential, namely:

1. Supply Chain Management and Food Safety
2. Know Your Customer (KYC) Compliance
3. International Trade and Cross-Border Payments
4. Healthcare Systems
5. Financial Management

The objective of these sessions was to enable students to develop a holistic understanding of how blockchain can revolutionize existing business processes. Each domain was presented through a systematic framework that included:

1. Current Challenges and Pain Points – highlighting inefficiencies, trust issues, and security concerns, supported with statistical evidence and industry reports.
2. Proposed Advantages of Blockchain Integration – illustrating how blockchain features such as transparency, immutability, traceability, and decentralization can address these challenges.
3. Case Studies of Implementations – analyzing real-world use cases to demonstrate how organizations have adopted blockchain to optimize processes.
4. Review of Existing Products and Solutions – examining available blockchain-based platforms and tools, along with their adoption rates and limitations.

This pedagogical approach allowed students to not only understand the theoretical underpinnings of blockchain but also critically evaluate its practical relevance across industries. By engaging with real-world case studies and data-driven insights, students were better prepared to conceptualize their own ideas for the subsequent review paper assignment.

C. Team Formation

To ensure balanced collaboration and equitable learning opportunities, the instructor adopted a structured approach to team formation. The teams were deliberately designed to be heterogeneous, comprising students with varying levels of academic performance and skill sets. In particular, the instructor considered students' scores from the terminal examination of the Cryptography course as well as qualitative inputs provided by course tutors. This strategy was employed to avoid potential bias that often arises when students are permitted to self-select their groups. In such cases, high-performing students may cluster together, resulting in one group excelling disproportionately while others underperform. By carefully curating diverse teams, the instructor aimed to foster peer learning, mutual support, and balanced contribution, thereby enhancing the effectiveness of the collaborative assignment. There were a total of 26 Teams with 3 or 4 members.

D. Domain Selection

Following the lecture series, each student team was asked to select a specific domain for further exploration and review paper writing. To ensure diversity of perspectives and avoid redundancy, the instructor required that each team work on a unique domain, thereby preventing duplication across groups. A Google Sheet was shared with all teams, where they recorded their preferences. Allocation followed a first-come, first-serve basis, providing both fairness and transparency. Teams that struggled to finalize a topic were guided with one-on-one mentoring sessions. While many students chose domains directly introduced during lectures (such as healthcare, supply chain management, financial services, or cross-border payments), teams were also encouraged to think beyond the lecture series and identify novel areas of application. This flexibility allowed for the exploration of domains such as:

1. Real Estate and Land Registry – Ensuring tamper-proof property records and ownership transfer.
2. Education and Credential Verification – Authenticating degrees and certificates across institutions.
3. Energy Trading – Peer-to-peer energy sharing and decentralized electricity grids.
4. Voting Systems – Ensuring transparency and preventing fraud in large-scale elections

At the same time, some students initially proposed domains where blockchain would not provide real value. In such cases, the instructor provided constructive feedback and redirected the teams toward feasible, industry-relevant applications. During the domain selection stage, several teams proposed applications where blockchain was not the most suitable solution. For example, ideas such as student attendance monitoring, timetable generation, library book tracking, and short-term file sharing were redirected, as these could be addressed more effectively through conventional systems like databases, inventory management, or cloud storage. Instead, teams were reassigned to more relevant domains—real estate and land registry, education and credential verification, energy trading, and healthcare (electronic health records)—where blockchain offers significant value and practical applicability.

E. Literature Review and Analysis

As part of the assignment, learners were required to collect and review 30 research papers published within the last five years, focusing on their chosen domain in relation to blockchain. They were instructed to use standard academic databases such as ScienceDirect, IEEE Xplore, and ACM Digital Library to ensure the quality and credibility of references. Appropriate guidance was provided on how to read scholarly papers critically and identify their core contributions.

For the first submission, each student individually reviewed a minimum of 10 research papers and presented their inferences in tabular form. The analysis highlighted aspects such as the technology stack employed, reported advantages, and identified challenges of the proposed systems. To facilitate comprehension, learners were encouraged to leverage AI-powered tools such as ChatPDF for extracting key insights.

TABLE I
RUBRICS FOR LITERATURE REVIEW AND ANALYSIS

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Collection & Quality of Sources	≥30 papers, all from standard databases (IEEE, ACM, ScienceDirect, etc.), recent (≤5 years), highly relevant to blockchain and chosen domain	25–29 papers from mostly credible sources; few outside the 5-year range	20–24 papers; mix of credible and less reliable sources; limited relevance.	<20 papers; poor or non-standard sources; weak domain relevance.
Coverage of Domain	Comprehensive coverage across multiple aspects of the domain; demonstrates depth and breadth of reading.	Good coverage of major aspects; some gaps remain.	Partial coverage; misses important subtopics or perspectives.	Very limited coverage; major gaps in the domain.
Critical Analysis	Thorough comparison of studies; clearly identifies technology stacks, advantages, and challenges; highlights research gaps.	Good analysis with some comparisons; partial identification of gaps.	Mostly descriptive summaries; limited cross-study analysis.	Purely descriptive; no critical analysis or connections made.
Use of Analytical Tools (Tables, ChatPDF, Litmaps, etc.)	Tables/visuals well-structured; tools used effectively to extract insights and show connectivity between studies.	Tools used adequately with minor clarity issues in outputs.	Tools used but insights not clearly reflected or poorly integrated.	Tools not used or used incorrectly with no added va lue.
Synthesis & Inference	Clear synthesis across papers; findings logically integrated; strong linkage to proposed blockchain system.	Good synthesis with some integration of findings.	Limited synthesis; findings remain fragmented.	No synthesis; each paper treated in isolation.

Subsequently, teams engaged in discussions to synthesize their findings, identifying commonalities and differences across studies. To deepen their understanding of research trends and interconnections, learners were introduced to visualization tools like Litmaps, which enabled them to map the relationships and connectivity among the selected studies. This process not only strengthened their literature review skills but also helped them recognize emerging directions and research gaps within their chosen domains. The work was evaluated using the rubric presented in Table I

F. Review Paper Preparation

After the literature review exercise, the instructor provided detailed feedback on the initial submissions. The feedback focused on three key areas: clarity in reporting, depth in analyzing the technology stack, and precision in identifying both the limitations of existing systems and research gaps for future exploration. This helped students move beyond surface-level summaries and develop a more critical understanding of the literature.

A three-week time frame was allotted for this stage. This gave students sufficient opportunity to search, analyze, and synthesize research papers without compromising academic rigor. The structured schedule also encouraged consistent progress and timely submission. To further support their work, students were introduced to the standard structure of a review paper. This included sections such as introduction, methodology of literature selection, thematic analysis, challenges, and future research directions. The aim was to help students become familiar with academic conventions in scholarly writing.

In addition, special sessions were conducted on the use of AI-powered research and writing assistants such as SciSpace and Jenni.ai. Demonstrations showed how these tools could assist with summarizing complex papers, generating coherent drafts, and checking for conceptual consistency. At the same time, equal emphasis was placed on the ethical dimensions of using AI in academic work. Discussions highlighted the importance of responsible usage, including maintaining academic integrity, avoiding plagiarism, and critically evaluating AI-generated content rather than accepting it uncritically. Through this structured guidance, students not only gained the methodological rigor required for literature-based research but also developed an awareness of the ethical responsibilities that accompany modern scholarly practices.

G. Team Presentations

Upon completion of the review paper, each team was required to deliver a 10-minute presentation summarizing their work. The presentation served as a reflective and evaluative exercise, allowing students to consolidate and communicate their learning outcomes. Specifically, each team was expected to:

- Highlight individual contributions of team members to the paper preparation.
- Summarize the key learning derived from the literature review and synthesis process.
- Discuss the challenges faced during paper writing, including difficulties in analyzing complex research articles, identifying gaps, or using AI-assisted tools.
- Share their experience in academic writing, emphasizing how the exercise enhanced their critical

thinking, collaboration, and technical communication skills.

This activity not only reinforced subject knowledge but also improved students' abilities in academic presentation, teamwork, and reflective practice.

V. EXPERIMENTAL RESULTS AND DISCUSSION

A. Discussion on RQ1

In connection with Research Question 1 (RQ1): How does collaborative review paper writing enhance students' understanding of blockchain technology and its applications across various domains?, the attainment of Course Outcome 6 (CO6) was considered as the primary indicator of learning achievement. As part of the Continuous Assessment Test 2 (CAT-2), three questions specifically mapped to CO6 were included, contributing to 30% of the total marks. The analysis of results revealed that approximately 80% of the learners scored above 85%, reflecting a strong conceptual understanding and application of blockchain technology. This represents a significant improvement compared to the previous batch, where performance levels were comparatively lower.

The performance in the Terminal Examination also confirmed the positive impact of the intervention. Table I shows the grade distribution between the Experimental Group (n=74) and the Controlled Group (n=65). The experimental group displayed a stronger performance in higher grades, with 13.5% of students securing S grade and 25.7% securing A grade, compared to only 6.2% and 16.9% respectively in the control group. Moreover, 37.8% of students achieved a B grade in the experimental group, almost double that of the control group (21.5%). In contrast, the control group had a larger share of lower grades, particularly in C grade (41.5%) compared to only 9.5% in the experimental group. This distribution indicates that the collaborative review paper writing activity not only helped more students achieve higher-order grades (77% in S, A, B combined) but also reduced the proportion of students clustering in the average performance category (C grade). Thus, the experimental group demonstrated greater mastery of blockchain concepts and applications, validating the effectiveness of the pedagogical approach.

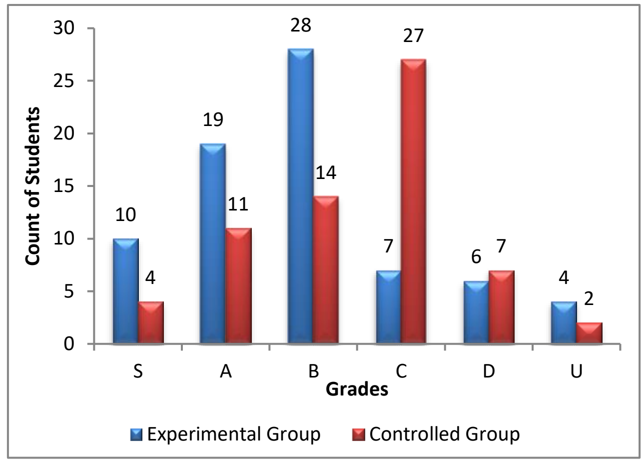

Fig. 1. Comparative Performance of Experimental Group and Controlled Group in Terminal Examinations.

B. Discussion on RQ2

To address Research Question 2 (RQ2)—"In what ways does engaging in collaborative authorship contribute to the development of 21st-century skills, such as analytical thinking, communication, teamwork, and presentation skills, among undergraduate students in a blockchain course?"—a structured survey form was designed and administered to the experimental group.

The survey consisted of 14 items, framed to capture both quantitative and qualitative dimensions of skill development. The items were organized into four core domains:

1. Analytical Thinking (Q1–Q3): Focused on students' ability to critically evaluate blockchain-related literature, identify research gaps, and synthesize multiple perspectives.
2. Communication (Q4–Q6): Assessed clarity in academic writing, articulation of technical ideas, and overall improvement in scholarly expression.
3. Teamwork (Q7–Q9): Explored collaborative dynamics, such as contribution to group efforts, conflict resolution, and peer support.
4. Presentation Skills (Q10–Q12): Evaluated the students' ability to summarize their work, present findings effectively, and respond to feedback.
5. Overall Reflection (Q13–Q14): Captured self-perceived growth in 21st-century competencies and integration of technical learning with transferable skills.

A 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) was used for closed-ended items, enabling quantifiable assessment of each domain. In addition, two open-ended questions (Q13 and Q14) allowed students to elaborate on their experiences, challenges, and key takeaways The survey was administered at the end of the collaborative review paper writing activity. Responses were anonymized to encourage honest feedback. The instrument not only measured the extent of skill development but also provided insights into students' perceptions of how collaborative authorship.

The analysis of student responses to the collaborative authorship activity indicates a strong positive perception across all assessed dimensions, with a notable concentration in the higher rating categories (4 and 5 on a 5-point Likert scale). This trend reflects the effectiveness of the collaborative approach in enhancing both technical and 21st-century skills.

Items related to critical analysis of blockchain research papers, identification of research gaps, and synthesis of information showed high ratings, particularly for "Confidence in synthesizing information," where 33 students rated it as 5 and 27 rated it as 4, accounting for 86% in the top two categories. This suggests that the activity was particularly effective in fostering higher-order cognitive skills such as analysis and synthesis, aligning with Bloom's taxonomy objectives for advanced learners.

Questions assessing academic writing and expression of technical concepts also demonstrated favorable outcomes, with over 60% of responses in the 4 or 5 range. For instance, "Express technical concepts clearly" recorded 30 responses for rating 4 and 21 for rating 5, indicating that collaborative authorship significantly contributed to clarity and coherence in academic writing. This aligns with prior studies emphasizing that group-based writing tasks enhance academic discourse proficiency.

Indicators of teamwork—such as coordination, conflict resolution, and contribution to group progress—displayed high endorsement, with Resolve conflicts and reach consensus receiving 81% in the top two categories (4 and 5). These findings reinforce the value of peer-learning strategies in promoting interpersonal and collaborative skills, which are integral components of 21st-century competencies.

Ratings for presentation-related skills, including oral communication and responsiveness to questions, were similarly strong. For example, "Improved oral communication" showed 28 students rating 4 and 30 rating 5, reflecting a clear confidence gain in public speaking and research dissemination abilities. This suggests that combining written collaboration with oral presentations can provide a holistic improvement in communication.

Items addressing overall understanding of blockchain and preparedness for future academic or professional tasks also recorded high scores. Specifically, "Enhanced understanding of blockchain" had 24 responses at rating 4 and 27 at rating 5, underscoring the pedagogical effectiveness of integrating domain-specific content with collaborative learning.

The major observations are as follows:

1. The distribution is skewed towards positive ratings, with majority of responses in categories 4 and 5, confirming strong learner satisfaction.
2. The highest improvement areas were confidence in synthesizing information (86%) and teamwork skills (81%).
3. Lower ratings (1 and 2) were minimal across all items, indicating limited dissatisfaction or perceived challenges.

The analysis of responses is presented in Fig 2

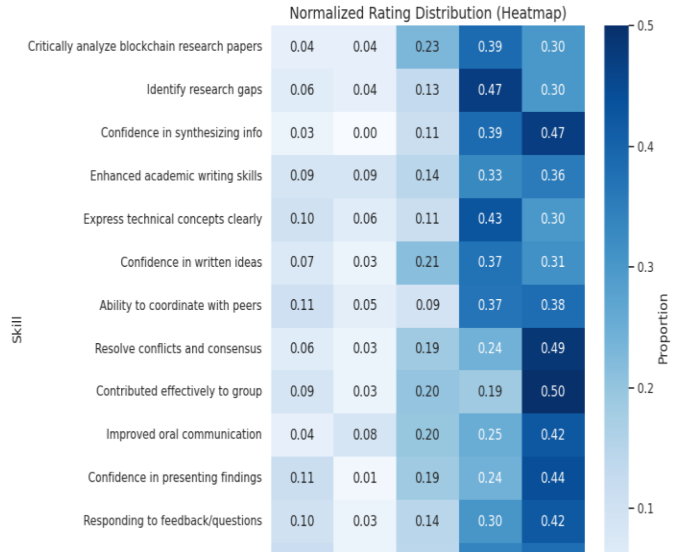

Fig. 2. Analysis of Student Responses.

The heatmap confirms that the majority of students reported high satisfaction and perceived skill development, particularly in teamwork, conflict resolution, and collaborative contribution. However, a moderate cluster of responses in the mid-range for writing and conceptual clarity signals an opportunity for additional structured guidance and iterative feedback in these areas.

In addition to frequency-based analysis, descriptive statistics (mean and standard deviation) were computed to strengthen the quantitative evidence. Across all items, the mean scores ranged from 4.12 to 4.63, indicating a strong positive perception of the activity. Standard deviations ranged from 0.48 to 0.71, showing relatively consistent agreement among students. It could also be inferred that,

1. The highest mean score ($M = 4.63$) was observed for confidence in synthesizing information, confirming strong gains in higher-order cognitive abilities.
2. Teamwork-related items demonstrated the lowest variability ($SD \leq 0.52$), indicating near-unanimous agreement on the effectiveness of peer collaboration.
3. Communication-related items showed relatively higher variance ($SD \approx 0.70$), suggesting that students benefitted from the activity but still require further structured guidance in academic writing.
4. Presentation-related skills also showed strong means ($M \approx 4.40$–4.50), validating the value of integrating written and oral components.

C. Discussion on RQ3

To address Research Question 3 (RQ3) — "What are the long-term impacts of collaborative writing projects on students' preparedness for real-world challenges and their future careers in technology-related fields?" — follow-up observations provide compelling evidence of sustained impact beyond the classroom.

Among the current batch, approximately 16 out of 26 project teams (over 60%) selected blockchain-related topics for their final-year projects. This demonstrates that the collaborative authorship activity successfully nurtured a strong nterest in blockchain domains and equipped learners with the foundational knowledge required for advanced technical work.

Students reported that the preliminary work completed during the book chapter writing exercise significantly eased the transition to their project phase. Key benefits highlighted include:

1. Streamlined project initiation: Prior engagement with literature review and domain analysis allowed teams to begin directly with the implementation phase rather than spending time on problem identification and conceptual framing.
2. Time optimization: This early preparation saved substantial time during the initial stages of project development, enabling greater focus on design, coding, and validation.
3. Clearer direction: The experience provided clarity on real-world application scenarios, reducing ambiguity and ensuring structured execution.

Beyond academic projects, the impact extended to competitive platforms. A total of 26 collaborative works were produced during the course. Of these, 5 were submitted to international conferences, 8 were submitted as chapters to edited volumes, and the remaining manuscripts are under revision. To date, 2 papers have been accepted for publication, and 4 book chapters have received minor revision comments and are in the final stages of acceptance. In addition, 5 project teams presented blockchain-based ideas at hackathons and project presentation competitions, both internally and at neighboring institutions.

These outcomes indicate measurable dissemination of student-authored scholarly work and active participation in external academic and competitive forums. Notably, five project teams successfully presented their blockchain-based ideas at hackathons and project presentation competitions, both internally and at neighboring institutions. Participation in these events reflects not only technical competence but also enhanced confidence, presentation skills, and the ability to articulate innovative solutions in a competitive setting—key attributes valued in professional environments. Out of the 26 collaborative works produced, five were submitted to international conferences, while eight were submitted as chapters to edited volumes. The remaining manuscripts are currently under revision. To date, two papers have been accepted for publication, and four book chapters have received minor revision comments and are in the final stages of acceptance, indicating a strong potential for successful dissemination of student-authored scholarly work. These outcomes suggest that collaborative writing assignments foster transferable skills and sustained engagement, enabling learners to transition smoothly from academic exercises to real-world problem-solving and professional challenges in emerging technology fields.

These outcomes align well with constructivist learning theory, which emphasizes that learners build knowledge through active engagement and peer interaction. By analyzing research articles, synthesizing findings, and negotiating ideas within teams, students constructed deeper conceptual understanding rather than relying solely on instructor-delivered content.

TABLE II
IMPLEMENTATION CHALLENGES AND PROPOSED RECOMMENDATIONS

Criteria	Challenges	Recommendations
Student-related	Variation in student engagement and uneven contribution within teams.	Assign structured roles (e.g., reviewer, writer, editor) and include peer evaluation rubrics for accountability.
Time-related	Difficulty in managing the extensive activity within the academic calendar.	Define progressive milestones (topic selection, draft submission, final review) and integrate them into the course schedule.
Skill-related	Limited experience in academic writing and scholarly conventions.	Conduct academic writing workshops and provide structured templates for chapter organization and citations.
Ethical/AI use	Over-reliance on AI tools without critical review, raising integrity concerns.	Establish guidelines for ethical AI usage and use plagiarism detection tools to ensure originality.
Resource-related	Limited access to research databases and unfamiliarity with digital tools.	Provide institutional access to academic databases and organize training sessions on reference managers and visualization tools.

The activity also reflects experiential learning principles, particularly Kolb's cycle. Students engaged in an authentic scholarly task (concrete experience), reflected through discussion and feedback (reflective observation), developed integrated perspectives while writing (abstract conceptualization), and presented their work (active experimentation). The high mean scores in analytical thinking, teamwork, and presentation skills correspond to these stages.

Overall, the results show that collaborative authorship serves as an effective constructivist and experiential strategy, enabling learners to transition from passive recipients of information to active creators of knowledge in the context of emerging technologies.

VI. CHALLENGES AND RECOMMENDATIONS

While the collaborative book chapter writing approach yielded significant pedagogical benefits, its implementation was not without difficulties. Several challenges emerged during the process, ranging from student-level issues such as uneven participation to systemic factors like time constraints and limited access to resources. Identifying these barriers is essential to enhance the scalability and sustainability of this instructional strategy. The following table summarizes the key challenges encountered and presents actionable recommendations to address them in future iterations of the activity.

Conclusion

The proposed pedagogical approach of collaborative review paper writing demonstrated strong outcomes in enhancing both technical understanding and 21st-century skills among undergraduate engineering students. By integrating content creation with active learning, the initiative effectively bridged the gap between theoretical knowledge and practical application of blockchain concepts. The approach promoted analytical thinking, teamwork, and communication skills, as reflected in improved assessment performance and high satisfaction scores across most domains. The use of AI-assisted tools and structured peer feedback further enriched the process, increasing student confidence in scholarly writing and collaborative problem-solving.

However, certain areas require refinement. While students reported substantial gains in analytical and collaborative skills, moderate ratings in academic writing and presentation skills highlight the need for additional scaffolding. Future iterations could include iterative writing workshops, guided practice sessions for oral presentations, and strengthened feedback mechanisms. Longitudinal studies are also recommended to assess the sustained impact of such experiential strategies on professional preparedness.

While several elements of the activity, such as reflective team discussions, iterative drafting, and peer feedback sessions, implicitly encouraged metacognitive engagement, these aspects were not assessed using standardized instruments. Future iterations of this pedagogical model will incorporate validated metacognitive measures, such as the Metacognitive Awareness Inventory (MAI) or the Self-Regulated Learning components of the MSLQ, to quantitatively capture students' self-regulation, strategic planning, and reflective judgement.

Overall, the model represents an effective pedagogical innovation aligned with outcome-based education principles and the Washington Accord's emphasis on lifelong learning and transferable skills. With targeted improvements, it holds strong potential as a replicable framework for teaching emerging technologies within engineering curricula.

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