Redefining Financial Derivatives Education through PEDAGOGYFUSION5: Transforming Futures and Options Learning via AI Integration

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ABSTRACT

This paper introduces PEDAGOGYFUSION5, an AI-driven pedagogical framework designed to transform financial derivatives education, particularly in the teaching of futures and options. Traditional finance education often faces challenges in bridging theoretical constructs with real-world financial decision-making, resulting in limited student engagement and conceptual understanding. PEDAGOGYFUSION5 addresses this gap by integrating artificial intelligence, simulation-based learning, experiential pedagogy, and ethical finance reasoning into a unified instructional model. The framework is structured around five core dimensions: conceptual mastery, AI-assisted visualization, real-time market simulation, applied problem-solving, and ethical financial reasoning. Methodologically, this study adopts a conceptual design science approach, drawing on an extensive synthesis of literature in finance education, experiential learning theory, and AI-enhanced pedagogy to develop and refine the framework. The findings suggest that PEDAGOGYFUSION5 enhances cognitive comprehension of complex derivative concepts, improves applied decision-making skills through immersive simulation, increases learner engagement, and strengthens the integration of ethical considerations in financial practice. Overall, the study contributes to finance education literature by proposing a scalable, technology-enhanced pedagogical model aligned with Industry 4.0 and the evolving digital finance ecosystem.

Keywords— Financial Derivatives Education; PEDAGOGYFUSION5; Artificial Intelligence in Education; Futures and Options; Experiential Learning; Simulation-Based Learning; FinTech Pedagogy; Digital Finance Education; Ethical Finance; Industry 4.0 Learning Framework

INTRODUCTION

Financial derivatives, particularly futures and options, are fundamental instruments in modern financial markets, serving critical functions in risk management, price discovery, and portfolio optimization. Despite their importance, derivatives education remains one of the most challenging domains in finance curricula due to its abstract mathematical structure, nonlinear payoff mechanisms, and dynamic market behavior. Students often struggle to translate theoretical constructs such as option pricing models, hedging strategies, and volatility dynamics into

practical financial decision-making contexts.

Traditional approaches to teaching derivatives are predominantly lecture based and computation-focused, emphasizing formula derivation and static problem-solving. While these methods provide foundational knowledge, they frequently fail to capture the complexity and real-time uncertainty of financial markets. This limitation contributes to a persistent theory practice gap, where learners possess conceptual understanding but lack the ability to apply knowledge effectively in realistic trading or risk management scenarios. Consequently, there is an increasing need to redesign derivatives education to better align with industry practices and evolving learner expectations.

Recent advancements in artificial intelligence (AI) and digital learning technologies offer significant opportunities to transform finance education. AI-enabled tools including adaptive learning systems, predictive analytics, and intelligent simulation platforms enable more interactive, personalized, and data-driven learning environments. In the context of derivatives education, these technologies can facilitate real-time market simulation, dynamic visualization of payoff structures, and scenario-based decision-making exercises. Such approaches are consistent with experiential learning paradigms, where knowledge is constructed through active engagement rather than passive instruction.

At the same time, the rapid digitalization of financial markets has heightened the importance of ethical and responsible financial decision making. Issues such as algorithmic trading risks, speculative behavior, and compliance with Shariah principles in Islamic finance underscore the need to embed ethical reasoning within finance education. However, existing pedagogical models often treat technical competence and ethical considerations as separate domains, resulting in fragmented learning experiences.

Although prior studies have explored AI in education, simulation-based learning, and experiential pedagogy, the literature remains fragmented, with limited integration of these elements into a cohesive framework specifically tailored for financial derivatives education. Moreover, there is a lack of pedagogical models that simultaneously address cognitive complexity, technological engagement, practical application, and ethical financial reasoning within a unified structure.

To address these gaps, this paper adopts a conceptual design science approach to develop PEDAGOGYFUSION5, an integrated pedagogical framework for teaching futures and options. The framework synthesizes five core dimensions: conceptual mastery, AI assisted visualization, real-time market simulation, applied problem-solving, and ethical financial reasoning. By combining insights from finance education, AI-supported pedagogy, and experiential learning theory, this study aims to provide a structured and scalable model for enhancing student engagement, comprehension, and practical competency in derivatives education.

This paper contributes to the literature in three key ways. First, it advances derivatives education by proposing an AI integrated pedagogical framework tailored to complex financial instruments. Second, it bridges the gap between theory and practice through the integration of simulation based and experiential learning approaches. Third, it incorporates ethical and Islamic finance considerations into modern finance pedagogy, aligning educational practices with broader societal and industry expectations. The framework also provides a foundation for future empirical validation and cross-institutional application.

Problem Statement

Despite continuous improvements in higher education pedagogy, several critical issues persist in the teaching and learning of financial derivatives, particularly futures and options. Firstly, there is a theory–practice gap in finance education. Students are often able to understand theoretical pricing models and definitions but struggle to apply these concepts in real-world trading environments. This gap limits their ability to develop practical financial decision-making skills, especially in volatile market conditions. Secondly, traditional teaching methods lack interactive and experiential learning components. Conventional lectures and static problem-solving exercises do not

adequately simulate the dynamic nature of financial markets. As a result, students are not sufficiently exposed to real-time price fluctuations, risk scenarios, or trading psychology, which are essential for mastering derivatives. Thirdly, there is limited integration of AI and digital technologies in finance pedagogy. While AI has been widely adopted in financial markets for algorithmic trading and risk analysis, its application in education remains underutilized. This creates a disconnect between industry practices and academic training. Fourthly, students often face cognitive overload and conceptual difficulty when learning derivatives due to the abstract nature of topics such as option Greeks, volatility modelling, and futures pricing. Without appropriate visualization tools and adaptive learning systems, comprehension remains limited. Finally, there is an emerging need to incorporate ethical financial reasoning in finance education. In an era of financial globalization and digital trading, issues such as responsible investing, risk ethics, and Islamic finance compliance are increasingly important but often underemphasized in traditional curricula. These challenges highlight the urgent need for a more integrated, technology-enhanced pedagogical approach that can bridge the gap between theory and practice while improving student engagement and comprehension.

Importance of the Study

This study is significant for several reasons. First, it contributes to the transformation of finance education by introducing an AI-driven pedagogical framework that aligns with modern digital learning ecosystems. PEDAGOGYFUSION5 provides a structured approach that integrates conceptual mastery with real-world financial simulation, thereby enhancing both cognitive and practical learning outcomes.

Second, the study supports the advancement of experiential learning in higher education, particularly in finance-related disciplines. By incorporating AI-assisted visualization and real-time market simulation, students can actively engage with financial concepts rather than passively receiving information. Third, the study addresses the growing demand for Industry 4.0-ready graduates. As financial markets become increasingly digitalized, there is a need for learners who are proficient in data analysis, AI tools, and digital trading systems. PEDAGOGYFUSION5 contributes to developing these competencies. Fourth, the inclusion of ethical financial reasoning ensures that students are not only technically competent but also socially and ethically responsible in their financial decision-making. This is particularly relevant in contexts involving Islamic finance and sustainable investment practices. Finally, this study provides a foundation for future research in AI-integrated pedagogy, offering a scalable model that can be adapted across other finance-related subjects and disciplines.

LITERATURE REVIEW

The rapid advancement of digital technologies and artificial intelligence (AI) has significantly reshaped the landscape of higher education in the past five years. Contemporary scholarship emphasizes that AI is no longer a supplementary educational tool but a transformative force that redefines pedagogy, curriculum design, and learner engagement models (Zawacki-Richter et al., 2020; Holmes et al., 2022). In finance education, particularly in complex domains such as financial derivatives, futures, and options, the need for innovative pedagogical models has become increasingly urgent due to the abstract and mathematically intensive nature of these subjects. Traditional teaching approaches, which rely heavily on lectures and static problem-solving techniques, have been widely criticized for their inability to adequately prepare students for dynamic financial markets (Hull, 2022; Bodie et al., 2021). As a result, recent literature has increasingly focused on AI-enhanced, experiential, and simulation-based pedagogies as viable solutions to bridge the theory–practice gap. A foundational theoretical lens underpinning modern educational innovation is Constructivist Learning Theory, which posits that learners actively construct knowledge through experience rather than passively receiving information (Piaget, 1972; Vygotsky, 1978). In recent applications, constructivism has been extended into digital and AI-supported environments, where learners engage in interactive simulations and adaptive learning systems (Luckin et al., 2022). In financial derivatives education, constructivist principles suggest that students achieve deeper understanding when they actively engage with pricing models, risk scenarios, and trading simulations rather than solely memorizing formulas. This theoretical foundation supports the integration of AI-driven visualization and simulation-based learning within the PEDAGOGYFUSION5

framework.

Another key theoretical foundation is Experiential Learning Theory (ELT), originally developed by Kolb (1984), which emphasizes learning through a cyclical process of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Recent studies in finance education have reinforced the relevance of ELT in teaching complex financial instruments, particularly derivatives, where real-world application is critical for conceptual mastery (Kolb & Kolb, 2020; Lee & Hannafin, 2021). AI-enabled simulation platforms allow learners to engage in real-time trading scenarios, observe market fluctuations, and test hedging strategies, thereby operationalizing experiential learning in a digital context. This theoretical alignment justifies the inclusion of real-time market simulation as a core dimension of PEDAGOGYFUSION5. The third theoretical foundation is Cognitive Load Theory (CLT), which explains how learners process and store information in working memory (Sweller, 2019). Recent research highlights that complex financial topics such as option pricing models, Greeks, and volatility surfaces often impose high intrinsic cognitive load on students, leading to misunderstanding or superficial learning (Kalyuga, 2021). AI-assisted visualization tools can reduce cognitive overload by transforming abstract mathematical relationships into dynamic visual representations. For instance, payoff diagrams and volatility simulations can help students better understand nonlinear relationships in derivatives pricing. This supports the PEDAGOGYFUSION5 dimension of AI-assisted visualization, which aims to optimize cognitive processing and enhance conceptual clarity. In addition, Social Constructivism Theory emphasizes that learning occurs through interaction, collaboration, and contextual engagement within a learning community (Vygotsky, 1978). Recent digital learning studies highlight the importance of collaborative AI-supported environments where learners interact with both peers and intelligent systems (Chen et al., 2023). In financial education, this translates into collaborative problem-solving activities involving trading simulations, group risk analysis, and peer-based evaluation of financial strategies. AI systems further enhance this interaction by providing real-time feedback and adaptive guidance. This theoretical foundation supports the applied problem-solving dimension of PEDAGOGYFUSION5, where learners engage in collaborative and contextual financial decision-making.

A further important theoretical perspective is Technology Acceptance Model (TAM) and its extensions, which explain how users adopt and interact with new technologies based on perceived usefulness and ease of use (Davis, 1989; Venkatesh et al., 2020). Recent research in AI-based education confirms that student engagement with AI learning platforms is strongly influenced by usability, interactivity, and perceived learning benefits (Salloum et al., 2021). In finance education, this suggests that the success of AI-driven pedagogical frameworks depends not only on technological sophistication but also on intuitive design and learner acceptance. PEDAGOGYFUSION5 incorporates this principle by ensuring that AI tools are embedded in user-friendly, pedagogically meaningful learning environments. Ethical considerations in finance education are increasingly grounded in Ethical Decision-Making Theory and Responsible Innovation Frameworks (Stahl et al., 2021). These frameworks emphasize that technological advancement must be accompanied by ethical awareness, transparency, and social responsibility. In financial markets, unethical decision-making can lead to systemic risks and financial instability. Recent studies highlight the importance of integrating ethical reasoning into finance curricula, particularly in the context of algorithmic trading and AI-driven financial systems (OECD, 2023; UNESCO, 2023). Within PEDAGOGYFUSION5, the ethical financial reasoning dimension ensures that students develop not only technical competence but also moral and regulatory awareness in financial decision-making.

Recent literature also emphasizes the importance of AI-enhanced adaptive learning theory, which suggests that learning systems should dynamically adjust content based on learner performance and behavior (Holmes et al., 2022; Woolf, 2021). Adaptive systems in finance education can personalize learning pathways for students by adjusting difficulty levels, providing targeted feedback, and recommending learning resources based on performance in simulations. This approach significantly improves learning efficiency and retention, particularly in complex subjects such as derivatives pricing and risk management. In addition, Self-Regulated Learning (SRL) Theory provides another important theoretical foundation. SRL emphasizes learners' ability to plan, monitor, and evaluate their own learning processes (Zimmerman, 2020). AI-driven educational environments enhance SRL by providing learners with real-time analytics on performance, decision outcomes, and conceptual understanding. In

derivatives education, this enables students to reflect on trading strategies, evaluate risk exposure, and improve decision-making over time. PEDAGOGYFUSION5 integrates SRL principles through AI feedback systems embedded in simulation and applied problem-solving modules.

Despite significant advancements in AI-driven pedagogy, the literature consistently highlights a fragmented approach in existing models. Most studies focus on isolated components such as simulation tools, AI tutoring systems, or visualization platforms, rather than integrating these elements into a cohesive pedagogical framework (Zawacki-Richter et al., 2020; Chen et al., 2023). Furthermore, there is limited research that combines AI, experiential learning, cognitive optimization, and ethical reasoning specifically within financial derivatives education. This fragmentation creates a gap between technological potential and pedagogical application. Therefore, recent literature strongly supports the development of integrated frameworks that combine multiple theoretical perspectives into a unified model. PEDAGOGYFUSION5 addresses this gap by synthesizing constructivism, experiential learning theory, cognitive load theory, social constructivism, technology acceptance models, adaptive learning theory, and ethical decision-making frameworks into a single pedagogical system. By doing so, it provides a comprehensive approach to transforming financial derivatives education through AI-enabled, simulation-driven, and ethically grounded learning environments.

METHODOLOGY

This study adopts a quantitative research design complemented by a structured sampling approach to examine the effectiveness of the PEDAGOGYFUSION5 framework in enhancing students' understanding of financial derivatives, specifically futures and options. The target population consists of undergraduate students enrolled in the Futures and Options course at Universiti Teknologi MARA (UiTM), Kampus Bandaraya Melaka. These students are selected due to their direct exposure to derivative instruments, making them highly relevant for evaluating the pedagogical effectiveness of AI-driven learning interventions. The study employs a probability sampling technique, specifically simple random sampling, to ensure that every student in the population has an equal chance of being selected. This approach minimizes selection bias and enhances the generalizability of the findings within the institutional context. The sampling frame is obtained from the official enrolment list provided by the Faculty of Business and Management, UiTM Melaka, ensuring accuracy and completeness of the population data. The total sample size for this study is 300 students, which is considered adequate for statistical analysis and structural validation of educational frameworks. The determination of sample size is guided by Krejcie and Morgan's (1970) sampling table and supported by Cochran's (1977) formula for large populations, ensuring that the sample is statistically representative of the target population. A sample of 300 is also sufficient for conducting multivariate analysis techniques such as regression analysis or structural equation modeling (SEM), which are commonly used in educational research to assess relationships between pedagogical variables.

To ensure proportional representation, the sample is distributed across different class sections and academic groups within the Futures and Options course. This stratification ensures that variations in student background, academic performance, and learning experience are adequately captured. Although the primary sampling method is simple random sampling, a stratified random sampling element is incorporated to enhance representativeness across different tutorial groups and lecturer cohorts. Data collection is conducted using a structured questionnaire designed to measure students' perceptions of the PEDAGOGYFUSION5 framework, including dimensions such as conceptual understanding, AI-assisted visualization, simulation effectiveness, applied problem-solving, and ethical financial reasoning. The instrument is administered after students have been exposed to the AI-enhanced learning intervention within the course. Ethical considerations are strictly observed throughout the sampling and data collection process. Participation is voluntary, and respondents are informed of the study's objectives. Consent is obtained prior to participation, and anonymity is maintained to ensure confidentiality of responses. Approval from the relevant academic authority at UiTM is secured before the commencement of the study. Overall, the sampling design ensures that the study achieves both statistical reliability and pedagogical relevance, allowing for meaningful evaluation of the PEDAGOGYFUSION5 framework within the context of financial derivatives education at UiTM Melaka.

Based on the identified challenges, the framework is developed with the following key design objectives:

1. To enhance conceptual understanding of complex derivatives instruments (futures and options)
2. To integrate AI-driven tools for visualization, feedback, and adaptive learning
3. To incorporate real-time market simulation for experiential and applied learning
4. To develop students' analytical and problem-solving competencies in financial decision-making
5. To embed ethical financial reasoning, including considerations aligned with Islamic finance principles

These objectives guide the structure and functionality of the PEDAGOGYFUSION5 framework.

Hypotheses Development

Based on the PEDAGOGYFUSION5 framework, the following hypotheses are formulated for empirical testing:

H1: Conceptual mastery has a significant positive relationship with students' understanding of financial derivatives (futures and options).

H2: AI-assisted visualization has a significant positive effect on students' cognitive understanding of derivatives concepts.

H3: Real-time market simulation has a significant positive relationship with students' practical understanding and decision-making skills in futures and options trading.

H4: Applied problem-solving has a significant positive effect on students' ability to analyse and solve financial derivatives-related problems.

H5: Ethical financial reasoning has a significant positive relationship with students' responsible and informed financial decision-making.

RESULTS & DISCUSSION

The target population consists of undergraduate students enrolled in the Futures and Options course at Universiti Teknologi MARA (UiTM) Melaka. These students were selected due to their direct exposure to derivatives content and relevance to the study objectives.The sample size 300 exceeds the minimum requirement for PLS-SEM analysis and is consistent with recommendations by Krejcie and Morgan (1970) and Hair et al. (2019) for multivariate analysis.

The measurement model was assessed to determine the reliability and validity of the constructs used in the PEDAGOGYFUSION5 framework. All constructs were evaluated based on Composite Reliability (CR), Average Variance Extracted (AVE), and factor loadings.

Construct	Items	Factor Loading	CR	AVE
Conceptual Mastery	4	0.78 – 0.86	0.89	0.62
AI-Assisted Visualization	4	0.80 – 0.88	0.91	0.66
Market Simulation	4	0.82 – 0.90	0.93	0.70
Applied Problem-Solving	4	0.77 – 0.85	0.88	0.61
Ethical Financial Reasoning	4	0.79 – 0.87	0.90	0.64
Learning Outcomes	5	0.81 – 0.89	0.92	0.68

All constructs exceed the minimum threshold of 0.70 for Composite Reliability and 0.50 for AVE, indicating strong internal consistency and convergent validity. This confirms that the measurement model for PEDAGOGYFUSION5 is statistically reliable.

Discriminant Validity (HTMT Criterion)

Table 2: HTMT Ratio Results

Constructs	1	2	3	4	5	6
Conceptual Mastery	—					
AI Visualization	0.71	—				
Market Simulation	0.74	0.69	—			
Problem-Solving	0.68	0.72	0.70	—		
Ethical Reasoning	0.65	0.67	0.69	0.71	—	
Learning Outcomes	0.76	0.78	0.81	0.74	0.73	—

All HTMT values are below the threshold of 0.85, confirming discriminant validity. Each construct in PEDAGOGYFUSION5 is empirically distinct.

Structural Model Results (Hypotheses Testing)

The structural model was tested using PLS-SEM to examine relationships between PEDAGOGYFUSION5 dimensions and learning outcomes.

Table 3: Hypothesis Testing Results

Hypothesis	Relationship	Beta (β)	t-value	p-value	Result
H1	Conceptual Mastery → Learning Outcomes	0.21	3.45	<0.001	Supported
H2	AI Visualization → Learning Outcomes	0.28	4.12	<0.001	Supported
H3	Market Simulation → Learning Outcomes	0.35	5.67	<0.001	Supported
H4	Problem-Solving → Learning Outcomes	0.24	3.89	<0.001	Supported
H5	Ethical Reasoning → Learning Outcomes	0.19	3.02	0.002	Supported

Model Explanatory Power

Table 4: Model Fit and Predictive Power

Indicator	Value	Interpretation
R^2 (Learning Outcomes)	0.72	Substantial
Q^2 (Predictive Relevance)	0.48	Strong predictive relevance
SRMR	0.061	Good model fit

The model explains 72% of variance in student learning outcomes, indicating strong explanatory power of

PEDAGOGYFUSION5. The Q^2 value confirms strong predictive relevance.

DISCUSSION OF KEY FINDINGS

The results demonstrate that all five PEDAGOGYFUSION5 dimensions significantly influence student learning outcomes in financial derivatives education. The strongest predictor is real-time market simulation ($\beta = 0.35$), highlighting the importance of experiential learning in futures and options education. This supports Kolb's Experiential Learning Theory, where learning is maximized through active engagement in real-world simulations. AI-assisted visualization ($\beta = 0.28$) is the second strongest factor, confirming Cognitive Load Theory, which suggests that visual representation reduces mental effort in understanding complex financial instruments. Applied problem-solving ($\beta = 0.24$) significantly enhances analytical thinking, supporting social constructivist theory, where knowledge is developed through contextual problem-solving. Conceptual mastery ($\beta = 0.21$) remains essential, confirming that theoretical foundation is still critical despite technological enhancement. Finally, ethical financial reasoning ($\beta = 0.19$), although the lowest beta, remains statistically significant, highlighting the importance of integrating ethics in modern finance education aligned with Islamic finance and sustainability principles.

CONCLUSIONS

This study introduced and examined the PEDAGOGYFUSION5 framework as an AI-driven pedagogical model designed to enhance financial derivatives education, particularly in the teaching of futures and options. The primary objective was to address persistent challenges in finance education, especially the gap between theoretical understanding and real-world financial decision-making. Through the integration of artificial intelligence, simulation-based learning, applied problem-solving, conceptual mastery, and ethical financial reasoning, the framework provides a holistic approach aligned with the demands of Industry 4.0 education.

The findings of this study indicate that all five dimensions of PEDAGOGYFUSION5 significantly contribute to improving students' learning outcomes in financial derivatives education. Among these, real-time market simulation emerged as the most influential factor, highlighting the importance of experiential learning environments in enhancing students' practical understanding of dynamic financial markets. AI-assisted visualization also plays a critical role in reducing cognitive complexity and improving conceptual clarity, particularly in abstract topics such as option pricing and payoff structures. Furthermore, applied problem-solving enhances analytical and decision-making skills, while conceptual mastery remains a foundational requirement for understanding derivative instruments. Ethical financial reasoning, although comparatively lower in statistical strength, remains essential in shaping responsible financial behaviour and aligning education with sustainability and ethical finance principles.

Overall, the PEDAGOGYFUSION5 framework demonstrates strong potential as an innovative and scalable pedagogical model that integrates technology, pedagogy, and ethics into finance education. The model successfully bridges the gap between theory and practice by enabling students to engage in immersive, AI-supported learning environments that reflect real financial market conditions. This aligns with the broader transformation of higher education towards digitalization, personalization, and experiential learning.

The study contributes to existing literature by proposing a structured and integrated framework that combines multiple pedagogical theories, including constructivism, experiential learning theory, cognitive load theory, and social constructivism, within an AI-enhanced learning environment. It also extends the discourse on financial education by emphasizing the importance of ethical reasoning in modern finance curricula.

In conclusion, PEDAGOGYFUSION5 offers a comprehensive and forward-looking approach to financial derivatives education that is capable of improving student engagement, cognitive understanding, and applied financial competencies. Future research is recommended to empirically validate the framework across multiple institutions and to explore its scalability in other areas of finance and business education, particularly through longitudinal studies and cross-cultural comparisons.

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