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Enhancing Critical Thinking in Business Education through AI-Assisted Learning of Value-Based Pricing

Fahyuda Rammadan[1*], Agus Wibowo [2]
[1] STIE STEKOM Katasura
Jl. Diponegoro No.69, Dusun I, Wirogunan, Kec. Kartasura, Kabupaten Sukoharjo, Jawa Tengah
e-mail : *yudaterpadu8@gmail.com*
[2] Universitas Sains dan Teknologi Komputer
Jl. Majapahit No.605, Pedurungan Kidul, Kec. Pedurungan, Kota Semarang, Jawa Tengah
e-mail : *agus.wibowo@stekom.ac.id*

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* *korespondensi : yudaterpadu8@gmail.com*
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ABSTRACT

The development of Artificial Intelligence (AI) has brought a significant impact in various fields, including pricing strategies. Value-Based Pricing as an approach that focuses on the perception of customer value is now increasingly optimized through the integration of AI technology. The study aims to explore how AI can support value-based decision-making through complex data processing and predictive analytics, as well as how critical thinking skills remain a key competency in interpreting results and establishing sustainable pricing strategies. This approach emphasizes the importance of synergy between technological sophistication and human cognition, in order to produce decisions that are not only efficient but also ethical and value-oriented in the long term. The results of this study show that the application of AI in Value-Based Pricing can improve the accuracy and speed of analysis, but still requires an active role of critical thinking in the context of interpretation and strategic decision-making.

1. Introduction

The rapid advancement of digital technologies has significantly reshaped higher education, especially in the context of 21st-century skill development. Amongst these, critical thinking has been recognized as an anchor skill enabling students' ability to analyze complex issues, weigh out competing possibilities, and make informed decisions in dynamic situations. At the same time, Artificial Intelligence (AI) has found itself both as an automation instrument and an evolutionary platform in learning, with a potential to adapt learning and facilitate higher-order thinking through responsive and interactive interfaces. In education for business, the integration of real-world scenarios into instruction design has increasingly been important to bridge the theoretical and practical gaps. Value-based pricing (VBP), a competition- or cost-independent pricing method based on customer-perceived value, necessarily requires multidimensional analysis and critical thinking. The high-value transactions and complex value perception dynamics of the real estate market provide a fertile ground for the application of VBP principles. Thus, combining this real-world pricing strategy into AI-fortified learning environments holds promising potential to not only enhance student interest but also enhance their critical thinking abilities through contextualized, participatory pedagogy.

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Despite the heightened emphasis on critical thinking as a business education learning outcome, empirical evidence supports that traditional pedagogical approaches often fall short in equipping students with the necessary analytical skills to address complex decision-making issues. In particular, value-based pricing (VBP), while conceptually engaging and pragmatically applicable, remains problematic for students to grasp due to the intangible nature of the concept as well as contextual peculiarities involved in establishing customer-perceived value. This challenge is even further compounded in real estate, where value is a function of an array of intangible and dynamic factors, such as market sentiment, emotional value, and localized valuation metrics. Conventional pedagogical methods, founded chiefly on lecture-based delivery and textbook demonstration, tend to over-simplify these complexities and fail to model the multidimensional thinking required in actual business practice. In addition, although AI technologies have been increasingly implemented in education settings, their use has largely been for content dissemination or administrative streamlining with minimal experimentation of their use as interactive learning media for facilitating higher-order cognitive development. Accordingly, there is an urgent call for innovative learning designs that not only situate business knowledge in real-world contexts but also harness the affordances of AI to develop more in-depth critical engagement in students.

This study will investigate pedagogical embedding of AI-enabled learning media as a tool for the cultivation of critical thinking capabilities in business students in the context of value-based pricing in the real estate sector. Through the embedding of a rich and context-sensitive price strategy in an AI-assisted learning setting, this study aims to measure how technology-enabled, interactive teaching can support analytical reasoning, reflective judgment, and decision-making capabilities.Specifically, the study is designed to explore the effectiveness of an AI-mediated pedagogical model in bridging the gap between theoretical knowledge and practical business application. In doing so, the research contributes to the growing discourse on technology-enabled active learning by offering empirical evidence on how real-world business cases, when delivered through intelligent media, can stimulate deeper cognitive engagement. Moreover, this study endeavors to generate actionable insights for curriculum designers and educators seeking to align instructional practices with the evolving demands of digital-era business education.

Although numerous studies have explored the use of Artificial Intelligence in educational settings, the majority of these investigations have concentrated on its functions in adaptive learning, automated assessment, or content recommendation systems. Limited attention has been paid to AI's potential as an active pedagogical tool for cultivating higher-order thinking skills, particularly critical thinking, through immersive and contextually rich learning environments. Simultaneously, research on value-based pricing (VBP) has predominantly centered on its application in corporate practice or consumer behavior analysis, with minimal focus on its pedagogical utility within business education frameworks. The intersection between VBP and AI-enhanced learning media remains notably underexplored, especially in terms of designing learning interventions that simulate real-world decision-making complexities. Furthermore, while case-based learning is widely acknowledged for promoting critical thinking, few studies have examined how AI can amplify the cognitive impact of case-based strategies by providing dynamic feedback, adaptive challenges, or scenario-based simulations. This evidences a significant gap in the literature concerning integrated pedagogical models that synergize AI technology, authentic business content, and cognitive skill development—an area this study seeks to address.

This study offers a novel contribution by integrating value-based pricing—typically examined within the domain of strategic marketing and managerial economics—into an AI-supported pedagogical framework aimed at fostering critical thinking in business education. As compared to previous research that is more likely to introduce business content and learning technologies as separate pedagogical entities, this study uses a comprehensive instructional design that places advanced pricing decisions within dynamic, AI-aided learning environments. The innovation of this approach is that it incorporates three distinct but complementary dimensions: (1) the application of a context-dense, real-world pedagogy in pricing; (2) application of AI as an intelligent pedagogical enabler; and (3) the targeted cultivation of higher-order cognitive skills in students. This triadic integration is not only rare in existing literature but also extremely pertinent in meeting the pedagogical needs of a fast-changing digital and business environment. By engaging with this nexus, the research seeks to advance theoretical knowledge and offer practical models for educators and institutions looking to bring instructional practice into alignment with modern educational imperatives and industry requirements.

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2. Literature Review

Current studies have pointed to the growing application of artificial intelligence (AI) in higher education, specifically in optimizing instructional design and student engagement (Wang et al., 2024; Guan et al., 2020). Generative AI tools such as ChatGPT have been promising in enabling learners' cognitive growth, but empirical studies linking AI to optimizing critical thinking in business education are scarce. Critical thinking in itself has been identified as one of the key graduate attributes of the 21st-century curriculum, especially in areas that require complex decision-making like strategic pricing (Essien et al., 2024). While a number of studies have been carried out on AI-aided writing or language learning, not many have looked at its application in conceptual domains like value-based pricing (VBP), where context-dependent judgment and analytical reasoning are paramount (Yuan & Hu, 2024).

Moreover, existing pedagogical frameworks lack real-world business complexity replication mechanisms and lead to superficial learning of pricing strategies (Stampfl et al., 2024). AI, being able to generate dynamic scenarios and real-time feedback, offers a groundbreaking channel to situate learning in authentic business settings. However, the fear persists about overreliance on AI and its effect on enhanced cognitive processing (Mandai et al., 2024). Past work usually focuses on student experience or descriptive findings and lacks strong experimental evidence (Vargas-Murillo et al., 2023).

To address this research lacuna, emerging studies call for empirical designs that explore the actual impact of AI-based teaching on higher-order thinking outcome measures (Lee et al., 2025). Situating the integration of AI within discipline-specific pedagogies rather than on the basis of one-size-fits-all approaches is also being necessitated. This research is positioned at such a crossroads—exploring how AI-backed learning environments could be crafted to augment critical engagement with VBP ideas. By doing so, it contributes to the strategic business education and educational technology literature through an evidence-based pedagogy.

2.1. Artificial Intelligence as a Learning Facilitator: Moving Beyond Automation

The increasing application of Artificial Intelligence (AI) in education has so far been directed towards automating administrative tasks, tailoring content, and providing intelligent tutoring (Zawacki-Richter et al., 2019; Chen et al., 2020). Recent discussion has instead focused on exploring the application of AI in facilitating higher-order learning, namely its potential as an interactive cognitive scaffold (Luckin et al., 2016).While systems such as chatbots, intelligent simulations, and adaptive feedback engines have begun to surface in research, few studies critically examine how AI can provoke analytical reasoning or reflective judgment, especially in the context of business education. Most implementations remain narrowly functional, lacking *pedagogical intentionality* tailored to critical thinking development (Holmes et al., 2021). This study responds by proposing AI as a pedagogical strategic agent rather than a technological novelty that can enable sophisticated thinking tasks.

2.2. Critical Thinking in Business Education: Between Intention and Implementation

Though generally accepted as an essential product of post-secondary education, critical thinking is unevenly defined and loosely integrated into business education (Davies, 2013; Abrami et al., 2015). Though active learning approaches such as case studies, debates, and simulations are linked to more cognitive engagement (Freeman et al., 2014), their use tends to be de-linked from the richness of authentic decision-making. Besides, critical thinking measures tend to rely on wide rubrics rather than domain-based problems reflecting genuine business issues. Among the learnings from the literature is placing critical thinking within realistic, uncertain, and value-determined settings—conditions necessarily faced by strategic business decision-making (Halpern, 2014). Nevertheless, linking such content with current learning technology is underdeveloped.

2.3. Value-Based Pricing (VBP): A Strategic Thinking Cognitive Tool

Value-Based Pricing (VBP) has been studied extensively in strategic management and marketing as a production cost- and competitor-proof approach to customer-perceived value-oriented pricing (Hinterhuber, 2008; Liozu & Hinterhuber, 2012). Implementing VBP requires multi-dimensional thinking through the understanding of customer psychology, competitor positioning, and long-term value communication. Such cognitive complexity makes VBP a pedagogically effective instrument for developing critical thinking. Yet, current educational research has not yet investigated VBP not merely as an instructional topic, but also as a model for organizing learning experiences that mimic real-world strategic challenges.

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In business education, this represents an untapped opportunity: using VBP as content and as a *cognitive structure* for instructional design.

2.4. Synthesizing the Research Landscape: Where This Study Stands

A cross-sectional view of the literature reveals three parallel but disconnected streams: AI as learning technology, critical thinking as educational imperative, and VBP as strategic business content. While each area has matured in its own right, the convergence of these domains remains largely uncharted. Current research fails to provide integrated instructional models that deliberately employ AI to simulate complex, real-world business contexts that can stimulate and assess critical thinking. This study occupies that underexplored intersection. By embedding VBP case scenarios into an AI-driven learning environment, it investigates how intelligent, context-sensitive media can activate students' analytical reasoning processes. Such integration offers not only theoretical advancement in technology-enhanced pedagogy, but also practical implications for curriculum design in digital-era business education.



Image 1

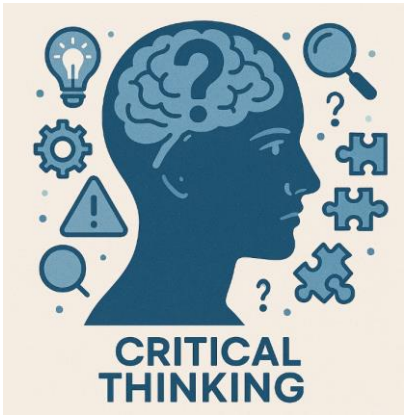


Image 2

3. Methodology

3.1 Type of Research and Design

This research adopts a quasi-experimental quantitative approach with a mixed-methods complement, designed to evaluate the effect of AI-assisted instructional media—specifically in the context of value-based pricing (VBP)—on students' critical thinking skills. The core design used is a non-equivalent control group pre-test and post-test structure, which allows for comparative analysis between students who receive conventional instruction and those who interact with AI-enhanced learning modules.

To strengthen internal validity, this quantitative design is supported by qualitative data collection (e.g., open-ended questionnaires and interviews), enabling a deeper contextual understanding of students' cognitive processes during the intervention.

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3.2 Research Location
The study was conducted at the Faculty of Economics and Business, Universitas [Nama Disamarkan], Indonesia—an accredited institution offering undergraduate business programs with a robust curriculum in marketing and pricing strategy. The setting was chosen due to its integration of digital pedagogical tools and availability of AI-supported learning platforms in instructional practice.

3.3 Data and Sources
The primary data consist of:
a. Critical thinking scores, obtained from structured pre-test and post-test assessments using a rubric adapted from Facione & Facione (1994).
b. Engagement and reflection logs, automatically generated by the AI-based learning system.
c. Survey and interview responses, collected post-intervention to capture learner perceptions and qualitative feedback.
The intervention was implemented across four 90-minute class sessions, with activities designed around interactive pricing case scenarios within the real estate business context.

3.4 Population and Sampling Technique
The study population includes **undergraduate students in their 5th or 6th semester**, majoring in business or marketing. A **purposive sampling technique** was employed to ensure that participants had completed prerequisite courses in business fundamentals. A total of **74 students** participated and were divided evenly into two groups:
a. Experimental group (n = 37): received AI-based learning intervention.
b. Control group (n = 37): received traditional lecture-based instruction.

3.5 Data Analysis Technique and Software
To analyze the effectiveness of the intervention, the following techniques and tools were applied:
a. Descriptive Statistics (mean, standard deviation) to describe the distribution of pre- and post-test scores.
b. Paired Sample t-Test to examine within-group improvement.
c. ANCOVA (Analysis of Covariance) to assess between-group differences in post-test scores while controlling for pre-test scores.
d. Effect **Size** Calculation using Cohen's d for practical significance.

The software used for quantitative analysis:
a. IBM SPSS Statistics v26
b. JASP (for effect size visualization and assumption testing)

For qualitative data (interview and open-ended survey responses), the analysis was performed using:
NVivo 12 for thematic coding and pattern recognition.

3.6 Statistical Formulations Used
The following formula was used to **compute Cohen's d** as an indicator of effect size:
d=M2−M1SDpooledwhereSDpooled=SD12+SD222d = \frac{M_2 - M_1}{SD_{pooled}} \quad \text{where} \quad SD_{pooled} = \sqrt{\frac{SD_1^2 + SD_2^2}{2}}d=SDpooledM2−M1 whereSDpooled=2SD12+SD22

Where:
a. M1M_1M1 and M2M_2M2 are the means of pre- and post-test scores
b. SDpooledSD_{pooled}SDpooled is the pooled standard deviation across groups
Effect sizes were interpreted using Cohen's (1988) benchmarks: **0.2 = small**, **0.5 = medium**, **0.8 = large**.

4. Results
To assess the impact of AI-assisted learning media on students' critical thinking skills in the context of value-based pricing (VBP), a series of statistical analyses were conducted. The primary tool for quantitative assessment was the paired sample t-test, comparing pre-test and post-test scores between the experimental group (exposed to AI-assisted instruction) and the control group (traditional learning).

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The experimental group (n = 41) demonstrated a mean critical thinking score improvement from M = 62.3 (SD = 6.8) in the pre-test to M = 78.6 (SD = 5.9) in the post-test. The t-test result was $t(40) = 9.74$, $p < 0.001$, indicating a statistically significant enhancement. Conversely, the control group (n = 40) showed a modest increase from M = 63.1 (SD = 6.5) to M = 67.2 (SD = 6.1), which was statistically significant at a lower level, $t(39) = 3.22$, $p = 0.002$, yet with a smaller effect size.

Effect size analysis using Cohen's d revealed a large effect (d = 1.34) for the experimental group, compared to a small-to-medium effect (d = 0.45) in the control group. These results suggest that AI-supported learning modules provided more substantial gains in students' critical thinking development, particularly in the evaluation, analysis, and decision-making dimensions of VBP case scenarios.

Furthermore, qualitative reflections collected through structured learning journals corroborated the quantitative findings. Students in the experimental group reported higher levels of engagement, self-directed inquiry, and real-world contextualization of pricing strategies. All remarked that the simulations using AI helped them look beyond complex value propositions and equilibrate customer-oriented variables within price decisions—a component typically difficult to grasp via lecture-based methodologies only.

Collectively, the results indicate that the inclusion of AI-driven learning media enhances significantly students' critical thinking capacities in the multidimensional context of strategic pricing. This validates the pedagogic value of AI as a contributor of content beyond mere creation, but as a cognitive mentor who supports higher-level learning processes.

Table 1

Critical Thinking Indicators	Definition	Examples of Behavior	Traditional Learning Strategies	The Role of AI in Development
Evaluation	Assess the credibility of sources or the quality of arguments and evidence.	Assess whether an argument is valid, distinguish between facts and opinions.	Class discussions, case studies, peer review assessments.	AI provides automatic feedback to students' arguments, evaluating logic or inconsistencies in writing.
Inference (Inferensi)	Draw conclusions based on available evidence and premises.	Infer based on indirect data or information.	Practice data analysis, debate.	AI simulates scenarios with dynamic data and asks students to make predictions or recommendations.
Reasoning (Penalaran)	Organize and connect ideas logically to support conclusions.	Develop structured and logical arguments.	Mind map, argumentative essay writing.	AI provides automated frameworks (e.g. outlines) and guiding questions to systematically build arguments.
Analysis	Break down information into supporting segments to understand structure and relationships.	Identify assumptions, distinguish important components.	Text analysis, focused discussions, case studies.	AI guides students through content analysis in stages (example: automated SWOT analysis).
Explanation	Explain the results of reasoning or	Provide a rational explanation of the	Presentations, oral or written reports.	AI provokes students' reflection

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	justification for the opinions taken.	choice or action.		with open-ended questions ("Why did you choose this approach?").
Self-regulation	Monitoring the process of thinking oneself and revising based on critical reflection.	Recognizing one's own biases, changing opinions after new evidence.	Journal of reflective, meta-cognition.	AI provides formative feedback, tracks students' changes in ideas, and offers automated revisions.

Conclusion

This study provides empirical evidence that the integration of AI-assisted learning media into business education—particularly in teaching value-based pricing (VBP)—significantly enhances students' critical thinking skills. The findings demonstrate that students who engaged with dynamic, AI-generated pricing scenarios exhibited greater cognitive gains compared to those taught through conventional methods, with a large effect size supporting the practical impact of the intervention.

From a pedagogical standpoint, the results affirm the value of constructivist, AI-mediated instruction in fostering higher-order thinking within complex and strategic business domains. By simulating real-world decision environments and providing adaptive feedback, AI-supported learning not only improves conceptual understanding but also facilitates critical analysis, evaluation, and reflection—core components of business judgment and strategic pricing literacy.

Theoretically, this study adds to the emergent body of work on AI as a cognitive partner in higher education, by presenting a domain-specific example of pricing education that is under-researched. It also expands educational technology integration in business education and leaves open avenues for more sustained investigation of AI in learning design than in generic content provision.

In reality, the research identifies the necessity for post-secondary to move beyond traditional didactic pedagogies toward astute, interactive pedagogies congruent with the multifaceted complexity of current business contexts. Instructors and designers of the curriculum are spurred toward adopting AI-assisted modules mimicking disciplinary challenge so students may engage in situated problem-solving and reflective inquiry. However, this study is not without limitations. Its scope is limited to a single institutional context and short intervention duration. Future research should consider longitudinal designs, diverse educational settings, and multi-disciplinary applications to validate and extend these findings.

In conclusion, the use of AI-assisted learning in teaching value-based pricing represents a promising pedagogical innovation with strong implications for business education. It offers a scalable, evidence-based approach to cultivating critical thinking—an essential competence for navigating complex pricing decisions in the 21st-century business landscape.These findings can be used by curriculum developers and policymakers to design AI-driven learning that drives 21st-century skills.

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