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Bridging Learner Needs and Instructional Design: Developing a GenAI-PBL Model for Critical Thinking and Moral Reasoning in Undergraduate Philosophy Education

Shujuan Zhao[1], Sirirat Petsangsri[1,*] & Jirarat Sitthiworachart[1]

[1]Department of Industrial Education, School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand

*Correspondence: Sirirat Petsangsri, Department of Industrial Education, School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand. Tel: 66-2-329-8000. E-mail: sirirat.pe@kmitl.ac.th

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Abstract

Despite the rapid adoption of generative artificial intelligence (GenAI) in higher education, limited research has developed pedagogically grounded instructional models that systematically integrate GenAI into philosophy education to foster higher-order learning competencies. This study aimed to develop and validate a Generative AI-Enhanced Problem-Based Learning (GenAI-PBL) instructional model to promote critical thinking, moral reasoning, and learning achievement among undergraduate philosophy students in China. A sequential mixed-methods research design was employed, consisting of a needs analysis followed by instructional model development and expert validation. In Phase 1, quantitative data were collected from 400 undergraduate students, complemented by qualitative interviews with five philosophy instructors from three universities. The findings revealed consistently high student needs across all dimensions (M = 3.99–4.23), particularly in AI-supported cognitive guidance, moral reasoning, and learning scaffolding, while instructors identified challenges related to facilitating higher-order thinking, integrating ethical discussions, designing AI-supported learning activities, and developing professional readiness for GenAI implementation. Based on these findings, a three-phase GenAI-PBL instructional model was developed, comprising pre-class scenario triggering, in-class inquiry and dialectical facilitation, and post-class reflection and assessment. The model was subsequently evaluated by five experts and demonstrated high pedagogical appropriateness (overall M = 4.38), with all components achieving an Index of Item-Objective Congruence (IOC) above 0.67. The proposed model provides a theoretically grounded and empirically informed framework for integrating GenAI into undergraduate philosophy education and offers practical guidance for enhancing critical thinking, moral reasoning, and learning achievement through AI-supported problem-based learning.

Keywords: generative artificial intelligence, problem-based learning, critical thinking, moral reasoning, philosophy education

1. Introduction

Generative artificial intelligence (GenAI) has emerged as a transformative force in higher education. The advent of large language models, such as ChatGPT and similar conversational AI systems, has altered how students access information, generate ideas, and engage in academic learning. Unlike earlier educational technologies that primarily supported information retrieval or automated assessment, GenAI offers interactive dialogue, context-sensitive feedback, and contextualized explanations that can facilitate deeper learning processes when appropriately integrated into instructional activities (Kasneci et al., 2023; Zawacki-Richter et al., 2019). Universities worldwide have consequently begun exploring how GenAI might be incorporated into curriculum design to enhance students' higher-order thinking and disciplinary understanding (Dwivedi et al., 2023).

Despite these opportunities, the integration of GenAI into higher education has generated significant pedagogical

concerns. Research suggests that uncritical reliance on AI-generated responses may encourage superficial learning, diminish independent reasoning, and weaken students' capacity for critical evaluation (Kasneci et al., 2023; Mollick & Mollick, 2023). Rather than functioning as autonomous learning agents, generative AI systems should therefore be regarded as cognitive tools whose educational value depends substantially on instructional design (Selwyn, 2019). Without appropriate pedagogical guidance, students may accept AI-generated answers instead of questioning assumptions, comparing alternative viewpoints, or constructing their own arguments, a concern particularly acute in disciplines emphasizing reflective inquiry and reasoned judgment.

Undergraduate philosophy education represents one such discipline. Philosophy courses aim to cultivate students' abilities to analyze complex arguments, evaluate competing perspectives, construct coherent justifications, and make ethically informed judgments. These competencies extend beyond conceptual knowledge and require sustained engagement with critical thinking defined as purposeful, self-regulatory judgment involving interpretation, analysis, evaluation, and inference (Facione, 1990) and moral reasoning, the capacity to deliberate about ethical conflicts and justify decisions through coherent argumentation (Rest et al., 1999). In the Chinese higher education context, however, philosophy and ideological-political education courses continue to rely predominantly on lecture-based approaches that emphasize theoretical transmission over dialogical inquiry (Liu & Wang, 2019). National policy documents have explicitly called for pedagogical reform to cultivate students' critical reflection and ethical reasoning (Ministry of Education of China, 2020), yet a persistent gap remains between these policy aspirations and prevailing instructional practices. Students frequently perceive philosophy courses as abstract, disconnected from real-world moral challenges, and insufficiently engaging (Sun, 2021).

The growing emphasis on competency-based outcomes further underscores the need to reconsider instructional approaches in philosophy education. Critical thinking has consistently been identified as an essential competency for university graduates, enabling learners to examine evidence systematically, question assumptions, and formulate reasoned conclusions (Facione, 1990). Moral reasoning enables students to recognize ethical dilemmas, consider multiple perspectives, and justify decisions according to coherent moral principles (Rest et al., 1999). Together with disciplinary learning achievement, these competencies constitute the core educational outcomes that philosophy education seeks to develop.

Problem-Based Learning (PBL) provides a promising instructional approach for achieving these objectives. Grounded in constructivist learning theory, PBL encourages learners to construct knowledge actively through authentic problems, collaborative discussion, self-directed inquiry, and reflective learning (Barrows, 1986; Hmelo-Silver, 2004). Rather than receiving knowledge passively, students investigate complex situations, evaluate evidence, formulate explanations, and justify their conclusions through dialogue. Empirical studies have demonstrated that PBL can improve conceptual understanding, problem-solving ability, and higher-order thinking across diverse disciplines (Dolmans et al., 2016; Savery, 2019) . Nevertheless, conventional PBL presents practical challenges. Students often experience difficulty initiating inquiry, organizing information, or sustaining meaningful discussion when confronting abstract or ill-structured problems, particularly in humanities disciplines where multiple interpretations may coexist (Hmelo-Silver et al., 2007) .

Recent advances in generative AI offer new possibilities for addressing these challenges. By providing adaptive questioning, immediate feedback, multiple perspectives, and contextual explanations, GenAI can function as a cognitive scaffold that supports learners throughout the inquiry process without replacing their reasoning (Belland et al., 2017; Azevedo et al., 2017) . When integrated within an appropriately designed PBL environment, AI can encourage students to compare alternative interpretations, examine underlying assumptions, and refine their arguments through continuous dialogue. In this context, the instructional role of AI shifts from delivering answers to facilitating deeper intellectual engagement, an approach closely aligned with constructivist principles emphasizing knowledge construction through interaction, reflection, and social negotiation.

Although research on artificial intelligence in education has expanded rapidly, several important gaps remain. First, most existing studies focus on general educational applications of GenAI, such as writing assistance, programming support, or personalized tutoring, whereas philosophy education, where critical inquiry and ethical deliberation are central learning objectives, has received comparatively limited attention (Zawacki-Richter et al., 2019). Second, previous research has primarily examined the effectiveness of individual AI tools rather than developing comprehensive instructional models that systematically integrate GenAI into established pedagogical frameworks such as PBL (Orozova & Angelova, 2025) . Third, despite recognition that instructional design determines the educational value of AI, few studies have investigated learners' and instructors' needs prior to designing AI-supported learning environments. Without systematic understanding of these needs, instructional models risk

misalignment with authentic teaching contexts and learner requirements.

To address these gaps, the present study aims to design and develop a constructivist Generative AI-enhanced Problem-Based Learning (GenAI-PBL) instructional model for undergraduate philosophy education in China. The study proceeds through two sequential phases: first, a needs analysis investigating students' and instructors' perceptions regarding the development of critical thinking, moral reasoning, and learning achievement within undergraduate philosophy courses; second, the development of an instructional model grounded in the needs analysis findings, constructivist learning theory, and PBL principles, subsequently refined through expert validation. This sequenced approach ensures that the proposed model is empirically informed by authentic learning needs and theoretically coherent with established pedagogical frameworks.

This study makes three contributions to the growing field of AI-supported higher education. It extends existing research by examining GenAI integration within philosophy education, a disciplinary context that has received limited scholarly attention. It proposes a theoretically grounded instructional model combining constructivist learning principles, PBL, and AI-supported cognitive scaffolding into a coherent pedagogical framework. By grounding model development in empirical needs analysis and expert validation, the study offers practical guidance for educators seeking to integrate generative AI into humanities education while preserving students' active engagement in critical inquiry and moral reasoning.

2. Literature Review

2.1 Generative Artificial Intelligence in Higher Education

Generative Artificial Intelligence (GenAI) has rapidly emerged as a transformative technology in higher education, creating new opportunities for personalized learning, adaptive feedback, and interactive knowledge construction. Unlike earlier AI applications that primarily supported information retrieval or automated assessment, contemporary large language models (LLMs) engage learners in contextual dialogue, generate explanations, and provide cognitive support during complex learning tasks (Kasneci et al., 2023; Dwivedi et al., 2023). Consequently, GenAI is increasingly regarded as a pedagogical tool capable of facilitating learner-centered education rather than merely improving efficiency.

Recent studies have shown that GenAI can enhance student engagement, self-regulated learning, and higher-order thinking when integrated into well-designed instructional activities (Crompton & Burke, 2023; Zawacki-Richter et al., 2019). Three pedagogical affordances of GenAI have been identified in the literature: dialogical affordance (engaging learners in extended questioning and dialogue), scaffolding affordance (providing adaptive feedback and cognitive support during inquiry), and generative affordance (producing explanations, counterarguments, and alternative perspectives) (Kasneci et al., 2023; Mollick & Mollick, 2023). Through these functions, AI systems encourage learners to clarify concepts, compare viewpoints, and reflect on their reasoning. However, researchers have warned that excessive reliance on AI-generated responses may reduce independent thinking and encourage superficial learning if instructional activities fail to promote critical evaluation (Kasneci et al., 2023; Selwyn, 2019). Real-world stakeholder analysis further highlights that many educators recognised GenAI's pedagogical promise but lack clear frameworks for discipline-specific implementation (Wu & Carroll, 2025).

These concerns are particularly relevant to philosophy education, where students are expected to construct logical arguments, evaluate competing perspectives, and justify ethical decisions rather than acquire factual knowledge. In this context, GenAI should function as a cognitive scaffold supporting inquiry and reflection instead of replacing human reasoning. Although educational applications of GenAI have attracted increasing scholarly attention, existing research has focused mainly on general higher education contexts—writing support, language learning, and programming education. Comparatively little research has examined systematic integration of GenAI into philosophy education through instructional models designed to develop critical thinking and moral reasoning (Orozova & Angelova, 2025).

2.2 Problem-Based Learning in Higher Education

Problem-Based Learning (PBL) is a learner-centered instructional approach that organizes learning around authentic, complex problems. Instead of receiving knowledge through lectures, students actively construct understanding by identifying problems, searching for relevant information, collaborating with peers, and reflecting on solutions. Grounded in constructivist learning theory, PBL emphasizes active inquiry, collaborative learning, and knowledge construction through meaningful experiences (Hmelo-Silver, 2004; Savery, 2019).

A substantial body of research demonstrates that PBL contributes positively to higher-order thinking, problem-solving ability, self-directed learning, and knowledge retention (Dolmans et al., 2016; Schmidt et al., 2011). By engaging students in inquiry and discussion, PBL encourages evaluation of evidence, integration of multiple perspectives, and application of theoretical knowledge to authentic situations. These characteristics make PBL particularly suitable for philosophy education, where learning requires argument analysis, ethical deliberation, and reflective judgment rather than concept memorization.

Despite these advantages, effective PBL implementation remains challenging. Students often require additional guidance when analyzing complex problems, organizing information, and sustaining productive discussions—particularly in disciplines involving abstract concepts such as philosophy (Hmelo-Silver et al., 2007). Research has distinguished three types of scaffolding needed in PBL: metacognitive scaffolding (supporting self-regulation and reflection), procedural scaffolding (guiding inquiry processes and task management), and conceptual scaffolding (clarifying key concepts and principles) (Belland et al., 2017). These forms of scaffolding are not always sufficiently available in conventional implementations. Systematic review evidence indicates that well-designed scaffolding within PBL settings can foster higher-order thinking and argument-building competencies, yet these forms of scaffolding are not always sufficiently available in conventional implementations (Azzaroiha et al., 2025).

Generative AI offers a promising solution to these challenges. Through adaptive feedback, questioning, and explanation generation, GenAI can support learners during different stages of problem solving while maintaining students' responsibility for independent reasoning. Rather than replacing PBL, GenAI has potential to strengthen its instructional effectiveness by facilitating inquiry, reflection, and collaborative knowledge construction. However, few studies have investigated how GenAI can be systematically integrated into a PBL framework specifically for philosophy education (Orozova & Angelova, 2025).

2.3 Critical Thinking in Higher Education

Critical thinking is widely recognized as an essential competency in higher education, enabling learners to analyze information, evaluate evidence, construct reasoned arguments, and make informed judgments. Rather than representing a single cognitive skill, contemporary research conceptualizes critical thinking as a multidimensional competence integrating cognitive abilities with dispositions such as open-mindedness, intellectual curiosity, systematic reasoning, and reflective judgment (Facione, 1990; Dwyer et al., 2023). Within philosophy education, critical thinking occupies a central position because students are expected not only to understand theories but also to critically examine assumptions, compare perspectives, and justify conclusions through logical argumentation (Bailin et al., 1999; Nussbaum, 2010). Crone and van Goch (2024) emphasised that critical thinking in humanities contexts extends beyond technical analytical skills to encompass open-minded moral-oriented dispositions toward inquiry.

In this study, critical thinking is operationalized through the dispositional framework of the California Critical Thinking Disposition Inventory—Chinese Version (CCTDI-CV). The instrument comprises seven dimensions: truth-seeking (willingness to pursue the most justified understanding); open-mindedness (readiness to consider alternative viewpoints); analyticity (tendency to apply reasoning and anticipate problems); systematicity (organized approach to complex issues); critical thinking self-confidence (trust in one's reasoning abilities); intellectual curiosity (intrinsic motivation to seek knowledge); and cognitive maturity (awareness that complex problems require contextual judgment) (Facione, 1992; Peng et al., 2004).

Recent studies indicate that learner-centered approaches, particularly inquiry-based and problem-based learning, contribute positively to critical thinking development by encouraging investigation of authentic problems, evidence evaluation, and collaborative discussion (Dolmans et al., 2016). Researchers have also explored GenAI's role in supporting critical thinking through adaptive questioning, explanation generation, and dialogic interaction (Kasneci et al., 2023). These functions may stimulate reflection and perspective comparison while providing timely cognitive support. However, scholars caution that inappropriate GenAI use may discourage independent reasoning if learners rely excessively on AI-generated responses without critical evaluation. Consequently, GenAI's educational value depends largely on instructional design that encourages questioning, interpretation, and justification rather than passive acceptance of outputs.

2.4 Moral Reasoning in Higher Education

Moral reasoning is a fundamental objective of philosophy education, enabling learners to recognize ethical issues, evaluate competing values, and justify decisions based on coherent moral principles. According to the neo-Kohlbergian perspective, moral reasoning involves analyzing ethical dilemmas, coordinating multiple

perspectives, and constructing reasoned moral judgments rather than following prescribed rules (Rest et al., 1999; Thoma, 2020). As Wienmeister (2025) observed that educational practice often suffers from a didactical gap: learning objectives for moral reasoning are frequently stated, yet concrete instructional exercises to foster such competencies remain underspecified. As contemporary societies become increasingly influenced by technological development and AI, ethical reasoning capacity has become more important in higher education.

Drawing upon Rest's Four-Component Model and subsequent refinements, moral reasoning competence in this study is conceptualized through five core elements: moral issue recognition (identifying ethical dimensions embedded in situations); perspective coordination (considering and integrating stakeholder viewpoints); norm principle differentiation (distinguishing rule-based compliance from principle-based justification); principle prioritization (prioritizing universalizable moral principles when rules or interests conflict); and justificatory coherence (maintaining logical consistency in moral arguments across competing considerations) (Rest et al., 1999; Thoma, 2020).

Philosophy courses develop moral reasoning through ethical case analysis, structured debate, and reflective dialogue. By examining real-world moral dilemmas, learners evaluate alternative viewpoints, balance conflicting values, and justify ethical decisions using logical arguments. Previous research shows that authentic problem-solving and collaborative discussion contribute positively to principled moral reasoning and ethical decision-making (Narvaez, 2002; Thoma et al., 2013).

Recent studies suggest that GenAI may further support moral reasoning by generating alternative perspectives, presenting counterarguments, and facilitating reflective dialogue (Baidoo-Anu & Owusu Ansah, 2023). However, researchers emphasize that AI should function only as learning support rather than moral decision-maker because ethical judgment ultimately requires human reflection and contextual understanding. Therefore, integrating GenAI into PBL may provide valuable cognitive support while preserving learners' responsibility for independent ethical deliberation.

2.5 Learning Achievement in Higher Education

Learning achievement represents the extent to which learners attain intended educational outcomes of an instructional program. In higher education, achievement extends beyond knowledge acquisition to include conceptual understanding, knowledge application, analytical reasoning, and transfer of learning to authentic situations (Dochy et al., 2003; Gijbels et al., 2005). Within the cognitive domain of Bloom's revised taxonomy, learning achievement encompasses remembering, understanding, applying, analyzing, evaluating, and creating—a hierarchy particularly relevant to philosophy education, where students are expected not only to recall concepts but also to apply them in analyzing ethical problems and constructing reasoned arguments (Anderson & Krathwohl, 2001; Nussbaum, 2010).

In philosophy education, achievement reflects students' capacity to understand philosophical concepts, analyze arguments, evaluate ethical issues, and apply philosophical reasoning to contemporary problems. Previous research indicates that PBL contributes positively to learning achievement by promoting active participation, meaningful knowledge construction, and long-term retention (Dolmans et al., 2016; Strobel & van Barneveld, 2009). AI-supported learning environments have also demonstrated potential for improving achievement through personalized feedback, adaptive support, and immediate guidance (Zawacki-Richter et al., 2019; Kasneci et al., 2023). Nevertheless, existing evidence suggests that achievement gains depend primarily on effective instructional design rather than technology use alone. In this study, learning achievement refers to students' mastery and application of philosophical concepts, to be measured through researcher-developed pre-test and post-test assessments aligned with course learning objectives.

3. Method

3.1 Research Design

This study employed a two-phase research and development (R&D) design to develop a Generative AI-Enhanced Problem-Based Learning (GenAI-PBL) instructional model for undergraduate philosophy education in China. Phase 1 comprised a needs analysis employing a mixed-methods approach to investigate students' and instructors' perceptions regarding the development of critical thinking, moral reasoning, and learning achievement. Phase 2 involved the systematic design of the instructional model based on needs analysis findings and theoretical frameworks, followed by expert validation to ensure content validity and pedagogical appropriateness.

The study was conducted within the Chinese higher education context, specifically targeting undergraduate philosophy and ideological-political education courses. These courses are compulsory across Chinese universities and serve as the primary setting for cultivating students' critical reflection and ethical reasoning (Ministry of Education of China, 2020). Three comprehensive universities in Yunnan Province—Chuxiong Normal University, Honghe University, and Wenshan University—participated in the needs analysis phase. Table 1 provides an overview of the two research phases, including participants, instruments, data analysis methods, and outputs.

Table 1. Overview of Research Phases, Instruments, and Data Analysis

Phase	Participants	Instruments	Data Analysis Methods	Output
Phase 1: Needs Analysis	Undergraduate students (n = 400) and philosophy instructors (n = 5)	Student questionnaire (5-point Likert scale); Semi-structured instructor interviews	Descriptive statistics (Mean, SD); Thematic analysis	Design requirements for GenAI-PBL model
Phase 2: Model Development & Validation	Subject-matter experts (n = 5)	Model evaluation form (IOC); Expert feedback	Mean scores; IOC analysis	Validated GenAI-PBL instructional model

3.2 Participants and Sampling Procedures

The target population for the needs analysis comprised undergraduate students enrolled in philosophy-related courses across the three participating universities. According to institutional statistics, total student enrollments were 13,651 at Chuxiong Normal University, 13,631 at Honghe University, and 14,189 at Wenshan University, yielding a combined population of 41,471 students.

A proportionate stratified random sampling strategy was adopted to ensure representative coverage across institutions. Each university constituted an independent stratum, with sample sizes allocated proportionally based on each institution's share of the total population. Based on Krejcie and Morgan's (1970) sample size determination table, a target sample of 400 students was established. Table 2 presents the population distribution and corresponding sample allocation across the three institutions.

Table 2. Distribution of Student Population and Sample Size

Institution	Student Population	Proportion (%)	Sample Size
Chuxiong Normal University	13,651	32.9%	132
Honghe University	13,631	32.9%	132
Wenshan University	14,189	34.2%	136
Total	41,471	100%	400

Additionally, five philosophy instructors from the same institutions were selected using purposive sampling. Selection criteria included substantial teaching experience (minimum five years), systematic understanding of the undergraduate philosophy curriculum, and practical expertise in course design and instructional implementation.

3.3 Research Instruments

Two primary research instruments were employed in Phase 1: a structured student questionnaire and semi-structured instructor interview protocols.

Student Questionnaire. A structured questionnaire was developed to investigate students' perceptions of current instructional practices and their expectations regarding GenAI integration within a PBL framework. The questionnaire comprised 26 items measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), organized into four conceptual dimensions derived from the theoretical framework: (a) need for enhanced cognitive and critical thinking skills (Items 1–6), (b) need for strengthened moral reasoning capacity (Items 7–12), (c) need for structured instructional scaffolding and adaptive feedback (Items 13–17), and (d) need for

engagement-oriented and interactive learning support (Items 18–23). Items 24–26 addressed AI ethics and risk perception.

Content validity was established through expert review by a panel of five specialists in philosophy education, educational technology, and research methodology. Experts evaluated item clarity, relevance, and representativeness using the Index of Item-Objective Congruence (IOC) method (Rovinelli & Hambleton, 1977). Items with IOC values of 0.67 or higher were retained. The finalized questionnaire demonstrated acceptable content validity (mean IOC = 0.84, range = 0.67–1.00). Internal consistency reliability was examined using Cronbach's alpha coefficient, with values of 0.70 or higher considered acceptable (Nunnally & Bernstein, 1994). The questionnaire achieved satisfactory reliability (overall $\alpha = 0.87$; dimension α ranging from 0.79 to 0.91).

Semi-structured interviews were conducted with philosophy instructors to obtain in-depth qualitative insights. The protocol focused on four core domains: (a) cognitive guidance challenges, (b) moral reasoning facilitation challenges, (c) instructional design and assessment support needs, and (d) professional readiness for GenAI integration. Semi-structured interviews were selected because they provide both structural guidance and flexibility, enabling consistency across participants while allowing elaboration of experiences and perspectives (Kallio et al., 2016). IOC validation by the same expert panel yielded acceptable content validity (mean IOC = 0.88).

In Phase 2, Expert Evaluation Form, a structured expert evaluation questionnaire was developed to assess the alignment and relevance of key model components: instructional objectives, problem-based learning activities, AI-supported learning functions, instructor facilitation strategies, and assessment mechanisms. Experts rated each component using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4 Data Collection Procedures

Quantitative data were collected through an online questionnaire administered via the Wenjuanxing platform. Standardized instructions and a uniform response procedure were employed. All participants completed the questionnaire voluntarily. The first page clearly informed participants of the research purpose, data usage, and anonymity measures. No personally identifiable information was collected. Data collection occurred over a four-week period.

Qualitative data were obtained through individual semi-structured interviews with five philosophy instructors. Interviews were conducted based on the predetermined protocol, ensuring structural consistency while allowing in-depth elaboration. Each interview lasted 45–60 minutes. All interviews were audio-recorded with informed consent and subsequently transcribed verbatim. To strengthen credibility, interview transcripts were returned to participants for member checking (Lincoln & Guba, 1985).

3.5 Data Analysis

Quantitative data from the student questionnaire were analyzed using descriptive statistical methods. Mean values (M) and standard deviations (SD) were calculated for each item and dimension. Table 3 presents the interpretation criteria for mean scores.

Table 3. Interpretation Criteria for Mean Scores (Five-Point Likert Scale)

Mean Score Range	Interpretation Level	Description
1.00 – 1.49	Very Low	Very low level of agreement or perceived need
1.50 – 2.49	Low	Low level of agreement or perceived need
2.50 – 3.49	Moderate	Moderate level of agreement or perceived need
3.50 – 4.49	High	High level of agreement or perceived need
4.50 – 5.00	Very High	Very high level of agreement or perceived need

Qualitative data from instructor interviews were analyzed using thematic content analysis following Braun and Clarke's (2006) six-phase framework: familiarization, initial coding, theme generation, theme review, theme definition, and report writing.

4. Results

4.1 Student Needs Assessment Results

A total of 400 undergraduate students from three Chinese universities completed the needs questionnaire, yielding a 100% response rate. Descriptive statistics were calculated for each of the four conceptual dimensions derived from the theoretical framework: (a) need for enhanced cognitive and critical thinking skills, (b) need for strengthened moral reasoning capacity, (c) need for structured instructional scaffolding and adaptive feedback, and (d) need for engagement-oriented and interactive learning support. Table 4 presents the mean scores and standard deviations for items assessing students' perceived needs for cognitive and critical thinking development.

Table 4. Students' Needs for Cognitive and Critical Thinking Skills

Item	Description	M	S.D.	Interpretation
1	I need more opportunities to analyze complex philosophical problems in depth.	4.21	0.74	High
2	I expect a GenAI-enhanced PBL model to help me improve logical reasoning and argument evaluation skills.	4.35	0.68	High
3	I hope to receive support in identifying logical fallacies and weaknesses in philosophical arguments.	4.08	0.82	High
4	I want more learning activities requiring critical comparison of different philosophical viewpoints.	4.19	0.71	High
5	I need help in critically evaluating the validity and reliability of AI-generated information.	4.42	0.65	High
6	I find it difficult to apply philosophical theories to real-life situations and need practice scenarios.	3.95	0.89	High

All six items received mean scores above 3.95, with the dimension mean of 4.20 within the "High" range. Item 5 received the highest mean (M = 4.42, SD = 0.65), indicating students are particularly concerned about critically assessing AI-generated content, aligning with Kasneci et al.'s (2023) observation that uncritical AI reliance may undermine analytical reasoning.

Table 5 presents results for items assessing students' needs for moral reasoning development. The dimension mean of 4.21 indicates consistently high perceived need. Item 9 received the highest mean (M = 4.33, SD = 0.69), suggesting students value personal ethical reflection—supporting Rest et al.'s (1999) emphasis on reflective engagement in moral development.

Table 5. Students' Needs for Moral Reasoning Capacity

Item	Description	M	S.D.	Interpretation
7	I need more training in analyzing real-world moral dilemmas.	4.28	0.72	High
8	I hope to explore multiple ethical frameworks when discussing moral issues.	4.15	0.78	High
9	I want learning activities that help me clarify my own moral values and reasoning process.	4.33	0.69	High
10	I expect dialogue-based learning to improve my ability to justify moral judgments.	4.09	0.81	High
11	I need help in identifying underlying moral conflicts in complex social issues.	4.24	0.73	High
12	I struggle when balancing conflicting moral principles and need guidance on prioritization.	4.18	0.76	High

Table 6 presents findings on students' expectations for structured support and feedback. The dimension mean of 4.23 reflects strong expectations for scaffolding. Item 15 received the highest mean (M = 4.45, SD = 0.64), confirming that feedback timeliness and quality are paramount, consistent with research on formative feedback in PBL (Belland et al., 2017).

Table 6. Students' Needs for Instructional Scaffolding and Feedback

Item	Description	M	S.D.	Interpretation
13	I need structured guidance when analyzing complex philosophical texts.	4.31	0.70	High
14	I hope to receive step-by-step prompts that gradually deepen my reasoning process.	4.38	0.67	High
15	I expect timely and constructive feedback during problem-solving activities.	4.45	0.64	High
16	I need personalized learning support based on my level of understanding.	4.12	0.79	High
17	I believe Generative AI can serve as an effective cognitive scaffold in philosophical inquiry.	3.87	0.92	High

Table 7 presents results for items assessing students' expectations for interactive learning experiences. The dimension mean of 3.99 falls within the "High" range. Item 22 received the highest mean (M = 4.40, SD = 0.66), indicating strong commitment to deep learning, a foundational PBL assumption (Dolmans et al., 2016).

Table 7. Students' Needs for Engagement-Oriented Learning Support

Item	Description	M	S.D.	Interpretation
18	I am more likely to actively participate in discussions in a GenAI-enhanced PBL classroom.	3.92	0.88	High
19	I would invest more effort in exploring philosophical problems in an interactive learning environment.	4.03	0.84	High
20	I believe a problem-based and AI-supported classroom would increase my interest in learning philosophy.	3.78	0.95	High
21	I prefer collaborative inquiry activities over traditional lecture-based instruction.	4.25	0.71	High
22	I aim to achieve a deep understanding of philosophical concepts rather than just memorizing them.	4.40	0.66	High
23	I feel anxious when expressing my own philosophical views and hope AI can provide a low-pressure practice space.	3.56	1.02	Moderate

Table 8. Students' AI Ethics and Risk Perceptions

Item	Description	M	S.D.	Interpretation
24	I am concerned that Generative AI might provide incorrect or biased information in philosophy learning.	4.34	0.70	High
25	I need guidance on how to use Generative AI ethically in academic work (e.g., avoiding plagiarism).	4.38	0.68	High
26	I am worried that relying on AI might hinder my own independent thinking capabilities.	4.29	0.74	High

4.2 Interview Results for Teacher Needs

Semi-structured interviews were conducted with five philosophy instructors to obtain in-depth qualitative insights into their instructional needs and challenges. Thematic analysis of the interview transcripts revealed four major themes aligned with the interview protocol domains: (a) cognitive guidance challenges, (b) moral reasoning facilitation challenges, (c) instructional design and assessment support needs, and (d) professional readiness for GenAI integration. As shown in Table 9, all five instructors (100%) reported challenges related to cognitive guidance and instructional design support, while four of five instructors (80%) identified challenges in moral reasoning facilitation and professional readiness for GenAI integration.

Table 9. Summary of Teacher Interview Themes

Item	Frequency	Representative Quote
Cognitive Guidance Challenges	5/5 (100%)	"Students can recite philosophical theories accurately in examinations, but when I ask them to critically evaluate an argument... they struggle significantly." (Instructor A)
Moral Reasoning Facilitation Challenges	4/5 (80%)	"The real challenge is helping students move beyond simply identifying which theory they prefer to actually constructing coherent moral justifications." (Instructor B)
Instructional Design and Assessment Support Needs	5/5 (100%)	"I'm open to integrating AI tools, but I don't have a clear framework for how to do this pedagogically." (Instructor E)
Professional Readiness for GenAI Integration	4/5 (80%)	"I've used ChatGPT myself for research, but I'm not confident about how to guide students in using it appropriately for philosophy learning." (Instructor C)

4.3 Proposed GenAI-PBL Instructional Model

Table 10. Overview of the Proposed GenAI-PBL Instructional Model

Phase	PBL Elements	GenAI Functions	Instructor Role
Pre-class: AI-Enhanced Scenario Triggering & Ethical Problematization	Problem presentation; Ethical questioning	Multi-perspective ethical simulation; Conceptual clarification; Structured prompting for value conflict identification; Preliminary argument mapping	Curates AI prompts; Sets inquiry boundaries; Ensures conceptual accuracy
In-class: AI-Enhanced Inquiry, Argumentation & Dialectical Facilitation	Inquiry-based exploration; Dialectical facilitation; Ethical reasoning development	Structured argument generation; Counterargument simulation; Logical coherence checking; Progressive moral justification prompting; hallucination detection, bias examination, and evidence-based evaluation of AI-generated claims	Dialectical moderator; Epistemic regulator; Challenges superficial reasoning; guides students in verifying AI-generated claims against credible sources, identifying potential bias, and distinguishing evidence-supported arguments from unsupported AI outputs.
Post-class: AI-Enhanced Critical Reflection & Metacognitive Consolidation	Critical reflection; Synthesis	Reflective prompting; Revision suggestions; Comparative analysis of reasoning evolution; Pattern recognition in ethical justification	Evaluative judgment; Process-oriented assessment; evaluates students' reasoning development, evidence use, response to counterarguments, and independent justification alongside the accuracy, coherence, and relevance of AI-assisted artifacts.

Based on the needs analysis findings and grounded in constructivist learning theory, PBL principles, and cognitive scaffolding research, the GenAI-PBL instructional model was systematically designed. Table 10 presents the three sequential phases with their corresponding PBL elements, GenAI functions, and instructor roles. To strengthen students' critical evaluation of AI-generated information, explicit epistemic verification scaffolding was incorporated into the in-class inquiry phase of the proposed GenAI-PBL model. Students are guided to identify potentially inaccurate claims or fabricated references, examine possible biases and missing perspectives, and verify AI-generated explanations against credible academic sources and relevant philosophical texts. Guiding prompts may include: "What evidence supports this AI-generated claim?", "Can the cited source be independently verified?", "Whose perspectives may be underrepresented in this response?", and "Does the conclusion follow logically from the available evidence?" Through these activities, GenAI is positioned not as an authoritative source of knowledge but as an object of critical inquiry. The instructor facilitates the verification process and requires students to justify whether, and to what extent, AI-generated content should be incorporated into their own arguments. Accordingly, under the 3 phases, we proposed our teaching model (see Figure 1).

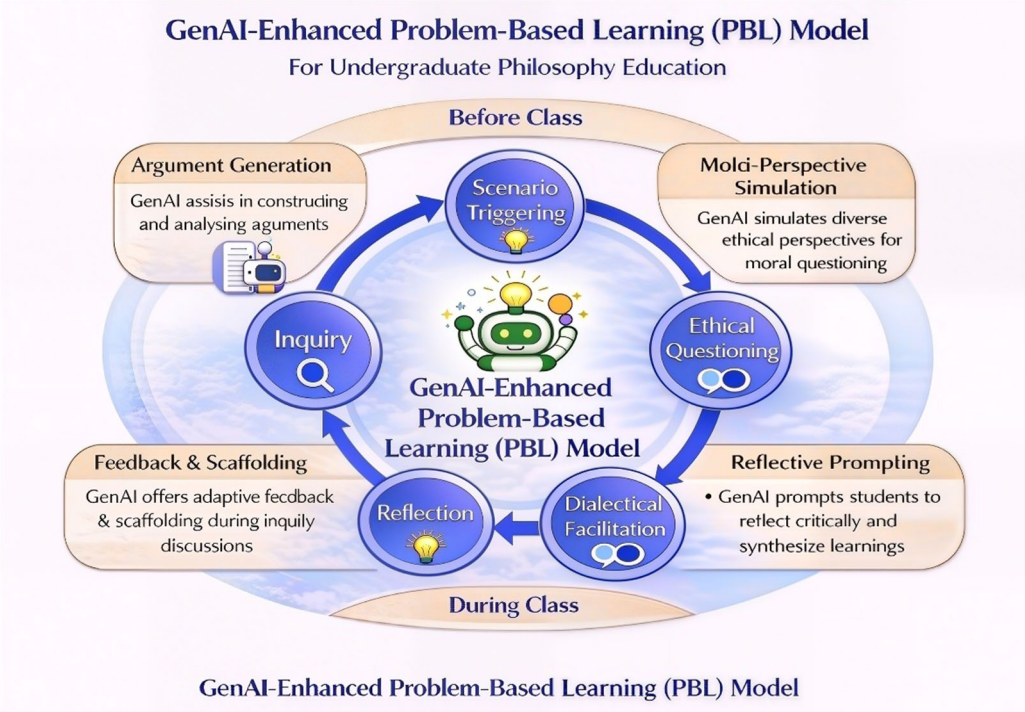


Figure 1. Proposed GenAI-Enhanced PBL Model

AI-enhanced developmental assessment distinguishes students' reasoning processes from the quality of their AI-assisted learning products. Process-oriented assessment focuses on how students identify problems, evaluate evidence, compare competing perspectives, respond to counterarguments, and revise their initial positions. Relevant evidence may include students' initial arguments, inquiry notes, records of AI-assisted revisions, reflective commentaries, and oral explanations of their reasoning. In contrast, artifact-oriented assessment examines the accuracy, logical coherence, relevance, and evidential support of the final products developed with AI assistance. Instructors should consider both dimensions when evaluating student learning, rather than treating the fluency or completeness of AI-generated outputs as direct evidence of students' competence. Students may also be asked to explain and defend their conclusions independently, thereby helping instructors determine whether AI-assisted revisions reflect genuine conceptual understanding and reasoning development. GenAI can support feedback and comparison across drafts, while the instructor retains responsibility for final evaluative judgments.

4.4 Expert Validation Results

A panel of five subject-matter experts evaluated the proposed GenAI-PBL instructional model. Table 11 presents the mean scores, standard deviations, and IOC values for each evaluated component. All eight components received

mean scores above 4.00, with IOC values above the acceptable threshold of 0.67. The overall model mean of 4.38 falls within the "Agree" range.

Table 11. Expert Validation Results for the GenAI-PBL Model Components

Component	M	SD	IOC	Interpretation
1. AI-Enhanced Scenario Triggering	4.60	0.55	0.87	Strongly Agree
2. AI-Enhanced Ethical Problematization	4.40	0.55	0.80	Agree
3. AI-Enhanced Inquiry Support	4.20	0.84	0.73	Agree
4. AI-Enhanced Argumentation Scaffolding	4.60	0.55	0.87	Strongly Agree
5. AI-Enhanced Dialectical Facilitation	4.40	0.89	0.73	Agree
6. AI-Enhanced Critical Reflection	4.60	0.55	0.87	Strongly Agree
7. AI-Enhanced Metacognitive Consolidation	4.20	0.84	0.73	Agree
8. AI-Enhanced Developmental Assessment	4.00	0.71	0.67	Agree

5. Discussion

The needs analysis reveals consistent alignment between student and instructor perspectives, confirming significant gaps in current philosophy instruction and strong demand for pedagogical approaches that systematically support higher-order thinking and moral reasoning.

Students reported high needs for cognitive support (M = 4.20), with the strongest endorsement for help in critically evaluating AI-generated information (Item 5, M = 4.42). This finding aligns with research indicating that while students recognize critical thinking as essential, they require explicit instructional scaffolding to develop analytical competencies systematically (Critical Thinking in the Humanities, 2024). Students' strong commitment to deep understanding (Item 22, M = 4.40) supports the appropriateness of PBL as a pedagogical approach, as systematic reviews confirm that PBL with structured scaffolding positively impacts critical thinking and higher-order reasoning (Lu, 2024; The Effect of Scaffolding Strategies, 2025). Students also demonstrated consistently high needs for moral reasoning support (Dimension Mean = 4.21), particularly for activities clarifying personal moral values (Item 9, M = 4.33). This finding is consistent with neo-Kohlbergian frameworks emphasizing that moral reasoning development requires reflective engagement with ethical dilemmas and structured opportunities to articulate moral positions (Rest et al., 1999; Thoma, 2020). The lower endorsement of dialogue-based learning (Item 10, M = 4.09) may reflect limited prior exposure to structured dialogical formats in Chinese philosophy courses.

All instructors reported difficulties guiding students' higher-order critical thinking, particularly in moving students beyond theoretical recitation to independent argument construction—corroborating research on PBL implementation challenges in humanities disciplines (Silver et al., 2007). Eighty percent identified challenges in facilitating moral reasoning development, consistent with research emphasizing that ethics teaching requires structured practice in perspective coordination and justificatory coherence (Moral reasoning skills, 2025). The universal instructor need for structured guidance in designing and assessing GenAI-enhanced instruction aligns with research on teacher readiness for AI integration, which identifies professional development as critical for effective implementation (Evolving Perspectives on Generative AI, 2025). Instructors' concerns about AI over-reliance echo broader scholarly warnings that unstructured GenAI use may encourage superficial learning and reduce independent reasoning (Kasneci et al., 2023; Selwyn, 2019).

These findings collectively suggest that successful GenAI integration into philosophy education requires both a coherent instructional model and sustained professional development addressing pedagogical and ethical dimensions of AI use.

6. Conclusion

This study developed and validated a Generative AI-Enhanced Problem-Based Learning (GenAI-PBL) instructional model for undergraduate philosophy education in China. Through a two-phase research design integrating needs analysis and expert validation, the study established that both students and instructors recognize significant gaps in

current philosophy instruction and strongly support pedagogical approaches that systematically cultivate critical thinking and moral reasoning. The proposed model, grounded in constructivist learning theory and PBL principles, operationalizes GenAI as a cognitive scaffold across three sequential phases: pre-class scenario triggering, in-class inquiry and dialectical facilitation, and post-class reflection and assessment. Expert validation confirmed the model's pedagogical appropriateness and content validity.

This study makes three primary contributions. Theoretically, it extends constructivist learning theory by conceptualizing GenAI as a cognitive scaffold within PBL, contributing to understanding of distributed cognition in AI-supported learning environments. Methodologically, it demonstrates a systematic approach to instructional model development grounded in empirical needs analysis and expert validation: a framework applicable to other disciplinary contexts. Practically, the study provides an empirically validated instructional model offering actionable guidance for educators, curriculum designers, and policymakers seeking to integrate generative AI into humanities education while preserving students' active engagement in critical inquiry and moral reasoning.

The findings are subject to certain limitations, including the regional focus of the needs analysis and reliance on self-reported data. Future research should implement the model in authentic classroom settings through quasi-experimental designs to evaluate its effectiveness on student learning outcomes. Comparative studies across disciplines and institutional contexts would further establish the model's transferability, and longitudinal research examining the sustained impact of GenAI-enhanced PBL on students' reasoning development over time would also be valuable. As GenAI technologies continue to evolve rapidly, ongoing investigation into their pedagogical integration remains essential for ensuring that instructional practices keep pace with technological advancements.

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Author Statements

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Author Contributions

Author contributions follow the CRediT (Contributor Roles Taxonomy). Use only the contributor roles applicable to this manuscript.

Conceptualization: Assoc. Prof. Sirirat Petsangsri, https://orcid.org/0000-0002-4828-1740

Methodology: Assoc. Prof. Jirarat Sitthiworachart, https://orcid.org/0000-0002-5750-6702

Formal analysis: Shujuan Zhao, https://orcid.org/0009-0007-6373-0106

Investigation: Shujuan Zhao, https://orcid.org/0009-0007-6373-0106

Writing – original draft: Shujuan Zhao, https://orcid.org/0009-0007-6373-0106

Writing – review & editing: Assoc. Prof. Sirirat Petsangsri, https://orcid.org/0000-0002-4828-1740

Supervision: Assoc. Prof. Sirirat Petsangsri, https://orcid.org/0000-0002-4828-1740

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