

# A Cluster-Based Approach to Optimize AI-Generated Case Study in University Logistics Courses

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**Abstract:** This paper investigates the implementation and effectiveness of AI-assisted case teaching within university logistics education, addressing critical gaps between technological potential and pedagogical practice. Through a comprehensive survey of logistics majors at Shenzhen Polytechnic University, combined with K-means clustering analysis, this research identifies three primary challenges: the predominance of entertainment-focused case selection undermining educational objectives, significant limitations in the timeliness and contextual depth of AI-generated materials, and insufficient inspirational impact on student learning. The clustering analysis further reveals three distinct student profiles, enthusiastic adopters, cautious participants, and resistant traditionalists, highlighting varied receptivity to AI-assisted methodologies. Root cause analysis demonstrates that these issues stem from inherent tensions in case teaching between authenticity and argumentation, divergent teacher competencies in curating and guiding AI-generated content, and widespread lack of student subjective initiative. In response, this paper proposes a structured framework for enhancing teaching effectiveness, emphasizing reality-grounded case design, integration of timely socio-industrial concerns, inclusive participatory mechanisms, and improved inspirational scaffolding. The findings underscore that successful AI integration requires moving beyond technological novelty to foster pedagogical synergy, where AI tools augment rather than replace critical educator roles. This study contributes to the evolving discourse on AI in education by providing empirical evidence and strategic insights for optimizing case-based learning in specialized vocational disciplines.

**Keywords:** AI-assisted case study, logistics, K-means clustering

## 1. Introduction

Case-based learning is widely recognized as a student-centered instructional approach that bridges theory and practice by immersing students in realistic problem-solving scenarios [1]. The integration of Artificial Intelligence (AI) into education is transforming traditional pedagogical models, offering new possibilities for personalized and interactive learning experiences [2][3]. The emerging paradigm of AI-assisted education represents a significant shift, moving beyond the use of technology as a simple tool towards a deeper, collaborative integration that can reshape educational goals, content, and methods [4]. Within this context, AI-assisted case teaching leverages intelligent tools to create dynamic and engaging learning environments, aiming to foster not only knowledge acquisition but also higher-order thinking skills [5].

AI-assisted case teaching is an instructional approach that presents students with specific problem-based scenarios to stimulate critical thinking and in-class discussion, ultimately helping them master knowledge and evoke intellectual and emotional engagement. To investigate the challenges in the implementation of case teaching in logistics courses at the university level, we conducted a questionnaire survey targeting 500 logistics majors at Shenzhen Polytechnic University. The survey aimed to collect authentic data for analyzing existing issues.

The integration of AI tools into case-based learning in logistics-related courses not only enhances students' understanding and application of knowledge but also enlivens the classroom atmosphere by highlighting the relevance of course materials to real-life situations. This helps achieve the instructional goal of empowering students to become active participants in their learning. To ensure data authenticity, the survey was administered anonymously, with respondents asked to answer based on their genuine perceptions. Out of 500 questionnaires distributed, 472 were returned, and 454 responses were valid.

Thus, the survey achieved a response rate of 94.4%, a validity rate of 90.8%, and an adoption rate of 90%.

## 2. Survey Design

As demonstrated in the Figure 1, this section begins by investigating the types of AI-generated cases used by logistics teachers, including discussion, reading, video, studio and presentation, is investigated; secondly, analyzing influencing factors; finally, designing the questionnaire content.

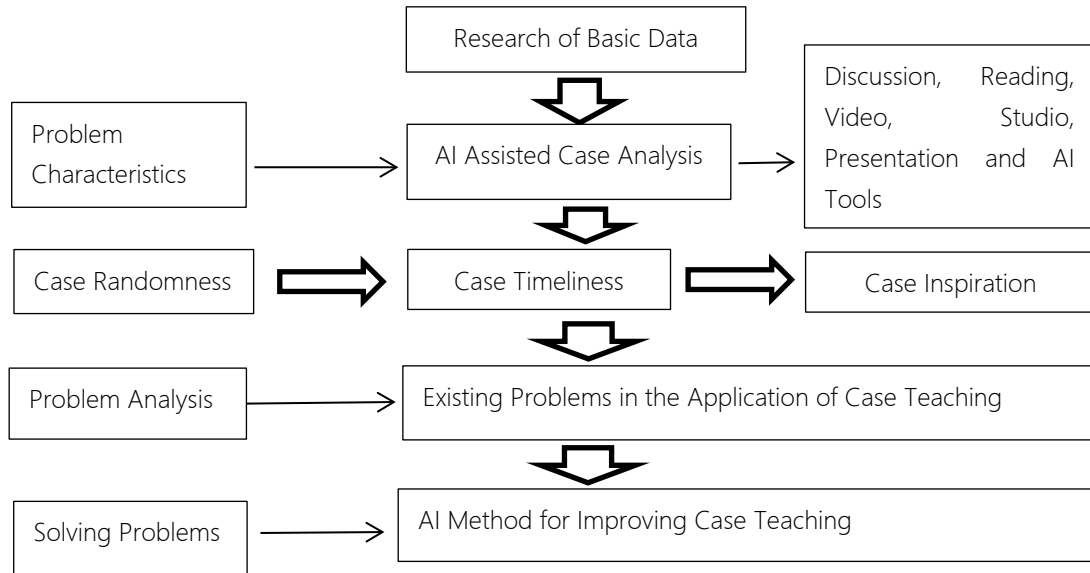


Figure 1: Survey Design and Implementation Framework

This survey plans to distribute questionnaires on a small scale and use a fine-tuned large language model (LLM), which is developed based on the ChatGLM, to design the questionnaires and collect survey data. The LLM uses the ChatGLM and the fine tuning method employs the Low-Rank Adaptation.

### 2.1. Randomness of AIGC Case Choices

As shown in Figure 2, corporate cases, textbook supplements, and news articles are commonly used as teaching materials. However, several issues exist in the selection of AIGC-supported cases.

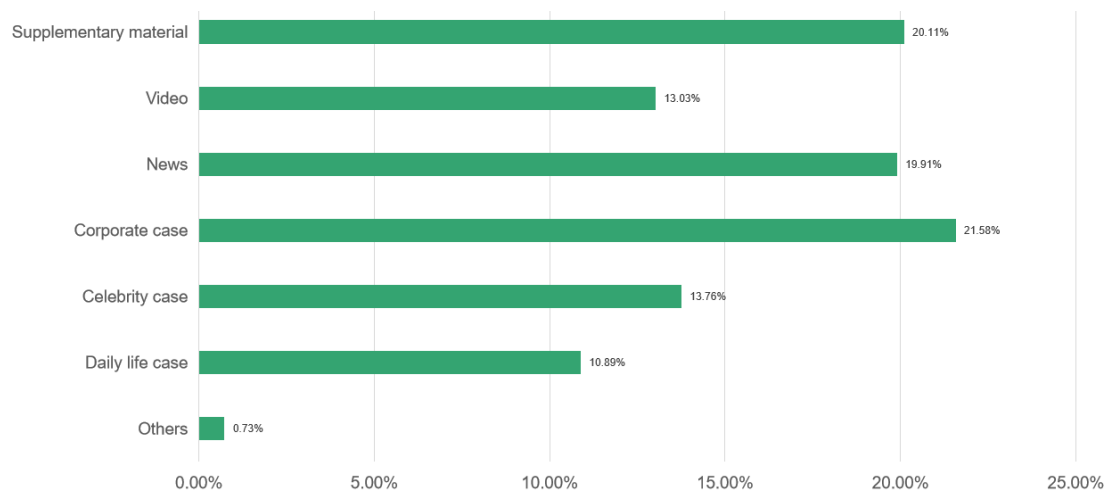


Figure 2: Distribution of AI-Generated Case Types in Logistics Education

One problem is that some lecturers, in an effort to create a relaxed classroom atmosphere, select case materials from entertainment or sports content based on student preferences. While such cases may be engaging, they tend to prioritize entertainment over educational value, which undermines instructional effectiveness. Students may distrust AI-generated cases if perceived as less authentic, highlighting the need for transparency in case sources [6].

Additionally, some chosen cases are not well-aligned with the textbook knowledge points. Although they may capture students' attention, they can divert focus away from learning objectives and diminish knowledge acquisition. To force a connection between the case and the course content, teachers may alter cases arbitrarily, a practice that not only compromises the authenticity of the case but also reduces student engagement.

Furthermore, these types of courses typically organize and explain knowledge from four dimensions: economic life, professional life, cultural life, and philosophy of life. Textbooks are generally structured at four levels: unit, class, frame, and subject, with content arranged in a logical progression from simple to complex. However, in the case selection process, the absence of a clear internal logical structure among knowledge points can easily lead to issues in teaching coherence and quality.

This misalignment between engagement and educational value highlights a common pitfall when introducing new technologies into the classroom without a strong pedagogical framework. This phenomenon can be understood through the lens of AI in education, where the initial appeal of the technology may overshadow its substantive learning objectives [7]. AI-generated cases in logistics courses can enhance student engagement, but their educational value depends on alignment with learning objectives and pedagogical design [8]. Furthermore, the selection of entertaining but irrelevant cases fails to adhere to the core principle of effective case teaching, which is to ground learning in realistic and relevant contexts that are close to students' lives and the subject matter [5][9]. A systematic review of AI in higher education cautions that without clear pedagogical leadership from educators, technology applications risk being driven by convenience rather than sound instructional design [3].

## 2.2. Case Timeliness

Figure 3 illustrates teachers' preferred approaches to using AIGC-generated cases. When incorporating case studies into new lessons, teachers often express concern about the timeliness of AI-generated case materials. They tend to utilize AIGC tools to present multimedia materials—such as videos, audio clips, and animations—that depict scenarios or convey facts visually and audibly. Following the presentation, students are encouraged to discuss and share their opinions.

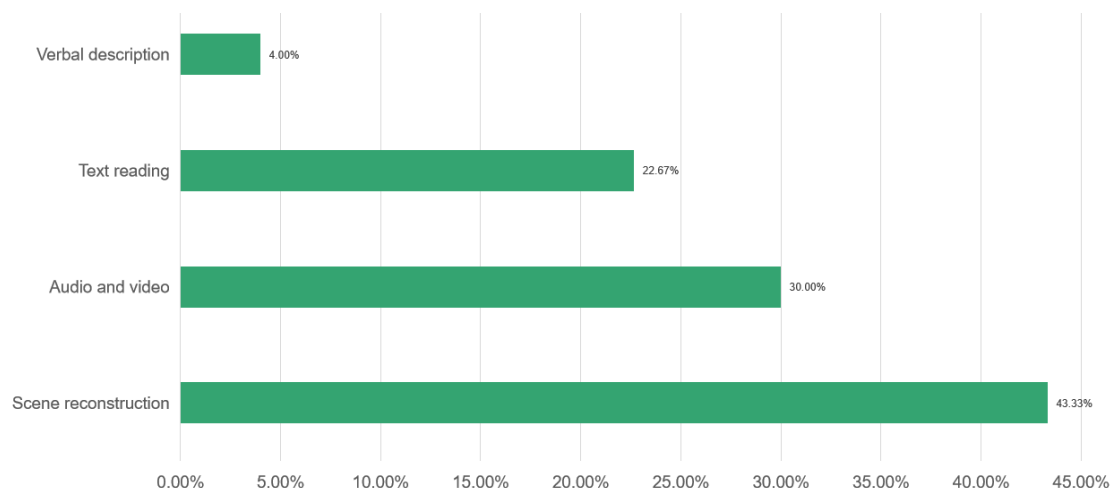


Figure 3: Instructional Approaches for AI-Assisted Case Implementation

However, this form of case delivery tends to focus predominantly on laying out the factual components of the case while overlooking students' intrinsic engagement and learning nature. Teachers typically prefer to maintain control over the pacing of the case presentation, allowing them to pause, reiterate, or elaborate on content based on students' comprehension. Nonetheless, the effectiveness of such teaching can be easily compromised by the timeliness of cases, which is partly dependent on the lecturer's ability to update materials. Moreover, the current limitations of AIGC in generating

historically accurate or contextually rich video data also diminish the persuasive power and appeal of case-based teaching to some extent. This challenge underscores that AI is not a panacea. An over-reliance on technology to generate context can lead to a dilution of the authentic, often messy, realities that make case studies truly valuable for critical discussion [10]. Therefore, the teacher's role in curating, adapting, and contextualizing AI-generated content remains paramount to ensure its educational validity and timeliness [3][16]. Virtual simulations using AI tools, such as warehouse management scenarios, provide experiential learning opportunities that bridge theory and practice in logistics education [12].

### **2.3. Case Inspiration to Students**

Cases are commonly used in compulsory logistics courses. When a logistics course focuses solely on introducing prominent figures and major companies in the logistics industry, such cases can be directly applied and are often closely related to the textbook content. However, this approach may undermine the inspirational value of the case study method.

Furthermore, issues exist in the design and organization of case content in textbooks. For instance, there is often a lack of discussion and exploratory elements in sections related to knowledge extension and humanistic perspectives, while questions tend to be closed-ended, limiting opportunities for follow-up student discussion.

Finally, the cases selected by lecturers are often straightforward, allowing students to arrive at the correct answer based on existing value judgments. As a result, it becomes difficult to encourage in-depth exploration of root causes.

## **3. The Causes of Problems in Case Teaching**

### **3.1. Specialties of Case Teaching Method**

The case teaching method holds significant importance in university logistics courses. This importance is evident primarily in two aspects:

First, the presentation of AI-generated cases normally have more considerations. An effective case-based pedagogy should prioritize hands-on and experiential learning, engaging students through activities such as role-playing and case reenactments. Although such interactive formats are highly instructive, they also impose greater demands on students. In practice, however, operational constraints often hinder the implementation of case presentations to their full vividness and depth. Ethical concerns, such as bias in AI-generated content and the dilution of academic rigor, require careful oversight when deploying cases in sensitive subjects like logistics ethics [13].

Second, case preparation and adaptation pose distinct challenges. Before introducing a AI-generated case in the classroom, lecturers must refine it to maintain authenticity while enhancing its analytical structure. Yet a inherent tension arises: emphasizing factual accuracy may dilute the logical argument, whereas strengthening the argument risks compromising the case's realism. This duality between authenticity and reasoning inevitably affects the efficacy of the case-based approach. This fundamental tension is not new but is accentuated by the use of AI. Effective case teaching has always required a careful balancing act, where the lecturer must refine the case to maintain its core truth while enhancing its pedagogical structure for specific learning objectives [5][14]. The survey results, which show students preferring cases for their interest rather than their theoretical value, reflect a core dilemma in pedagogy: the effort to increase student engagement can sometimes blur the focus on academic rigor [15][16].

As illustrated in Figure 4, survey responses indicated that most interviewees approved of the cases selected by lecturers. However, their preference was frequently based on the cases' intrinsic interest rather than their utility in facilitating the understanding of theoretical knowledge. This reflects a core dilemma in case teaching: efforts to enhance student engagement may inadvertently obscure the emphasis on academic rigor.

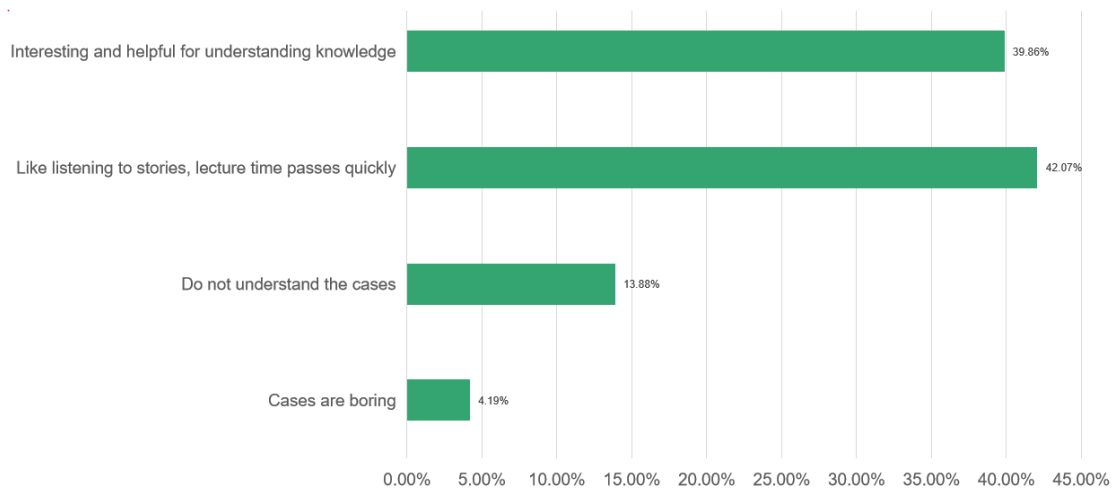


Figure 4: Student Preferences and Perceptions of Case Quality

### 3.2. The Quality of Teachers Varies

While AI assists primarily with data generation, the lecturer retains the leading role in the case teaching method. Their selection of cases and their control over the teaching process determine whether the desired instructional outcomes can be achieved. The following issues are commonly observed in the application of case method by logistics teachers:

First, teachers often lack clarity regarding the actual impact of the case method. While it can help overcome key teaching challenges and deepen students' understanding, it also has the potential to enhance their emotional attitudes and values. However, in actual teaching practice, many teachers overlook this affective learning objective. In case selection, some deliberately cater to students' preferences when designing classroom content. This one-sided pursuit of an engaging classroom atmosphere can result in a reversal of priorities, where entertainment overshadows educational substance. Teacher training programs must address competencies in AI tool curation and pedagogical adaptation to avoid misalignment between technology and learning goals [17]. NLP tools can analyze student reflections on cases, providing teachers with data to refine case design and address learning gaps [18].

Second, teachers may misapply the case method. While fresh, real-world cases can engage students and stimulate thinking, effective guidance is essential to steer students toward the intended learning direction. Case adaptation is crucial to bridge the gap between the case context and the students' own experiences, thereby triggering reflection and emotional connection. Yet for convenience, some teachers directly use trending online news as cases without adequate processing or contextualization. Such materials are often controversial and, if introduced without proper adaptation or guidance, may lead to student confusion and disrupt the planned teaching process.

Finally, teachers often neglect the summarization phase. Effective summarization should not only clarify the educational insights from the case but also redirect students' focus back to the learning objectives. While many teachers use cases to encourage diverse thinking, they frequently fail to integrate summary segments that transition smoothly to subsequent activities. This omission reduces the coherence and overall effectiveness of the lesson. This deficiency highlights a gap in leveraging the full power of the case method. The transition from exploration to consolidation is critical. As emphasized in modern pedagogical models like the "Human-AI Collaboration" framework, the teacher's role as a guide who helps students synthesize insights and connect discussions back to core concepts is irreplaceable [5]. UNESCO's framework for AI literacy also underscores that educators must be equipped to facilitate meaning-making from technology-mediated interactions [19].

### 3.3. Students Lacking Subject Consciousness

Case method refers to the use of story-based scenarios to evoke students' emotions, stimulate their motivation to learn, and inspire practical action. However, a lack of subjective initiative among students—resulting in low enthusiasm for participating in case-based learning—constitutes one of the method's key challenges. According to survey data, a considerable number of students are reluctant to

engage in case method activities. Among them, 40.75% cite overwhelming academic workloads as the reason for being unable to devote time to case preparation. Another 18.94% express hesitation due to a strong reliance on teachers and textbooks, showing little confidence in shifting their learning approach. Additionally, 4.41% explicitly reject the idea of case selection, believing it to be the teacher's responsibility rather than their own.

Without dialogue, there can be no real communication or true education. Dialogue and communication are fundamental to the process through which teachers impart knowledge. If students resist this form of teaching, even the most well-intentioned educational exchanges become ineffective. Adaptive AI systems can tailor case complexity based on student performance, addressing individual learning gaps in logistics courses [20].

Moreover, university students today already face considerable academic pressure. Courses such as logistics are often perceived as "relaxed" or "easy," with case materials sometimes regarded as supplementary stories of little practical value. While students ought to be the central agents in the classroom, without a sense of subjective agency and active involvement, the course's intended educational outcomes are unlikely to be achieved.

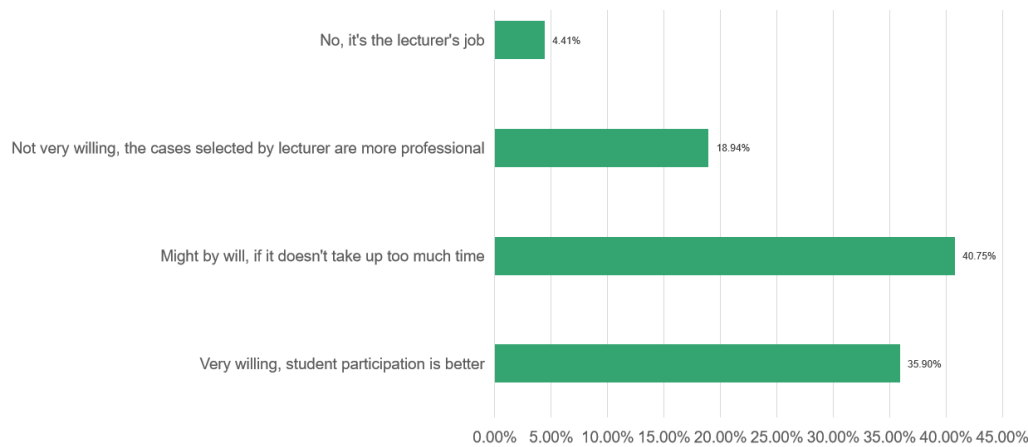


Figure 5: Student Attitudes towards Collaborative Case Selection

### 3.4. K-means Cluster Analysis of Data

This paper conducts a K-means clustering analysis on the survey data collected from 454 valid responses. This unsupervised machine learning approach allows us to identify natural groupings among students based on their perceptions and experiences with AI-generated case studies [11].

The clustering analysis utilized responses from key survey questions addressing various dimensions of AI-assisted case teaching, including perceived educational value of AI-generated cases, level of student engagement during case discussions, timeliness and relevance of case materials, inspiration and critical thinking stimulation and technical quality of AI-generated content [15].

The data are normalized by min-max scaling. The optimal number of clusters was determined through the elbow method, which identified  $k=3$  as the point where the within-cluster sum of squares (WCSS) began to plateau significantly. The algorithm is implemented in Python. The following is the initial parameter settings [16].

```
case_study_kmeans = KMeans(
    n_clusters=3,      # Number of clusters (k)
    init='k-means++', # Smart initialization
    max_iter=300,     # Maximum iterations
    tol=1e-4,         # Tolerance for convergence
    random_state=42   # Reproducibility
)
```

The objective function of AI-assisted case teaching data is implemented as follows.

case\_study\_wcss = case\_study\_kmeans.inertia\_

The distance update function is coded as follows.

for i in range(case\_study\_kmeans.n\_clusters):

    cluster\_points = X[labels == i]

The squared Euclidean distance between a case study data point  $\phi(x_i)$  and a cluster centroid  $\mu_h$  in the feature space can be computed using the kernel:

$$\|\phi(x_i) - \mu_h\|^2 = K(x_i, x_i) - \frac{2}{n_h} \sum_{\phi(x_j) \in S_h} K(x_i, x_j) + \frac{1}{n_h^2} \sum_{\phi(x_j), \phi(x_m) \in S_h} K(x_j, x_m)$$

where  $n_h$  is the number of points in cluster  $h$ , and  $S_h$  presents the set of points in cluster  $h$ . Then the program runs to minimize the kernel-based distance.

The K-means algorithm partitioned the student population into three distinct clusters, each representing unique patterns of interaction with AI-assisted case teaching.

#### (1) Enthusiastic adopters

This group demonstrated high appreciation for AI-generated cases, particularly valuing their timeliness and real-world relevance. Students in this cluster reported strong engagement levels and perceived the cases as significantly enhancing their understanding of logistics concepts. They showed particular enthusiasm for cases incorporating current industry trends and technological developments.

#### (2) Cautious participants

The largest cluster exhibited moderate satisfaction with AI-assisted case teaching but expressed concerns about the depth and analytical rigor of AI-generated materials. These students appreciated the interactive nature of case discussions but desired more structured guidance from instructors and clearer connections to theoretical frameworks.

#### (3) Resistant traditionalists

This segment preferred traditional teaching methods and expressed skepticism toward AI-generated cases. They perceived the cases as lacking authenticity and depth, with some respondents noting concerns about the potential for AI biases in case selection and development.

## 4. Improve the Effectiveness of Case Teaching

To address the identified challenges and harness the full potential of AI-assisted case teaching, it is imperative to develop strategies grounded in sound pedagogical principles. The following recommendations are informed by both the classic tenets of effective case-based learning [5][9] and emerging insights on the integration of AI in education [2][16]. The goal is to move beyond using AI as a mere novelty and towards its strategic application as a tool to enhance, rather than replace, the fundamental elements of good teaching.

### 4.1. Improve pertinence based on reality

Lecturers should use cases to ground in real-life contexts. The primary goal of moral education in university logistics courses is to cultivate ethical understanding through everyday experiences. Therefore, case selection must adhere to the principle of "closeness to reality, life, and students", that is, case materials should be relatable to students' lived experiences, socially relevant, and logically coherent. Combining AI with blockchain can verify the authenticity of logistics case data, enhancing trust and relevance in case-based assessments [21].

### 4.2. Combine the latest public concerns to improve case timeliness

In our rapidly changing world, university teachers must be adept at gathering and processing information. Their role involves curating timely social issues and trends to develop teaching cases, while also ensuring these materials meet practical pedagogical demands. Importantly, educators must transcend the mere pursuit of student engagement, avoiding the use of light-hearted entertainment or gossip. Every current event or trend selected for the classroom must be rigorously evaluated to affirm

its consistency with socialist core values and its contribution to the core goals of the logistics curriculum. Gamified AI simulations, such as optimizing supply chains for sustainability, make complex logistics concepts tangible and socially relevant [22].

#### ***4.3. Explore the potential of students and encourage them to join***

The case method is a heuristic teaching approach that engages students in classroom discussion by presenting them with specific educational scenarios involving problems or dilemmas. At its core, it emphasizes guided discovery and active learning. Therefore, when introducing cases, teachers should strive to create an equal and natural communication environment, allowing students to immerse themselves in the scenario and learn through subtle yet meaningful engagement. AI-facilitated peer feedback during case discussions provides immediate insights, helping students refine their logistics solutions iteratively [23].

However, a common issue in current practice is that some teachers tend to focus only on high-achieving students while neglecting those who perform poorly—a phenomenon sometimes referred to as "awarding the top 10." This approach is ineffective in encouraging broad participation. It is essential for teachers to abandon the misconception that classroom performance should be the sole criterion for attention. Instead, they should recognize that every student is a main body of the class and ensure that each has the opportunity to contribute in discussions. Involving students in co-creating AI-generated cases increases ownership and aligns cases with their lived experiences, boosting engagement [24]. AI scaffolding tools, such as hint systems for case analysis, reduce cognitive load for low-achievers without compromising challenge [25].

#### ***4.4. Improve the inspiration of case***

The effective use of the case method requires teachers to articulate specific teaching purposes and create a dynamic for equal interaction with students. Central to this approach is adapting to students' ideological characteristics, facilitating their alignment with the principles of ideological and moral development while satisfying learning objectives. This requires following the established teaching methodologies of logistics education to ensure the theoretical coursework meets student needs, thereby achieving complete pedagogical integration. Ultimately, the inspiration derived from a case is a measure of its success in stimulating higher-order thinking. AI-assisted tools show significant promise in creating immersive and complex scenarios that challenge students [26]. However, as proposed by the "Human-AI Collaboration" model, the ultimate aim should be to use these tools to foster an environment of "wisdom inquiry," where students are guided to ask deeper questions and develop more nuanced understandings [5]. This aligns with the broader vision for AI in education: to augment human intelligence and create more meaningful, inspiring learning experiences for all students [2][19]. AI debate platforms that simulate supply chain dilemmas encourage students to analyze trade-offs, fostering critical thinking beyond static case studies [27]. AI-supported collaborative case solving improves team-based decision-making in logistics, mirroring real-world industry practices [16].

### **5. Conclusion**

This study has systematically investigated the implementation and effectiveness of AI-assisted case teaching in university logistics courses, revealing both the significant potential and substantial challenges of this emerging pedagogical approach. Through empirical survey data from 454 logistics majors and subsequent K-means clustering analysis, our research provides nuanced insights into how AI technologies are transforming case-based learning in specialized vocational education.

The findings demonstrate that while AI-assisted case teaching offers promising opportunities for creating dynamic learning environments, its effectiveness is frequently compromised by three critical issues: the tendency to prioritize entertainment value over educational objectives in case selection, limitations in maintaining case timeliness and contextual richness, and insufficient inspirational impact on student learning. The clustering analysis objectively delineates three distinct student profiles with markedly different receptivity to AI-assisted methodologies—enthusiastic adopters, cautious participants, and resistant traditionalists. This segmentation reveals that student responses to AI-generated cases are far from homogeneous, necessitating differentiated teaching strategies.

Our analysis traces these challenges to fundamental sources: the inherent tension in case teaching methodology between authenticity and argumentation, significant variations in teacher competency for

curating and guiding AI-generated content, and a pervasive lack of student subjective initiative. Particularly noteworthy is the discrepancy revealed between student preferences for interesting cases and the need for theoretical depth, as shown in Figure 4, highlighting the delicate balance educators must maintain between engagement and academic rigor.

In response to these challenges, this study proposes a comprehensive framework for enhancing AI-assisted case teaching effectiveness, emphasizing four strategic dimensions: contextualized and reality-grounded case selection, integration of timely socio-industrial concerns, inclusive participatory mechanisms that address diverse student needs, and inspirational scaffolding that stimulates higher-order thinking. The implementation of these strategies must account for the varied student profiles identified through clustering analysis, ensuring that pedagogical approaches are tailored to different learning preferences and engagement patterns.

The strong student interest in collaborative case selection, as evidenced in Figure 5, underscores the importance of adopting co-creative approaches that enhance ownership and relevance. This finding aligns with our broader conclusion that successful AI integration requires moving beyond technological implementation to foster pedagogical synergy, where AI tools augment rather than replace the critical role of educators as learning facilitators.

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