



Exploring the Application of Knowledge-Enhanced Large Language Models in Automotive Marketing Education: A Case Study of ERNIE Bot

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ABSTRACT

With the rapid evolution of intelligent and electric vehicle technologies, the automotive industry faces significant transformation, especially in autonomous driving, connected systems, and global market integration. This shift has heightened the demand for skilled automotive marketing professionals equipped with both practical expertise and cross-cultural competence. This study explores the application of Baidu's ERNIE Bot as a knowledge-enhanced large language model in automotive marketing education. Focusing on its capabilities to innovate teaching content, optimize instructional methods, expand virtual training, and enhance cross-cultural sensitivity, we investigate ERNIE Bot's effectiveness in preparing students for global industry challenges. Case studies illustrate ERNIE Bot's role in guiding students through culturally tailored virtual marketing scenarios, emphasizing the importance of cultural adaptation in customer engagement and international sales. The findings suggest that knowledge-enhanced language models not only enrich educational content but also improve students' practical and global marketing skills, offering a valuable tool for reforming vocational education in automotive marketing.

Keywords:

Knowledge-enhanced large language model; automotive marketing education; automotive intelligence and electrification; ERNIE bot; vocational education

Received: 7 Oct. 2024

Revised: 11 Nov. 2024

Accepted: 20 Nov. 2024

Published: 31 Dec. 2024

1. Introduction

In recent years, with the rapid development of technologies such as artificial intelligence, big data, and cloud computing, the automotive industry has accelerated its shift toward intelligence and electrification. The trend toward intelligence is primarily reflected in advancements in autonomous driving, smart connected systems, and in-car intelligent entertainment, which have transformed automobiles from traditional means of transportation into multifunctional intelligent mobile spaces that integrate travel, entertainment, and daily life [1]. Electrification, on the other hand, refers to the rise of new energy vehicles (NEVs), with electric vehicles (EVs) being the most prominent example. Powered by clean energy, these vehicles not only reduce environmental pollution but also improve energy efficiency, marking a crucial direction for the future development

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of automobiles [2]. As shown in Figure 1, in recent years, governments around the world have introduced various policies, such as purchase subsidies, tax incentives, and charging infrastructure development [2], to promote the growth of the new energy vehicle industry. As a result, the production and sales of new energy vehicles, represented by electric vehicles, have been steadily increasing in the global automotive market, with market penetration rates continuously rising. Against this backdrop, China's automotive industry has experienced rapid growth, driven by a combination of policy support, technological innovation, and market demand. In August 2024, the monthly sales of new energy vehicles in China reached 1.02 million units, with a market share of 51%. NEVs have now become a major component of the automotive market. The advancement of intelligence and electrification in the automotive industry, along with the implementation of China's automotive globalization strategy, has brought unprecedented development opportunities for vocational colleges specializing in automotive marketing. On one hand, the expanding market for NEVs and the application of intelligent technologies have sharply increased the demand for specialized talent in automotive marketing, providing graduates with extensive employment opportunities [6-9]. On the other hand, the internationalization strategies of automotive brands require marketing professionals to possess a global perspective and cross-cultural communication skills, presenting an opportunity for the automotive marketing curriculum to undergo significant reform and improve educational quality [10]. However, despite the rapid transformation of the automotive industry, a clear research gap remains in understanding how knowledge-enhanced large language models can specifically contribute to automotive marketing education. This study aims to address this gap by providing an in-depth analysis of the application of ERNIE Bot in this context [11]. First, the content and methods of automotive marketing education must keep pace with industry developments by continuously updating the curriculum to include knowledge related to intelligent and electric vehicles, as well as emerging marketing techniques such as cross-border e-commerce and digital marketing. Second, students must not only acquire a solid foundation of theoretical knowledge but also develop practical skills and innovative thinking, enabling them to navigate and adapt to the complexities of a rapidly changing market environment [12-14]. Lastly, as Chinese automotive brands expand internationally, cultivating students' global competitiveness to excel in the global marketplace remains a major challenge for automotive marketing education [15,16].

In recent years, global interest and investment in artificial intelligence (AI) technology have reached unprecedented levels. As a key driving force behind the new wave of technological revolutions and industrial transformations, AI is profoundly reshaping various sectors of human society [17,18]. The deployment of knowledge-enhanced large language models (LLMs), such as ChatGPT, Claude, and Gemini, has enabled the general public to leverage AI to enhance efficiency and creativity in both learning and work [19]. In China, many people use Baidu's ERNIE Bot, a platform with similar functions to ChatGPT [20]. ERNIE Bot features capabilities such as knowledge enhancement, retrieval enhancement, conversational improvement, and image recognition, providing new insights and opportunities for educational innovation [21]. Recently, advancements in AI, particularly in the development of LLMs, have significantly impacted the educational sector. Studies by Malik *et al.*, [22] and Neves *et al.*, [18] highlight AI's potential to enhance educational content delivery, personalize learning, and improve engagement across disciplines. These studies demonstrate how AI-driven tools can assist in dynamic knowledge retrieval, adaptive learning environments, and real-time feedback, thus supporting educators and learners in achieving better outcomes. However, most existing research has focused on general applications in fields like computer science, language learning, and business education, while the specific benefits and

challenges of applying these technologies to automotive marketing education remain underexplored.

In the context of automotive marketing education, the potential of knowledge-enhanced large language models is substantial. In teaching, educators can use these models to create intelligent teaching support systems, offering students personalized learning resources and feedback, which in turn improves teaching efficiency and quality. For students, these models can act as personal learning advisors, offering real-time support and guidance, helping them enhance their language skills, logical thinking, and overall academic foundation for future careers. Additionally, these models can simulate real-world marketing scenarios, allowing students to engage in role-playing and hands-on training, thereby boosting their practical and creative abilities. More importantly, the potential of knowledge-enhanced large language models in cross-cultural communication and international marketing makes them a powerful tool for cultivating globally competitive talent in automotive marketing. Through their translation and language processing capabilities, students can easily overcome language barriers, gaining an understanding of the cultural norms and market demands of different countries and regions. This prepares them for future careers in international marketing, equipping them to excel in global markets.

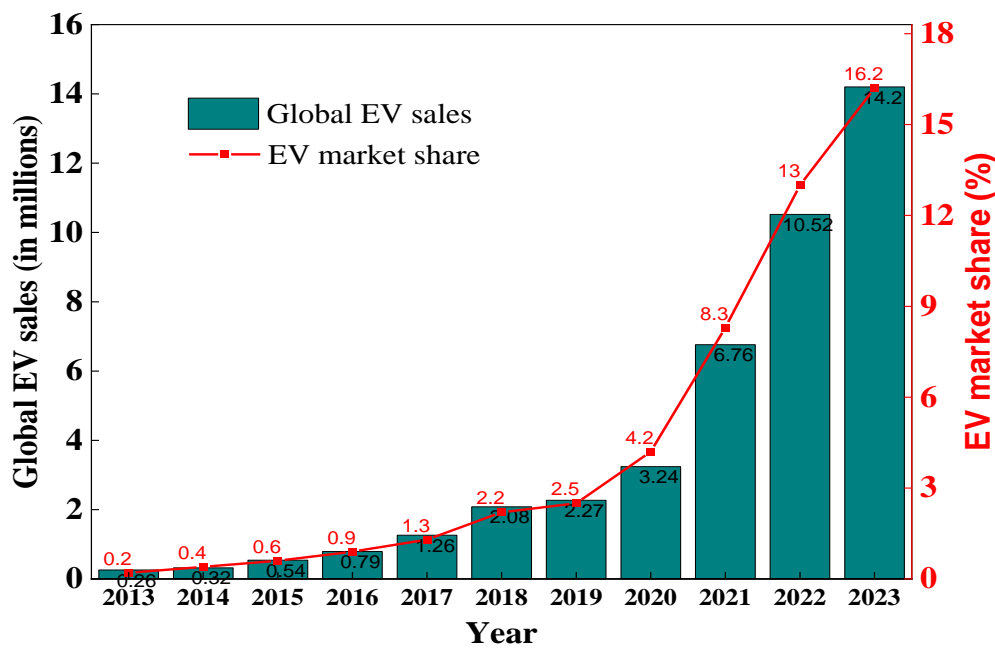


Fig. 1. The numbers of new energy vehicles in global from 2013 to 2023

In conclusion, the advancement of intelligent and electric technologies in the automotive industry, along with the implementation of China's automotive globalization strategy, presents vocational colleges specializing in automotive marketing with both significant opportunities and formidable challenges. The integration of knowledge-enhanced LLMs such as ERNIE Bot could offer unique opportunities for automotive marketing education by providing students with current industry insights, assisting in the development of practical marketing skills, and preparing them for cross-cultural engagement in international markets. Yet, there is limited research that directly addresses how these advanced models can contribute to vocational education settings, especially in niche domains such as automotive marketing. By building on the foundation of existing AI-enhanced educational practices, this study seeks to explore these underrepresented applications,

thereby bridging a critical research gap in automotive marketing education and providing valuable insights for educational reform and innovation in the automotive marketing discipline.

2. The Primary Applications of ERNIE Bot in Teaching

Like other knowledge-enhanced large language models, ERNIE Bot is based on deep learning natural language processing technology, with the highest commercially available version being 4.0 Turbo. ERNIE Bot offers powerful language processing and comprehension capabilities. In the automotive marketing program, its application not only brings unprecedented convenience to teaching but also significantly improves the quality and efficiency of instruction.

2.1 Innovating Teaching Content

Leveraging its vast knowledge base and real-time data retrieval capabilities, ERNIE Bot provides teachers with a continuous stream of educational resources. It can assist in the design and generation of teaching content, broadening and deepening the scope of the curriculum to better align with industry realities.

Case Study 1: As shown in Figure 2, in an automotive marketing course, teachers can use ERNIE Bot to search for the latest market analysis reports, industry trend forecasts, and cutting-edge marketing concepts, incorporating these insights into their lectures and materials. For instance, with ERNIE Bot, instructors can easily access up-to-date data on the NEV market, including sales figures, growth rates, and consumer preferences. This enables them to present students with a dynamic and real-world view of the automotive market in the classroom. Such content not only enriches the learning experience but also sparks students' interest and engagement.

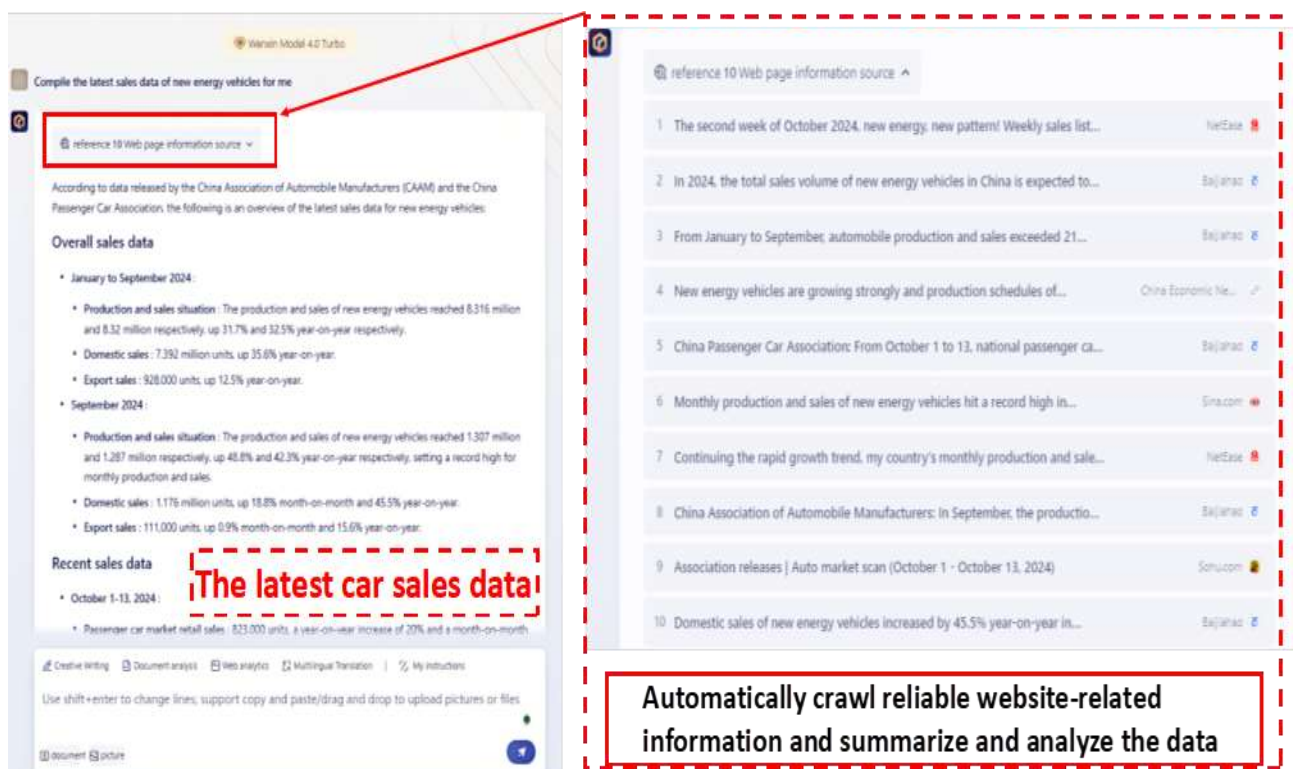


Fig. 2. Using ERNIE Bot to obtain the latest effective teaching resources

2.2 Optimizing Teaching Methods

ERNIE Bot's intelligent questions and answers (Q&A) and conversational capabilities provide strong support for optimizing teaching methods [24]. Teachers can leverage these features to create more flexible and diverse classroom interactions, enhancing both teaching efficiency and effectiveness. Moreover, ERNIE Bot can offer personalized teaching suggestions based on students' learning characteristics and needs, helping teacher's better guide their students.

Case Study 2: In an automotive sales techniques course, instructors can utilize ERNIE Bot's virtual dialogue function to simulate real-world sales scenarios, engaging students in role-playing and interactive activities. Students can adjust their sales strategies and communication techniques based on ERNIE Bot's feedback, which helps improve their practical skills. Additionally, ERNIE Bot records student learning data and feedback, allowing teachers to track each student's progress and identify areas of difficulty. This enables instructors to create personalized teaching plans and offer tailored guidance and support to each student.

2.3 Expanding Practical Training Programs

ERNIE Bot's virtual training feature allows teachers to create highly realistic automotive marketing practice environments, enabling students to master essential skills through simulated operations and improve their practical abilities. This type of simulation not only reduces the cost of training but also enhances its safety and efficiency [25,26].

Case Study 3: In an automotive marketing planning training session, instructors can use ERNIE Bot's virtual training platform to design a comprehensive marketing project for students. Within the virtual environment, students can conduct market research, analyze competitors, position target markets, and develop marketing strategies. ERNIE Bot provides real-time feedback and evaluation, enabling students to continually adjust and refine their marketing plans until they achieve optimal results. This form of simulated training not only enhances students' practical skills but also fosters teamwork and problem-solving abilities.

2.4 Tracking Student Growth

ERNIE Bot meticulously records and tracks every question and interaction students engage in throughout their learning journey. From pre-class preparation to in-class performance and post-class review, it provides comprehensive tracking and recording. This offers teachers detailed learning data, enabling them to gain an accurate understanding of each student's progress and challenges. With this data, teachers can provide targeted formative assessments, promoting holistic student development.

Case Study 4: In an automotive marketing course, a teacher used ERNIE Bot to support teaching. At the beginning of the course, Student A struggled with the concepts of market segmentation and positioning. By interacting with ERNIE Bot, he asked a series of questions about target customer groups and market segmentation strategies. As the course progressed, Student A, through continued interactions with ERNIE Bot, gradually grasped the principles and methods of market segmentation. ERNIE Bot recorded Student A's performance and learning data throughout the process, including the questions he asked, the discussions he participated in, and the assignments he completed. This data provided the teacher with a thorough analysis of Student A's learning progress, allowing for a precise assessment of his performance and improvement. At the end of the course, the teacher conducted a formative assessment of Student A based on the data recorded by

ERNIE Bot. This assessment not only evaluated his understanding of market segmentation but also considered his demonstrated thinking skills, communication abilities, and creativity during the learning process.

3. Primary Applications of ERNIE Bot in Student Learning

From expanding knowledge to enhancing skills, knowledge-enhanced large language models like ERNIE Bot offer students limitless possibilities through their real-time updates, intelligence, and interactivity. This section will explore four key areas: knowledge enhancement and dynamic updates, intelligent Q&A and problem-solving assistance, image recognition and fault diagnosis, and virtual training with simulated operations.

3.1 Knowledge Enhancement and Dynamic Updates

In the field of automotive marketing, market trends, product technologies, and regulatory policies are constantly evolving. ERNIE Bot integrates and retrieves vast amounts of real-time information, providing students with the most up-to-date and comprehensive knowledge resources, helping them stay aligned with industry developments.

Case Study 1: A student majoring in automotive marketing was completing an internship at a 4S dealership when the customer manager asked for assistance in creating a marketing plan for the NEV market. However, due to outdated textbooks, the student struggled to access the latest market data. By using ERNIE Bot, the student was able to easily obtain up-to-date information on NEV sales, policy subsidies, and technological breakthroughs, gaining a deeper understanding of the field and laying a strong foundation for future career planning.

3.2 Intelligent Q&A and Problem-Solving Assistance

Automotive marketing involves numerous complex concepts and theories, and students inevitably encounter challenging questions during their studies. ERNIE Bot's intelligent Q&A feature provides students with instant solutions and assistance, helping them better understand and master key knowledge points.

Case Study 2: While reviewing automotive marketing strategies, a student struggled to distinguish between "precision marketing" and "big data marketing." Through ERNIE Bot, the student received a clear comparison of the two concepts, along with real-world examples, such as how an automotive brand used big data to analyze consumer behavior and deliver targeted advertisements. This in-depth explanation allowed the student to gain a more profound understanding of both concepts.

3.3 Image Recognition and Fault Diagnosis

In the automotive marketing program, the ability to interpret images and diagnose faults is essential. ERNIE Bot's image recognition technology helps students quickly understand the structure, components, and functions of vehicles, as well as diagnose potential faults and their solutions.

Case Study 3: During a practical training session, the instructor displayed the engine bay of a new car. As shown in Figure 3, using ERNIE Bot's image recognition feature, students were able to quickly identify key components such as the engine, transmission, and battery, while also learning

their basic operating principles. When the instructor mentioned a possible fault, students could apply their knowledge to make initial diagnoses, demonstrating improved performance in the training session.

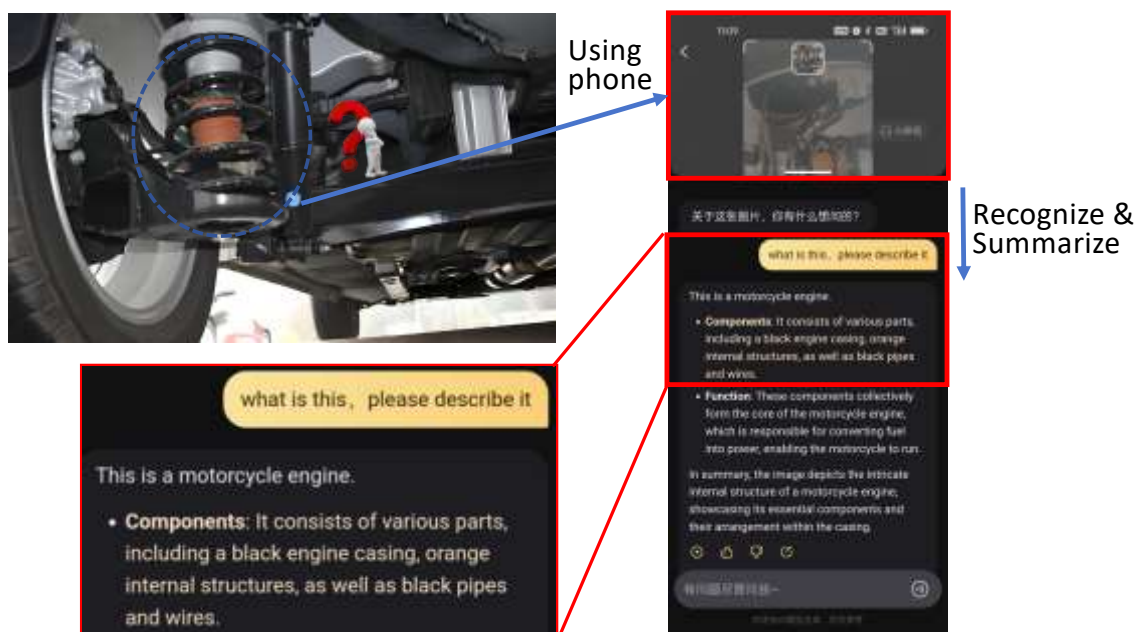


Fig. 3. Using ERNIE Bot's image recognition function to solve questions in time

3.4 Virtual Training and Simulated Operations

ERNIE Bot's virtual training feature offers a flexible platform for immersive, hands-on practice in automotive sales and marketing, allowing students to gain essential skills through simulated scenarios. Given the globalized nature of the automotive market, cross-cultural understanding has become crucial in marketing practices. ERNIE Bot, with its advanced cognitive abilities, can provide culturally relevant guidance to students as they engage with international marketing scenarios.

Case Study 4: During a simulated automotive sales session, ERNIE Bot guided students in interacting with virtual customers from diverse cultural backgrounds. ERNIE Bot provided real-time feedback on adjusting communication and sales tactics to fit cultural norms, highlighting the impact of cultural sensitivity on building trust and achieving sales success. This exercise enhanced students' practical marketing skills and cross-cultural awareness, preparing them for effective engagement in global markets.

4. Data Analysis

To evaluate the impact of ERNIE Bot on student learning outcomes, we conducted a pre-test and post-test assessment involving 100 students enrolled in the automotive marketing program and 20 instructors from Jiangxi Polytechnic University. The assessments measured key competencies, including market trend understanding, customer segmentation, product marketing strategy, and cross-cultural communication. As shown in the comparison chart (Figure 1), students' post-test scores showed significant improvement after ERNIE Bot was introduced, with an average increase of 18 points across the evaluated areas.

Figure 4 highlights these improvements, particularly in product marketing strategy and cross-cultural communication, where scores average rose by over 20 points. These results indicate that

ERNIE Bot effectively enhances students' practical skills and prepares them for global market challenges.

Additionally, students completed a satisfaction survey focusing on engagement, understanding, and enjoyment of course content. The survey results demonstrated a 30% increase in overall satisfaction, reflecting students' positive reception to the ERNIE Bot-enhanced curriculum. Qualitative feedback from instructors through interviews also revealed increased teaching efficiency, with many noting the ease of accessing updated content and the positive effect on classroom interaction. Quantitative data were analyzed using SPSS, while qualitative feedback was processed using NVivo, ensuring reliability and thematic consistency.

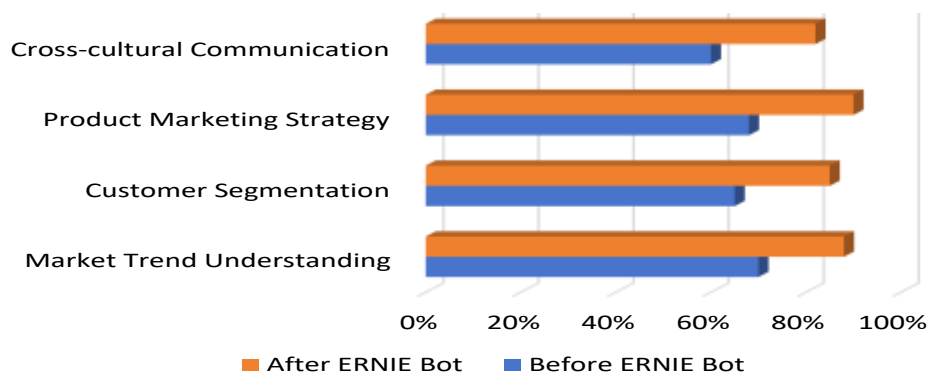


Fig. 4. Comparison of student performance before and after integration of ERNIE Bot in automotive marketing education

5. Recommendations for Using ERNIE Bot

5.1 Recommendations for Teachers Using ERNIE Bot

5.1.1 Mastering the functions and features of ERNIE Bot

First and foremost, teachers should fully understand the various functions and features of ERNIE Bot, including its intelligent Q&A, conversational simulation, and virtual training capabilities. By gaining a deep understanding of these features, educators can better plan their teaching process and design activities that meet the specific needs of their students, thus maximizing ERNIE Bot's role as a teaching aid. To enhance teachers' ability to use knowledge-enhanced large language models and other AI applications and tools, as shown in Figure 5, teachers should actively participate in relevant AI application courses to obtain certifications such as AI trainer credentials. This will enable them to guide students in mastering the use of various AI applications [27,28].



(a)



(b)

Fig. 5. (a) The training site (b) artificial intelligence trainer certificate

5.1.2 Flexibly applying ERNIE Bot according to teaching objectives

The automotive marketing curriculum covers a wide range of knowledge and skills, so teachers should apply ERNIE Bot in a customized manner based on specific teaching goals and student needs. For beginners, ERNIE Bot can be used to explain foundational concepts and provide basic exercises. For advanced students, more complex marketing cases and strategy analysis tasks can be assigned. Teachers can also adjust the use and difficulty level of ERNIE Bot based on students' learning progress and feedback, ensuring that each student receives personalized support suited to their level [29].

5.1.3 Monitoring data feedback for personalized teaching

ERNIE Bot records every student interaction and learning data in detail. Teachers should closely monitor this feedback and data to understand each student's progress, challenges, and preferences. By leveraging this information, educators can offer more personalized guidance and support, helping students overcome learning barriers and improve their overall learning outcomes.

5.1.4 Integrating ERNIE Bot with other teaching methods to form a comprehensive teaching system

While ERNIE Bot offers significant advantages in the teaching process, it cannot fully replace traditional teaching methods [16,23]. Teachers should integrate ERNIE Bot with other instructional approaches, such as lectures, case studies, and group discussions, to create a comprehensive teaching system. This combination allows educators to harness the supportive role of ERNIE Bot while compensating for any potential limitations, ultimately providing students with a more well-rounded and in-depth learning experience.

5.2 Recommendations for Students using ERNIE Bot

5.2.1 Defining learning objectives based on career goals

Students should begin by clearly identifying their future career goals, such as automotive sales consultant, marketing specialist, or customer relations manager. By analyzing the specific professional knowledge and skills required for these roles, students can define their learning objectives and needs. Using ERNIE Bot's intelligent recommendation feature, students can quickly locate learning resources and courses relevant to their target roles, allowing for more focused and effective learning. This approach not only improves learning efficiency but also ensures that the acquired knowledge is closely aligned with future career development.

5.2.2 Improving questioning skills for efficient interaction

When interacting with ERNIE Bot, students should focus on enhancing their questioning skills to express their problems and needs more accurately. By refining their language and identifying key terms, students can receive quicker and more precise feedback from ERNIE Bot. Additionally, students should learn to leverage ERNIE Bot's prompts and guidance features to engage in deeper reflection and discussion, fostering more efficient interactions. This not only helps students gain a better understanding of key concepts but also cultivates critical thinking and problem-solving skills.

5.2.3 Engaging in active learning and skill development

Students should adopt an active learning mindset, fully utilizing the diverse resources and tools ERNIE Bot offers. Beyond completing basic learning tasks, students should proactively engage in skill development, such as role-playing in simulated marketing scenarios or practicing through virtual training platforms. These exercises enable students to better apply theoretical knowledge in practice, improving their practical skills and professional competencies.

5.2.4 Building a personal knowledge system

In the process of studying automotive marketing, students should focus on constructing their own personal knowledge systems. By using ERNIE Bot's intelligent categorization and tagging features, students can organize and consolidate key concepts, forming a structured knowledge framework. Additionally, students should learn to integrate newly acquired knowledge with their existing understanding, continuously expanding and refining their knowledge structure. This approach not only helps students better grasp the material but also prepares them to quickly adapt to new knowledge and technologies in their future careers.

6. Conclusions

The findings of this study offer several practical implications for educators and industry professionals. First, the integration of ERNIE Bot into automotive marketing education can significantly enhance students' ability to access up-to-date information, engage in realistic practice scenarios, and develop cross-cultural marketing skills. For educators, ERNIE Bot provides a versatile tool for tailoring teaching methods to individual student needs, thereby improving overall learning outcomes. Industry professionals can also benefit from graduates who are better prepared for the complexities of global automotive marketing, thanks to the skills and knowledge gained through AI-enhanced education.

Acknowledgement

This research was funded by Jiangxi Province Education Science "14th Five-Year Plan" General Project (22GZYB119) and Jiujiang Vocational and Technical College Course Ideological and Political Teaching Research Project (2021016).

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