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Practice and Research on Value Guidance Teaching in Automobile Construction Course Based on the ADDIE Mode

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Abstract: Against the backdrop of advancing value guidance and ideological cultivation in university professional courses, this paper takes the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) as the framework to explore the systematic design and practical paths of value guidance integration in the Automobile Construction course, and analyzes three key pain points: superficial integration of professional knowledge and ideological and cultural elements, engineering students' overemphasis on technology over morality, and tight course schedules. Based on the five stages of the ADDIE model-Analysis, Design, Development, Implementation and Evaluation-it constructs a three-dimensional demand diagnosis framework, builds a three-dimensional symbiotic teaching resource system, adopts a three-dimensional infiltration teaching strategy, and establishes a dual-dimensional evaluation system of professional competence and professional and ideological literacy. Practice shows that this design transforms value guidance from an add-on to an embedded component, achieves the unity of knowledge transmission and value guidance, and provides a systematic reference path for the integration of value guidancein engineering professional courses.

Keywords: ADDIE Model; Automobile Construction; Value Guidance; Engineering Courses; Professional Literacy

1. Introduction

Ideological and cultural cultivation with value guidance represents an important direction for higher education reform in the new era, aiming to organically integrate ideological and cultural education into professional course teaching, achieving deep integration of knowledge transmission and value guidance. As a core course for vehicle engineering majors, "Automobile Construction" not only serves as the foundation for students to master automobile structure and working principles, but also serves as a key link in cultivating students' practical abilities, innovative awareness, and professional qualities. However, traditional teaching of the "Automobile Construction" course often focuses on the transmission of technical knowledge while neglecting the integration of ideological and cultural education into the specialized course, resulting in a lack of effective connection between students' professional knowledge learning and value shaping. Against the background of the comprehensive implementation of the current educational concept of integrating value guidance into specialized courses, how to organically integrate ideological and cultural elements into the teaching of the "Automobile Construction" course has become an important issue in the educational reform of vehicle engineering majors [1].

In recent years, scholars have conducted extensive research on the teaching design, implementation strategies, and evaluation systems of value guidance integration in specialized courses [2-3], proposing the "value guidance, knowledge transmission, ability cultivation" trinity educational concept [4-7]. In terms of mining and integrating methods for ideological and cultural elements, Li Shengqin et al. [8] took the Vehicle System Dynamics course as an example and constructed a "one center, two main lines, three stages, four integrations" value guidance teaching model based on the OBE concept, clarifying course value guidance objectives from four dimensions: "individual and team, individual and profession, individual and society, individual and future," providing a reference systematic path for the

integration of ideological and cultural education in engineering courses. Regarding the mining of ideological and cultural elements in automotive specialized courses, Li Dezhen et al. [9] proposed establishing a two-dimensional mining system for ideological and cultural elements, horizontally improving the coverage of the mining process and vertically deepening the interpretation and sublimation of mining results, highly integrating ideological and cultural elements with the teaching practice of Automotive Design courses, and achieving value guidance through diversified classroom teaching methods. At the methodological level of ideological and cultural element mining, Xiao Hua et al. [10] took the "Optical Fiber Communication" course as an example, conducting in-depth mining of ideological and cultural elements in different knowledge points from both vertical and horizontal dimensions, using storytelling and problem-guided methods to explore the academic and social value of value guidance key points, effectively broadening the depth and breadth of ideological and cultural education in specialized courses. However, research on value guidance teaching for the "Automobile Construction" course in vehicle engineering majors remains scarce, especially in terms of how to combine professional characteristics, systematically mine ideological and cultural elements, and design operable teaching models, there is still a lack of systematic theoretical construction and practical verification.

The systematic and iterative characteristics of the ADDIE model provide methodological support for solving the fragmentation problem in the above value guidance education research [11]. This model emphasizes full-process design from analysis to evaluation, enabling the systematic embedding of ideological and cultural elements in all aspects of teaching.

Based on this, this paper takes the ADDIE model as the theoretical framework, combines the characteristics of vehicle engineering majors, and explores the reform path of value guidance teaching in the "Automobile Construction" course, aiming to achieve the organic integration of professional knowledge and ideological and cultural education through systematic teaching design, cultivating vehicle engineering professionals with patriotic feelings, craftsmanship spirit, and innovative abilities.

2. Overview of the ADDIE Model

The ADDIE model is one of the most influential classic frameworks in the field of instructional system design, and is widely applied in multidisciplinary course design for its systematic, operable and iterative advantages. For the Automobile Construction course, this model is adopted to carry out value guidance teaching design through its five interconnected and iterative stages: Analysis, Design, Development, Implementation and Evaluation, which together form an optimized closed-loop teaching design process, as shown in Fig. 1.

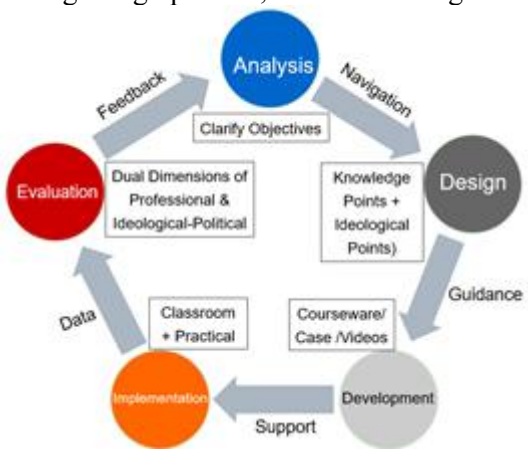

Figure. 1 Value Guidance Teaching Design of Automobile Construction Course Based on ADDIE Model

The analysis stage is the starting point of teaching design, where teachers systematically explore ideological and cultural elements in the course by clarifying industry talent standards, professional quality requirements, and student cognitive patterns, providing precise navigation for subsequent design. The design stage, based on the analysis results, develops a teaching objective system that includes both professional knowledge objectives and value guidance education objectives, designing teaching content, teaching methods, and evaluation methods to ensure the organic integration of value guidance points with professional knowledge points. The development stage focuses on the construction of teaching resources, including case libraries, teaching videos, practical projects, etc., providing supporting carriers for teaching implementation. The implementation stage applies the developed teaching resources to actual classrooms and practical sessions, integrating ideological and cultural education into specialized courses through diverse teaching methods in a tacit manner. The evaluation stage conducts

multidimensional evaluation of implementation effects, covering both professional knowledge mastery and ideological and professional literacy achievement, and feeds the evaluation results back to the previous four stages, forming a continuous improvement closed-loop iteration mechanism [11].

The ADDIE model has high adaptability with the value guidance teaching of the "Automobile Construction" course. First, its systematic design framework can effectively solve the "fragmentation" problem of value guidance education, achieving systematic embedding of ideological and cultural elements through full-process planning. Second, the model emphasizes the unity of theory and practice, aligning with the "learning by doing" characteristics of engineering courses, allowing value guidance to naturally emerge in professional practice. Finally, the iterative nature of the model provides methodological support for the continuous optimization of value guidance teaching, enabling teaching to continuously adjust based on feedback, ultimately achieving the organic unity of "cultivating automotive craftsmen" and "shaping industry pillars."

3. Analysis of Difficulties in Value Guidance Teaching of the Automobile Construction Course

Currently, the construction of value guidance education in the "Automobile Construction" course has entered the "deep water zone," facing multiple deep-seated contradictions. Accurately identifying these difficulties is a prerequisite for systematic teaching design [12].

3.1 Superficial Integration of Professional Knowledge and Ideological and Cultural Elements, Prominent "Two Skins" Phenomenon

Superficial integration is a prominent problem in the current construction of value guidance education in the "Automobile Construction" course. Although researchers and front-line teachers have fully explored the points for value guidance integration, how to achieve the integration of value guidance points with professional knowledge to be "like salt dissolving in water" - neither overshadowing the main content nor subtly nurturing students' ideological character - remains a difficult problem to be solved. For example, when explaining engine technology, only mentioning the achievement of "localization" without delving into the scientist spirit and independent innovation journey behind technological breakthroughs results in value guidance education becoming a mere formality, making it difficult to trigger students' emotional resonance and value identification.

3.2 Engineering Students' "Technology First" Mindset, Insufficient Sensitivity to Ideological and Cultural Elements

Vehicle engineering students, after extensive engineering training, generally develop a tendency to "value technology over humanities." Students often focus on understanding and mastering technology itself, paying insufficient attention to non-technical factors such as social ethics, environmental protection, and historical context involved in technology. At the same time, long-term cognitive training focused on formula derivation, structural analysis, and principle verification has left students lacking the habit of examining technological development from multiple perspectives such as society, history, and ethics. This cognitive mindset increases the difficulty of value guidance education, requiring more strategic teaching design to break through [13].

3.3 Tight Course Schedule, Constraining the Depth of Value Guidance Education

The "Automobile Construction" course has only 44 class hours of theoretical teaching and 12 class hours of experimental teaching, requiring the completion of explanations of the structure and principles of the five major systems of automobile engines and the four major systems of the chassis. The teaching task itself is quite heavy. Under these conditions, deeply integrating value guidance-related content faces three challenges: First, not all knowledge points are naturally suitable for value guidance education; it is necessary to select and excavate value guidance touchpoints with high integration and persuasiveness (such as combustion chamber shape design and environmental responsibility), which requires a huge workload. Second, superficial integration of ideological and cultural elements has limited effect and may trigger student resistance, while in-depth exploration will excessively occupy classroom time. Third, how to achieve tacit

integration of ideological and cultural elements and value guidance within limited time poses extremely high demands on the sophistication of teaching design.

The above three difficulties intertwine to form the deep-seated predicament of value guidance education construction. The solution lies in: for the integration logic, deeply excavating the historical context, character stories, ethical conflicts, and social impacts behind technical knowledge in the "design" stage, constructing a narrative chain of "technologizing stories, valorizing stories"; for the mindset issue, adopting heuristic, discussion-based, and reflective teaching methods in the "implementation" stage, creating "dilemma situations" (such as cost vs. safety, performance vs. environmental protection), guiding students to actively engage in value analysis; for the time constraint, doing a good job of value guidance teaching map planning in the "analysis" and "design" stages, selecting 3-5 core chapters for in-depth integration demonstration, achieving "less is more" rather than "full coverage" [14].

4. Value Guidance Teaching Design and Implementation Based on ADDIE Model

Combined with the professional characteristics of Automobile Construction course and the actual learning needs of students, this paper carries out the whole-process design of value guidance teaching around the five core stages of the ADDIE model, and forms a set of systematic and operable teaching implementation plan with clear objectives, rich resources and scientific evaluation. The following will elaborate on the specific design ideas and implementation measures of each stage of the model in the integration of value guidance and professional teaching.

4.1 Analysis Stage - Precise Positioning of Ideological and Cultural Elements under Three-Dimensional Demand Diagnosis

In the analysis stage, teachers achieve precise positioning of ideological and cultural elements based on the "three-dimensional demand diagnosis" framework - industry talent standards, professional quality requirements, and student cognitive patterns. This framework builds a channel for integrating professional knowledge and value guidance through systematic demand analysis.

Industry talent standards are the strategic fulcrum of industry-education integration. The "compound, innovative, international" talent cultivation goals proposed in the "Medium and Long-Term Development Plan for the Automobile Industry" establish the strategic orientation of teaching design. At the practical level, policy texts need to be transformed into value carriers in teaching contexts. For example, by analyzing the case of technological breakthroughs in new energy vehicle "three-electric" technology, the transfer of national strategic needs to teaching contexts is achieved, enabling students to perceive industrial mission in technology learning.

Professional quality requirements are a practical paradigm for the integration of morality and profession. Based on the "public safety first principle" emphasized in SAE professional ethics standards and the "preventive quality control" concept in the IATF 16949 system, the cultivation of automotive professional qualities needs to focus on building three major awarenesses: quality and safety awareness (such as understanding of automobile recall systems), intellectual property awareness (such as patent design specifications), and sustainable development awareness (such as automobile lifecycle assessment). These professional qualities are both components of professional competence and natural carriers of value guidance education.

Student cognitive patterns are the adaptation criteria for educational science. The target students for this course are third-year students, around 21 years old. Students at this stage have prominent critical thinking and begin to question existing conclusions (such as discussions on the rationality of traditional fuel vehicle ban policies), but their dialectical thinking ability still needs guidance (they tend to fall into binary thinking patterns). As digital natives, students have strong adaptability to fragmented learning and are skilled at quickly obtaining information through short videos and knowledge graphs; they also have obvious reliance on concrete cognition, with much higher acceptance of 3D dynamic demonstrations of engine operation principles than two-dimensional diagram explanations. These cognitive characteristics provide important basis for choosing forms of value guidance teaching.

Through the systematic analysis of the above

three dimensions, a solid foundation is laid for the next stage of value guidance teaching design.

4.2 Design Stage - "Technologizing Stories" Path for Value Guidance Integration

Addressing the problem of superficial integration between value guidance points and professional knowledge points, the design stage focuses on deeply excavating the historical context, character stories, ethical conflicts, and social impacts behind technical knowledge, forming a thinking chain of "technologizing stories, valorizing stories." Taking the "engine combustion technology" module as an example, the following story-based teaching chain is designed, as shown in Fig. 2.

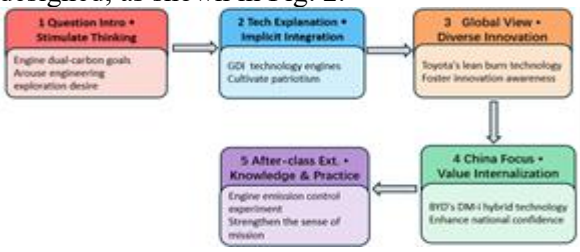

Figure 2. Flowchart of the Five-Step Teaching Chain

Step 1: Problem Introduction, Triggering Thinking. The teaching begins with the open-ended question "How can engines provide sufficient power while reducing pollution and achieving the 'dual carbon goals'?" to stimulate students' desire for exploration.

Step 2: Technical Explanation, Tacit Integration. Technical points such as "combustion chamber design" and "fuel-air mixing technology" are explained, while tacitly integrating ideological and cultural elements - social responsibility (making students aware that the compression ratio, injection pressure, and other parameters they design in the future are directly related to the carbon neutrality strategy) and engineering ethics (how engineers make value choices between cost control and environmental responsibility).

Step 3: Global Perspective, Multidimensional Innovation. The path to breaking through is unfolded around the global history of technological development for "achieving efficient and clean combustion technology." Citing the exploration cases of companies such as Delphi in the US developing homogeneous charge compression ignition (HCCI) technology, and the continuous improvement journey of traditional giant Bosch in Germany gradually increasing the injection pressure of gasoline direct injection technology from 100bar to 350bar, the value guidance point is deeply explored: innovation is multidimensional - disruptive breakthroughs from "0" to "1" are innovation, and continuous improvement from "1" to "100" is also innovation; both together constitute the driving force of technological progress.

Step 4: Focus on China, Internalization of Values. The case of Geely Auto's "Raytheon Power" engine achieving a thermal efficiency exceeding 43%, ranking among the world's top tier, is introduced, with emphasis on the technological innovations made by engineers in combustion chamber shape design. The value guidance point is reflected in the internalization of values: serving the country through industry is not an abstract slogan but making world-class engines, giving Chinese automobiles a powerful "Chinese heart."

Step 5: After-Class Extension, Integration of Knowledge and Action. An open-ended assignment is given: for a certain engine design plan, rank the four dimensions of "performance, environmental protection, cost, innovation" and explain the reasons. In completing the assignment, students need to weigh technical indicators against value orientations, experiencing the real choices of technical ethics, innovation, and responsibility awareness, achieving comprehensive training in value judgment and professional analysis, completing the closed loop of value guidance education.

4.3 Development Stage — Construction of a "Three-Dimensional Symbiosis" Teaching Resource System

In the teaching resource development stage, a "three-dimensional symbiosis" teaching resource system is constructed, deeply integrating ideological and cultural elements into the knowledge context of automobile construction, avoiding the "two skins" phenomenon of value guidance education and professional teaching at its source.

First Level: Technology Evolution and Spirit Inheritance Symbiosis Layer. The "Chronicle of Technological Breakthroughs in China's Automobile Industry" is compiled and embedded in the engine module teaching. As students explore the development trajectory of turbocharging technology (1984-2023), they simultaneously decode the spirit of craftsmanship behind the "Weichai Power

thermal efficiency breakthrough 52% milestone" - decades of technological accumulation, thousands of experimental improvements, and the persistent dedication of the engineering community. Through the dual narrative of technology history and spirit history, the synchronized resonance of technical principle learning and industry-serving education is achieved.

Second Level: Technical Standards and Ethical Principles Integration Layer. In the teaching of automotive safety systems, an "ESP Electronic Stability Program Failure" simulation sandbox is developed, creating a dilemma situation: students need to complete two dimensions of decision-making - the technical dimension (diagnosing wheel speed sensor signal failure) and the ethical dimension (evaluating the balance between "cost control and safety redundancy"). Through the dual-track analysis of the ISO 26262 functional safety standard and the SAE J3016 autonomous driving ethical guidelines, students are guided to establish the professional awareness that "technical decisions must be anchored in humanistic care."

Third Level: Engineering Practice and Moral Cultivation Unification Layer. In new energy vehicle construction experiments, a "battery thermal management ethics workshop" is created. Students' technical task is to design liquid cooling system parameters (flow rate/temperature/pressure); on this basis, they conduct ethical reasoning, evaluating the impact of different cooling strategies on the full lifecycle carbon emissions of batteries; finally, they optimize the technical plan based on the temperature control goals of the Paris Agreement. This forms a closed-loop cultivation path of "technical parameter optimization - sustainable development concept shaping," enabling students to complete moral cultivation in engineering practice [15].

4.4 Implementation Stage — "Three-Dimensional Infiltration" Teaching Strategy Practice

In the implementation stage, targeting the "technology-first" mindset of engineering students, relying on the "three-dimensional symbiosis" teaching resource system, the "three-dimensional infiltration" teaching strategy is adopted to achieve deep integration of professional knowledge and ideological and cultural education.

First Dimension: Situational Infiltration - Creating Value-Conflict Technical Situations. In classroom teaching, typical cases are used to create value-conflict situations. For example, when explaining the braking system, the "Toyota brake scandal" incident is introduced, allowing students to analyze technical causes while considering the professional responsibility of engineers when facing corporate interests versus public safety. The key to situational infiltration is not to directly give value judgments, but to allow students to autonomously discover problems and generate confusion in the situation, thereby triggering value reflection.

Second Dimension: Practical Infiltration - Cultivating Professional Character Through Hands-On Operations. In the disassembly and assembly practice session, the "6S management" concept (Sort, Set in order, Shine, Standardize, Sustain, Safety) is implemented throughout. Students not only learn standardized disassembly and assembly skills but also realize the professional character of "rigor, standardization, responsibility" through repeated practice. The teacher provides timely guidance: "Each bolt's torque standard is not groundless, behind it is respect for life safety." This transforms professional norms from external constraints into internal recognition.

Third Dimension: Reflective Infiltration - Clarifying Value Cognition Through Collision of Views. Micro-debates are organized around hot issues in the automotive industry, such as "liability attribution in autonomous driving accidents" and "the pros and cons of electric vehicle subsidy policies." In the exchange of views, students need to mobilize professional knowledge to support their arguments while confronting the ethical dilemmas brought by technological development. The teacher acts as a guide, not preset with standard answers, but helping students clarify value cognition and form rational judgments through reflection.

4.5 Evaluation Stage — Dual-Dimensional Evaluation and Closed-Loop Iteration Mechanism Construction

In the evaluation stage, a "professional + ideological and cultural" dual-dimensional evaluation system is established, comprehensively assessing the actual effectiveness of value guidance teaching through multiple sources of feedback data,

forming a continuous improvement mechanism.

Diversification of Evaluation Subjects. The perspectives of teacher evaluation, student self-evaluation, and group mutual evaluation are integrated. Teacher evaluation focuses on observing professional competence and professional qualities; student self-evaluation focuses on learning experience and value gains; group mutual evaluation focuses on character performance in teamwork. Multi-subject evaluations cross-validate each other, improving the objectivity of evaluation.

Dual-Dimensional Evaluation Content. The professional dimension is quantitatively assessed through classroom tests, experimental performance, and course design; the ideological and cultural dimension is qualitatively assessed through classroom observation records, reflection log analysis, and open-ended questionnaires. For example, after the engine combustion technology module, an open-ended question is set: "As a future automotive engineer, how do you view the relationship between performance and environmental protection?" Through students' written expressions, the depth and changes in their value cognition are captured.

Closed-Loop Evaluation Results. Evaluation results are systematically fed back to the analysis, design, development, and implementation stages: if it is found that students' resonance with a certain value guidance point is low, the analysis stage re-examines the assessment of student conditions; if the integration of ideological and cultural elements in a certain teaching session is rigid, the design stage optimizes the integration path; if teaching resource support is insufficient, the development stage supplements and improves. Finally, a closed-loop optimization system of "design-implementation-feedback-iteration" is formed, demonstrating the dialectical unity of "cultivating craftsmen" and "shaping craftsmanship spirit" in engineering education.

5. Practical Results and Reflections

After two rounds of teaching practice, preliminary results have been achieved in the value guidance teaching reform of the "Automobile Construction" course based on the ADDIE model. Teaching supervisor evaluations indicated that the classroom "integrated ideological and cultural elements naturally without rigid didacticism." Classroom observations revealed that students showed high participation in discussions on topics such as "engineer responsibility," "technical ethics," etc., and were able to combine professional knowledge for value analysis. In their post-class reflection journals, many students expressed "a new understanding of engineers' social responsibility" and "a strengthened sense of mission toward the automotive industry." Feedback from enterprise internships indicated that employers generally reported students had "good professional qualities" and "a strong sense of responsibility."

At the same time, practice has also revealed directions that need further exploration: how to more precisely quantify the achievement of ideological and professional literacy? How to achieve deeper integration of more chapters within limited class hours? How to promote this teaching model on a larger scale? These issues will be continuously explored in subsequent research.

6. Conclusion

This paper explores the systematic design and practical path of value guidance teaching in the "Automobile Construction" course using the ADDIE model as a theoretical framework.

Research shows that the value guidance teaching design based on the ADDIE model can transform value guidance education from an "add-on" to an "embedded" component, achieving the organic unity of professional knowledge transmission and value guidance, providing a reference systematic path for the integration of value guidance education in engineering professional courses.

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