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Teaching Research on the Dual Closed-Loop Model from the Perspective of Fostering Virtue and Cultivating Talent: A Case Study of Principles of Automatic Control

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Abstract: This paper embarks on its exploration by rejuvenating the curriculum and instructional approaches for the Principles of Automatic Control, with the aim of bringing them into harmony with the talent - nurturing aspirations of application - focused institutions. Thereupon, it formulates a dual - closed - loop teaching paradigm that seamlessly incorporates ideological and political education. Subsequently, by leveraging a case - based investigation of students hailing from two automation classes within the 2022 cohort at the School of Information Engineering, Hangzhou Dianzi University, a dual - closed - loop control system is meticulously devised. The results gleaned from this study suggest that the judicious application of inner - loop proportional control serves to fortify the integration of ideological and political education, thereby enabling students to progressively adapt and gravitate towards a stable state. Should the pre - defined course objectives remain unfulfilled, appropriate ideological and political initiatives can be introduced to effectuate necessary adjustments, thus ultimately achieving the desired educational ends. Finally,data - driven simulations validate that the cascade control system efficaciously accomplishes the objective of fostering virtue through educational means, and this teaching model evinces extensive applicability across cognate courses.

Keywords: dual closed-loop, fostering virtue and cultivating talent, mathematical modeling, stability

1.Introduction

The efficacy of cultivating virtue and nurturing students stands as the fundamental yardstick for appraising all educational undertakings. In contemporary universities, the core mission is to groom well - rounded socialist builders and successors, with an emphasis on the harmonious development of moral, intellectual, physical, aesthetic, and labor aspects. While ideological and political education courses are of pivotal importance in fulfilling this mission, their solitary efforts are inadequate. Thus, it is imperative that each course capitalizes on its distinct features and collaborates with other disciplines to effectively materialize the objective of cultivating virtue and nurturing students.

Numerous scholars have delved into relevant research. For instance, Guo et al. (2023) expounded on the significance of this educational mission. Jiang et al. (2020) put forward teaching reform methods for the Principles of Automatic Control course through the integration of ideological and political education. Xiang. (2019) analyzed the main characteristics, challenges, and solutions for conducting online teaching of the Principles of Automatic Control during the pandemic. Wang et al. (2019) organically blended ideological and political education with course content, teaching objectives, and students' learning styles and ideals in the Principles of Automatic Control course. Zhu (2021) explored ideological and political elements based on

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professional training goals and graduation requirements, devising typical teaching cases to achieve subtle and imperceptible education. Zhang et al. (2021), however, pointed out that many studies in the literature have yet to formulate a robust teaching model. If the ideological and political approaches in natural science courses cannot complement and permeate professional courses, it will be arduous to accomplish the seamless integration of professional and ideological education.

By synthesizing the advancements and trends in various universities, it becomes manifest that integrating ideological and political education into the Principles of Automatic Control course is efficacious in applied universities. Liu et al. (2020) proposed that developing a dual - closed - loop teaching model for the Principles of Automatic Control course, by harnessing popular social media and online platforms, constitutes an effective means of attaining the goal of cultivating virtue and nurturing students. This approach not only enriches the teaching methods but also enhances the educational outcomes, contributing to the overall development of students in both academic and moral dimensions.

2. Problem Description

2.1 How to effectively promote ideological and political education with the goal of "fostering virtue and nurturing students"

For the highly theoretical course, Principles of Automatic Control, the adoption of a dual - closed - loop model that seamlessly integrates theoretical knowledge with ideological and political education presents an effective solution to this challenge, as posited by Zheng & Wang (2021). Within this framework, the inner feedback loop harnesses ideological and political elements to stimulate students' active engagement in theoretical learning. Conversely, the outer loop makes use of professional knowledge to modulate and enhance their proficiency in specialized skills, as elaborated by Zhang et al. (2021). This synergistic approach guarantees the harmonious integration of professional and ideological education, thereby enabling the fulfillment of the fundamental mission of cultivating virtue and nurturing students.

2.2 How to innovate a student-centered multidimensional smart teaching model

To enhance teaching quality and learning outcomes, educators are obligated to perpetually optimize their pedagogical approaches. In the contemporary educational landscape, harnessing advanced information technologies and integrating high - quality educational resources emerges as a viable strategy. This enables the development of a multidimensional smart teaching model. This model serves to bridge the gap between in - class and extracurricular activities. Instead of fixating on exam - oriented performance, students are guided to shift their attention towards the holistic learning processes. Such an innovative approach is in perfect consonance with the modern educational philosophy that espouses a student - centered pedagogy. This student - centered paradigm not only caters to the diverse learning needs of students but also empowers them to take greater ownership of their learning journey, ultimately fostering a more engaged and effective learning environment.

2.3 How to develop diversified practical teaching guided by competency development

The practical aspect of the Principles of Automatic Control course is designed with the explicit objective of cultivating engineering talents. It achieves this by effectively connecting theoretical knowledge with real - world applications. In light of the development of students' competencies and the requirements of control engineering, it is of utmost importance to explore diverse practical teaching models. During this entire process, educators ought to deliberately foster students' engineering awareness. The spirit of craftsmanship should be emphasized, as it is an integral part of engineering education. Moreover, a systematic approach should be adopted to develop students' capabilities to solve complex engineering problems related to automation. This comprehensive approach not only equips students with the necessary technical skills but also instills in

them the professional values and attitudes essential for success in the field of control engineering.

2.4 How to construct diversified assessment methods for continuous improvement

A comprehensive course evaluation system necessitates a thorough analysis of students' learning outcomes and the establishment of a continuous improvement mechanism. In the contemporary educational context, the assessment framework should evolve from a solely outcome - based evaluation to a more sophisticated hybrid approach that integrates both process and outcome metrics. By harnessing a wide array of formative data, educators are empowered to conduct a systematic evaluation of the extent to which course objectives and graduation requirements are being met. This enables iterative refinements to the educational process. Such refinements are crucial for maintaining and enhancing educational efficacy, ensuring that students receive the highest - quality education that equips them well for their future academic and professional pursuits. This approach also aligns with the principles of evidence - based education, where decisions are made based on reliable data rather than assumptions, leading to more effective teaching and learning experiences.

3. Solution

3.1 Control system structure diagram

The dual - closed - loop teaching model takes its inspiration from the dual - loop concept in cybernetics. In this model, the principal loop is meticulously devised to facilitate students' acquisition of professional knowledge. Meanwhile, the auxiliary loop, which doubles as the inner loop, is exclusively committed to ideological and political education. Through the integration of the auxiliary loop into the forward pathway of the principal loop, our intention is to arouse students' fervor for theoretical learning.

The auxiliary loop plays a pivotal and indispensable role in guiding students to concentrate on ideological and political studies. This not only enriches their comprehension within this realm but also remarkably enhances the overall caliber of their learning experience, as evidenced and supported by the research of Zhu et al. (2020). It serves as a driving force that propels students to engage more deeply with the subject matter, fostering a more comprehensive and profound understanding that extends beyond mere academic knowledge.

Feedback mechanisms are intricately incorporated within both the primary and the auxiliary loops of the dual - closed - loop teaching model. These mechanisms are of paramount importance as they enable continuous and meticulous adjustments to the teaching system. Educators can harness the feedback provided by students as a valuable resource to refine and optimize the teaching content and methodologies. By doing so, it is ensured that students can progress towards their learning objectives in an efficient and effective manner.

The overarching and ultimate objective of this dual - closed - loop system is to successfully fulfill the significant educational mission of cultivating virtue and nurturing students. Through its practical implementation, students stand to benefit in multiple ways. Not only will they be able to master the relevant professional knowledge comprehensively, but they will also have the opportunity to establish and internalize correct ideological and political perspectives. This, in turn, contributes to a comprehensive enhancement of their overall capabilities, equipping them better for future academic and professional endeavors.

To provide a more intuitive and accessible understanding of this model, Figure 1 presents a detailed schematic diagram of the dual - closed - loop teaching model that incorporates ideological and political elements. It serves as a visual aid that helps to clarify the structure and operation of this innovative teaching approach.

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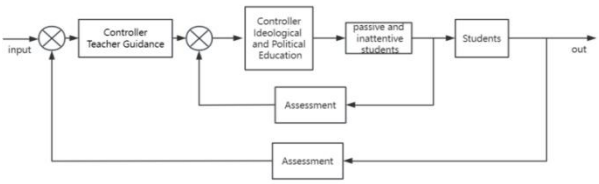

Figure 1 Teaching Mode of Double Closed-loop System

3.2 Input signal: constructing the educational objectives of the "principles of automatic control" course, which integrates ideological and political education, functions as the input signal

In line with the professional talent cultivation goals, the emphasis lies in nurturing applied talents who are practical, innovative, and in pursuit of excellence. Students are to be educated to possess qualities such as diligence, rigour, patience, dedication, and the drive for excellence. Through the setting of course objectives, knowledge transfer, skill development, and quality - related goals are effectively interlinked, thus forming an educational objective centred around the core educational tenet of "fostering virtue and cultivating students", as presented in Table 1.

Table 1 Course Objectives of "Three-All Education"

Goals	Content
Knowledge Goals	Understand the development process and concepts of automatic control syst ems.
	Master the concepts of automatic control principles.
	Master the methods of mathematical modeling.
	Master the three main tools for analyzing system performance.
Ability Goals	Proficiently perform mathematical modeling and derive transfer functions.
	Master time domain analysis, root locus, and frequency domain analysis.
	Proficiently apply three correction methods.
	Enhance practical engineering capabilities.
Quality Goals	Foster patriotism and achieve moral education.
	Develop team spirit and mutual assistance.
	Cultivate a rigorous spirit and stimulate national responsibility.

Educational Aims of the “Principles of Automatic Control” Course with the Integration of Ideological and Political Education. Facilitate the all - round development of students in aspects of professional proficiencies and ideological comprehension.

By formulating these educational aims, the course endeavours to establish a comprehensive foundation. This foundation not only conveys professional knowledge but also nurtures students' ideological and political attributes, thereby realising the core educational principle of fostering virtue and cultivating students.

3.3 Controller

The primary controller encompasses diverse teaching approaches utilized by teachers, such as the knowledge graph as shown in Figure 2.

The secondary controller is the ideological and political case repository that teachers integrate into the teaching process, as presented in Table2.

As depicted in Figure 2, institute the course of "Principles of Automatic Control" on the Chaoxing platform and fashion an all-embracing curriculum system. This system incorporates teaching plans, meticulous chapter particulars, teaching resources, comprehensive knowledge diagrams, objective diagrams, ideological and political diagrams, and

problem diagrams. Employ a substantial volume of data to train an AI assistant.

The charts on the Chaoxing platform are instrumental in systematically documenting and scrutinising the curriculum design, the breadth of coverage of teaching content, and the realisation of learning objectives. Consequently, it enables the evaluation of the rationality of the curriculum architecture and the integrity of knowledge elements, ensuring that the curriculum architecture is sound and well - structured, the teaching content is comprehensively covered, and no pivotal knowledge elements are overlooked.

Furthermore, by closely monitoring students' learning advancement, participation rates, and the utilisation of teaching resources, issues within the teaching process and students' areas of bewilderment can be detected in a timely fashion, furnishing data support for the continual refinement of the course. Teaching strategies and resource allocation can be adjusted and optimised in a targeted manner, rendering the teaching design more scientifically sound and efficient, and enhancing the quality of instruction and students' learning outcomes.

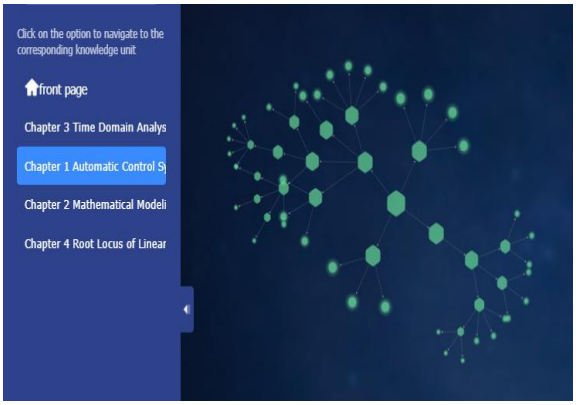

Figure 2 Knowledge Graph of Principles of Automatic Control.

The establishment and subsequent perfection of an all-encompassing ideological and political case library prove to be significantly more advantageous for the advancement of courses. As illustrated in Table 2, a variety of approaches, including case-oriented teaching, independent inquiry, heuristic instructional methods, and situational experience-based teaching strategies, are adopted. These are implemented with the aim of fulfilling the fundamental objective of nurturing students' moral character through education.

Table 2 Ideological and Political Elements

Knowledge Units	Professional Knowledge Points	Ideological and Political Elements	Integration of Ideological and Political Elements	Ways of Implementing
Chapter 1 Introduction	The development of the principle of automatic control. The concept of the principle of automatic control.	Confidence in science and technology. Confidence in culture. Patriotism.	The introduction of the concept of the principle of automatic control through rocket launches helps establish cultural confidence and confidence in science and technology. The deeds of Qian Xuesen inspire students' national spirit and patriotic feelings.	Case analysis Classroom interaction.

Knowledge Units	**Professional Knowledge Points**	**Ideological and Political Elements**	**Integration of Ideological and Political Elements**	**Ways of Implementing**
Chapter 2 Mathematical Modeling	Transfer function Differential equation Block diagram Simplification of block diagram Mason's formula.	Self-reliance. Hard work and entrepreneurship. Unity and cooperation. Selfless dedication.	The transfer function leads to the relationship of connecting the preceding and the following. By enumerating the process of mathematical modeling, the rigorous working attitude of scientists is inherited.	Video learning. Case analysis. Classroom interaction.
Chapter 3 Time-domain Analysis of Linear Systems	Responses of first-order and second-order systems. Steady-state error.	Patriotism. Rigor.	Based on the analysis of the concept of system response, the equivalence between output and input is analyzed. Through the analysis of steady-state error, the rigor of rocket launches is introduced, emphasizing that a small mistake may lead to irreversible losses.	Case analysis. Classroom interaction.
Chapter 4 Root Locus	The concept of root locus. Methods of drawingroot locus.	Abiding by laws and disciplines. Innovation. Patriotism. Rigor.	Through the introduction of root locus, the idea that nothing can be accomplished without norms or standards is introduced. The stability judgment of the system is completed according to appropriate criteria.	Case analysis. Classroom interaction.
Chapter 5 Frequency-domain Analysis	The concept of frequency characteristics. Drawing Nyquist diagrams. Drawing Bode diagrams. Nyquist stability criterion.	Patriotic feelings. Awareness of the rule of law. Awareness of innovation. Awareness of social responsibility.	The introduction of material stories involves three famous figures: Nyquist, Bode, and Nichols. They conducted research on the frequency characteristics method in different periods and made outstanding contributions, reflecting the spirit of "Many hands make light work."	Video viewing. Case analysis.

3.4 Measuring components

Table 3 illustrates the curriculum evaluation system, which encompasses theoretical assessment through a closed-book final exam for evaluating theoretical knowledge, practical skills assessment based on lab hands-on ability, presentation defense, and report scoring, and regular assessment that includes attendance and classroom performance rates and contributes to the moral education assessment within the course.

Table 3 Course Assessment

Assessment Component	Description
Theoretical Assessment	Closed-book final exam assessing theoretical knowledge in the course.
Practical Skills Assessment	Evaluation based on hands-on lab skills, presentation defense, and report scoring.
Regular Assessment	Includes attendance and classroom performance rates, contributing to moral education assessment in the course.

This assessment framework is designed to conduct a comprehensive evaluation of students' knowledge acquisition, practical proficiency, and moral growth within the course, which is in harmony with the integration of ideological and political education.

To gain an in-depth understanding and make an accurate assessment of students' learning processes and outcomes, it is of utmost necessity to establish the problem map depicted in Figure 3. Through the process of responding to the questions on this map, the learning effects of students can be efficiently relayed back, empowering teachers to pinpoint both their students' strong suits and areas that need improvement. Moreover, the target map illustrated in Figure 4 has been formulated. This map delineates the specific learning aims and objectives. By scrutinizing the learning data presented in Figure 5, it becomes feasible to objectively determine whether students have attained the anticipated goals. Such a systematic approach facilitates the customization of teaching strategies and the provision of appropriate assistance, thereby enhancing students' learning experiences and overall academic accomplishments.

Figure 3 Question Map

Figure 4 Target Map.

Figure 5 Learning Situation Statistics

4. Mathematical Modeling

This paper undertakes an in - depth research endeavor and constructs a dual - loop control system. The foundation of this system lies in a mathematical model formulated around the student population. As is vividly illustrated in Figure 6 and Figure 7, within the framework of a classical control system, it principally encompasses four key components: namely, the controller, which is responsible for generating control signals; the actuator, tasked with physically implementing these signals; the controlled object, whose behavior is being regulated; and the detection device, which monitors and provides feedback on the state of the controlled object.

A series regulation system, by its very nature,

constitutes a dual - loop configuration. In this setup, two regulators are arranged in a series connection. Through their harmonious and coordinated operation, the system ensures that the controlled variable is maintained with utmost precision at a pre - determined specified value. The secondary loop within the series regulation system is characterized by its low - inertia property, enabling it to respond rapidly, and high efficiency in its operation. Conversely, the primary loop exhibits high inertia, which implies a more sluggish response, and a relatively low operating frequency. Series regulation is predominantly utilized to counteract and neutralize any disturbances that transpire within the secondary loop. Once these disturbances become evident in the intermediate variable, the secondary regulator can promptly and effectively offset them, thereby safeguarding the stability and accuracy of the overall control system.

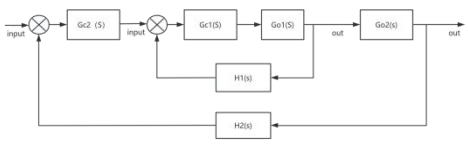

Figure 6 Cascade Control Structure Diagram

Suppose a unit negative feedback control sys tem is depicted in the diagram. The controlled o bjects consist of two first-order inertia links, and the controller employs proportional adjustment. The transfer functions of these components are a s follows:

$$G_{01}(S) = \frac{K}{1+ST_1} \quad G_{c1}(S) = K_{C1} \tag{1}$$

$$G_{02}(S) = \frac{K}{1+ST_2} \quad G_{c2}(S) = K_{C2} \tag{2}$$

Assuming the unit input signal is regarded as a unit step function, we can obtain the system's response and analyze whether the output signal can stably, accurately, and quickly track the input signal.

Let's take the example of two classes of students from the Automation major of the School of Information Engineering, Hangzhou University of Electronic Science and Technology, batch 22, for analysis. These two classes are regarded as two independent entities, much like two independent control elements. We can determine a suitable time parameter.

Based on the average grades of these two majors.The mathematical models for Class 1 and Class 2 are as follows:

$$G_{O1} = \frac{1}{(30s+1)} \cdot \frac{1}{(3s+1)} \quad G_{O2} = \frac{1}{(10s+1)} \cdot \frac{1}{(s+1)\ \ } \tag{3}$$

Using the attenuation curve from classical control theory, we adjust the system. When K=12, the step response of the secondary loop shows a 4:1 step attenuation curve. At this point, the settling time T S =7.62 seconds.

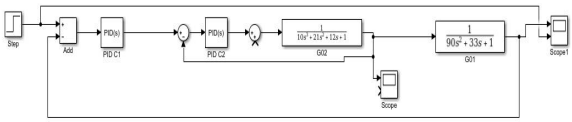

Figure 7 Simulink Modeling

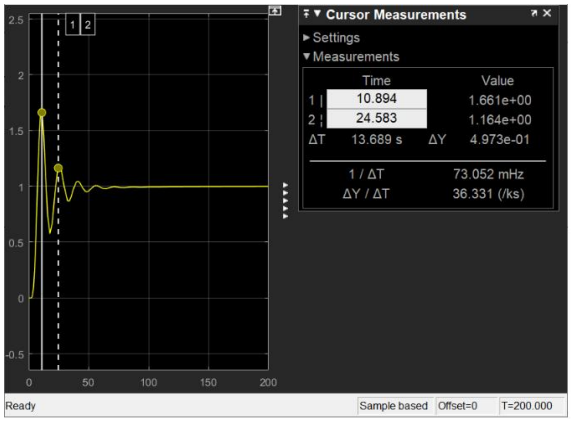

Figure 8 Single-loop Result

By setting an appropriate inner loop proportional control, we can increase the emphasis on ideological and political education to an optimal level. As depicted in Figure 7, we observe that students can continuously adjust themselves to reach a stable state. However, this does not yet achieve our course objectives. At this point, we can incorporate ideological and political elements into the knowledge points. By continuously correcting and adjusting,

students can reach the desired steady - state value and achieve the expected teaching outcomes. Figure 8 visually demonstrates the process and how the adjustments made lead students closer to the educational goals. Figure 9 also shows that the expected goals can be achieved.

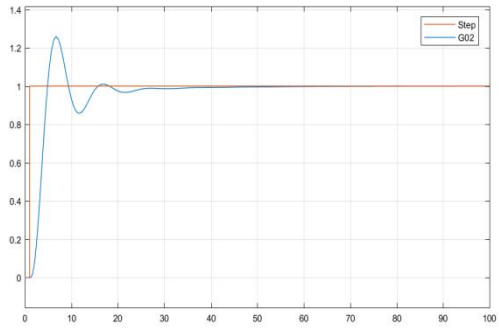

Figure 9 Cascade Control System Result

To achieve better teaching outcomes, a proportional control element can be added to the outer loop controller. By enhancing the ideological and political education, students can achieve a stable and healthy state. Subsequently, we can incorporate knowledge points combined with ideological and political elements. Through assessment methods, we can determine whether students have achieved the expected teaching objectives. As shown in the figure, students have reached the expected teaching goals. The results also indicate that the educational outcomes align with the principle of fostering virtue through education.Figure 10 demonstrates that the expected goals can be achieved.

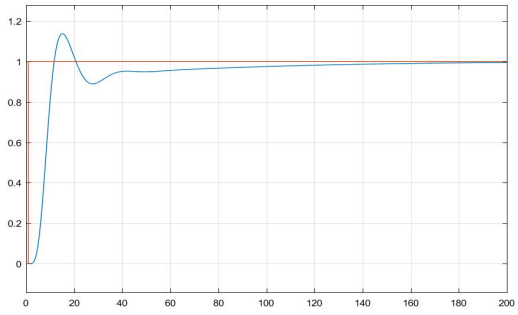

Figure 10 Corrected Result

This analysis framework helps us understand how to achieve teaching objectives and expected outcomes by adjusting the proportional controller and incorporating ideological and political education projects. The results demonstrate that this approach effectively supports the goal of fostering virtue throWhen setting KP1=11.5, the step response of the secondary loop exhibits a 4:1 step attenuation curve, with a settling time of TS=17.740s.Figure 12 shows that after continuous modifications, the expected goals can be achieved more stably.

Applying such a teaching improvement to the same course in different majors and different courses in the same major, the teaching effects are as shown in the table 5 and table 6.

The following shows the teaching effects of different majors within the same institution and different courses within the same major. For different majors in the same institution (Table 6), taking Automation, Electrical, Mechanical, and Electronics majors as examples, the traditional teaching pass rates are 60, 50, 50, and 60 respectively, while the improved teaching pass rates are 90, 85, 80, and 88 respectively. The traditional teaching postgraduate exam rates are all 5 for these majors, and the improved ones are 25, 20, 30, and 30 respectively. The traditional teaching competition participation rates are all 5, and the improved ones are 80, 50, 50, and 50 respectively.

Regarding different courses within the Automation major, for courses like Principles of Automatic Control, Image Processing of Vision Inspection Machine, Modern Control Theory, and Computer Control Systems, the traditional teaching pass rates are all 60, and the improved teaching pass rates are 90, 90, 85, and 85 respectively. The traditional teaching postgraduate exam rates are 5 for the first three courses and 6 for Image Processing of Vision Inspection Machine, and the improved ones are 30, 25, 30, and 30 respectively. The traditional teaching competition participation rates are all 5, and the improved ones are all 80.

Table 5 Teaching Effects of Different Majors

Different Majors at Unified Institution	Traditional Teaching Pass Rate	Improved Teaching Pass Rate	Traditional Teaching Postgraduate Exam Rate	Improved Teaching Postgraduate Exam Rate	Traditional Teaching Competition Participation Rate	Improved Teaching Competition Participation Rate
Automation	60	90	5	25	5	80
Electrical	50	85	5	20	5	50
Mechanical	50	80	5	30	5	50
Electronics	60	88	5	30	5	50

Table 6 Teaching Effects of Different Courses within the Same Major

Different Courses in Automation Major	Traditional Teaching Pass Rate	Improved Teaching Pass Rate	Traditional Teaching Postgraduate Exam Rate	Improved Teaching Postgraduate Exam Rate	Traditional Teaching Competition Participation Rate	Improved Teaching Competition Participation Rate
Automatic Control Principles	60	90	5	30	5	80
Vision Inspection Machine Image Processing	60	90	6	25	5	80
Modern Control Theory	60	85	5	30	5	80
Computer Control Systems	60	85	5	30	5	80

Through data simulations, it has been convincingly demonstrated that cascade control systems are capable of effectively attaining the educational objective of fostering both moral integrity and intellectual growth. This efficacious educational approach is highly adaptable and can be readily incorporated into analogous courses. The validation of the outcomes, conducted among students within the same major but across different courses, among those from diverse majors yet enrolled in the same course, and among students from various majors and courses, collectively illustrates that teaching research employing a dual-loop model is indeed instrumental in realizing

the educational aspiration of cultivating students' moral character alongside their intellectual capabilities.

Conclusion

This research has impressively crafted a dual - closed - loop teaching model for the “Principles of Automatic Control” course, ingeniously melding ideological and political education with professional knowledge. The highly theoretical nature of this course has always posed teaching challenges, but our model offers an elegant solution. Moreover, it presents a novel outlook for teaching reforms in similar courses at applied universities. Through constructing the dual - closed - loop system and relevant mathematical models, we've demonstrated that adjusting the inner - loop proportional control and integrating ideological and political elements into knowledge points helps students better achieve their learning aims. The improved pass rates, postgraduate exam rates, and competition participation rates across different majors and courses vividly prove the model's effectiveness. Our designed assessment system, which combines theoretical, practical, and regular evaluations, comprehensively assesses students' learning outcomes. It enables educators to identify students' strengths and weaknesses, facilitating targeted teaching adjustments, in line with the modern student - centered and continuously - improving educational concept. Nonetheless, implementing this model may encounter difficulties in diverse educational environments. For example, creating the ideological and political case library requires a substantial amount of teachers' time and effort, and integrating new teaching methods with existing resources needs more exploration. Also, the long - term impact on students' career development and ideological growth remains to be monitored and evaluated. Future research could optimize the teaching model for better adaptability to various teaching scenarios. Exploring advanced technologies like AI and VR to enhance the teaching experience is also a promising direction. Additionally, interdisciplinary research can further integrate ideological and political education with other professional courses for more comprehensive student development. Overall, this study is a valuable reference for promoting engineering education reform in cultivating virtuous and talented students.

Conflict of Interest

The author declares that she has no conflicts of interest to this work.

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References

Guo, W., Wu, K., Duan, W. J., & Song, H. Y. (2023). Research on the teaching reform of principles of automatic control integrating ideological and political education. *China Modern Educational Equipment, 3*(405), 114-116.

Li, L., & Guo, H. X. (2021). Exploration of teaching practice for the principles of automatic control course during the pandemic. *Southern Agricultural Machinery, 52*(12), 155-156, 159.

Jiang, G. J., Li, Q., & Li, B. Q. (2020). Discussion on the reform of the principles of automatic control course integrating ideological and political education. *Science and Education Guide, 2020*(18), 43-44.

Wang, L. H. (2021). Exploration of ideological and political construction in the principles of automatic control course. *Light Industry Science and Technology, 37*(10), 133-134.

Wang, X. Y., Xiang, Y. Y., Li, Y. L., & Liang, J. F. (2019). Optimization of the use of implicit education carriers for college students in the

self-media era: A case study of the WeChat official accounts of five key universities in Guangdong Province. *New Media Research, 12*, 56-58.

Xiang, M. (2019). Exploration of methods for implicit ideological and political education in universities in the self-media era. *Journal of Jinzhou Medical University (Social Science Edition), 3*(17), 87-89.

Zhu, W. X. (2021). Design and practice of teaching cases for principles of automatic control integrating ideological and political education. *Journal of Electrical and Electronic Education, 43*(5), 16-19, 38.

Zhang, Y., Liu, S. B., & Chu, J. B. (2021). Exploration and practice of teaching reform for principles of automatic control course. *Journal of Electrical and Electronic Education, 43*(4), 75-77.

Liu, T. T., Da, C., & Ye, S. (2020). Dual closed-loop teaching model integrating ideological and political feedback: Exploration of teaching reform for the principles of automatic control course. *Journal of Multimedia and Network Teaching (Monthly Edition), 2020*(10), 79-82, 85.

Zhu, W. X. (2021). Design and practice of ideological and political teaching cases in the course of "Principles of Automatic Control". *Journal of Electrical & Electronic Education, 43*(5), 16-19, 38.

Zheng, E. R., & Wang, S. E. (2021). Exploration and practice of ideological and political education in the course of "Modern Control Theory". *Journal of Electrical & Electronic Education, 43*(6), 52-55.

Xia, Y. L., & Xie, X. (2019). Research on the ways to enhance the effectiveness of ideological and political courses by taking the WeChat public platform as the carrier. *University Education, 19*(3), 100-103.

Zhang, Q., Zhang, D. X., & Li, G. L. (2021). Research on the online and offline blended teaching mode of "Principles of Automatic Control". *Journal of Electrical & Electronic Education, 43*(6), 31-34, 60.

Zhu, X. Q., Ding, Z. Y., & Zhu, C. (2020). Teaching methods of growth mindset in the cultivation of innovative talents. *Journal of Higher Education Research, 43*(1), 104-109

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