A Study on the Strategic Differentiation of New Engineering Specialties Established in Applied Undergraduate Colleges During the AI Era

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Abstract. The onset of the artificial intelligence (AI) era has brought about significant challenges and opportunities for the transformation and enhancement of traditional engineering education. This study delves into the imperative and strategic approaches for differentiated development in the establishment of new engineering disciplines within applied undergraduate colleges. The research begins with an exploration of the essence and unique attributes of new engineering education, examining the impact of AI and then scrutinizing the prevalent homogenization within new engineering programs globally. Utilizing differentiation theory, the paper proposes a suite of strategies aimed at distinguishing specialty profiles, innovating curriculum structures, diversifying teaching methods, and fortifying practical teaching components. These strategies are designed to align educational offerings closely with industry demands and to nurture a new generation of engineers with both innovative and practical capabilities. The paper concludes with case studies that illustrate the successful experiences and practices of leading institutions, offering insights for other colleges. This work not only offers theoretical insights and practical recommendations for the new engineering discipline establishment in applied undergraduate colleges but also contributes to broader educational reform and the innovation of talent cultivation models.

Keywords: New Engineering, Applied Undergraduate Education, Artificial Intelligence, Specialty Differentiation, Strategy

1 Introduction

New engineering refers to the discipline field that ADAPTS to the development needs of the new era and integrates emerging technologies such as big data and artificial intelligence with traditional engineering education [1]. It emphasizes interdisciplinary integration, innovation ability cultivation and practical skills enhancement. Application-oriented colleges and universities are different from traditional colleges and universities (academically oriented) in that they focus [2] on developing students' vocational ability and practical innovation ability.

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With the rapid development of the global economy and the continuous advancement of science and technology, artificial intelligence (AI) has become a key force driving industrial and social change. In this context, with the rapid cross-integration of various disciplines and the emergence of new technologies and new engineering majors, traditional engineering education is facing the challenge of transformation and upgrading to meet the new requirements for engineering and technical talents in the new era. At present, most applied colleges and universities in our country are still in the state of not successful transformation, and they still follow the traditional colleges and universities in the theories and methods of professional construction. As a result, there is a certain disconnect between the existing engineering education system and the needs of the industry, especially in the field of emerging technologies such as artificial intelligence.

Therefore, the research on the differentiation strategy of new engineering majors in application-oriented undergraduate colleges will not only help optimize the allocation of educational resources and improve the quality of education, but also promote the successful transformation of application-oriented colleges and universities, promote the deep integration of education and industry, and train more high-quality engineering and technical talents for the society.

The purpose of this study is to explore the differentiation strategy of applied undergraduate colleges in the setting of new engineering majors, so as to adapt to the new requirements of engineering and technical talents in the era of artificial intelligence. The main research questions include:

- What is the current situation of new engineering major setup in applied undergraduate colleges?
- What are the new requirements for the new engineering major setup in the era of artificial intelligence?
- How to develop a differentiated strategy to achieve a close combination of specialty setting and industry needs?
- What challenges might these strategies face in practical application, and how should they be addressed?

2 The Current Situation of The New Engineering Major Setup for Application-Oriented Undergraduate Students in China

In the era of artificial intelligence, the rapid cross-integration of disciplines has led to the emergence of new technologies and new majors. At present, application-oriented undergraduate colleges in China are still in the transition period, and there are some commonalities in the specialty setting of application- oriented undergraduate colleges, especially the problem of specialty homogenization is particularly prominent. This is mainly due to the following factors:

- University ranking and evaluation are still dominated by academic types, such as papers, projects, or basic theoretical courses, resulting in application-oriented colleges and universities to rely on evaluation when building majors. As a result of the interdisciplinary integration required by the new engineering major, the curriculum

system of these schools centers around multiple majors when setting up the new engineering major, the subject learning burden of the students in the new engineering major is heavy, and many courses emphasize theory, so that the students cultivated are not strong in application ability and cannot keep up with the depth of theory, which makes it difficult for students to find employment and study.

- Some application-oriented undergraduate colleges and universities lack the experience and courage to carry out in-depth reform in major construction and management. The vast majority of administrators of applied undergraduate colleges and universities are born in research-oriented colleges and universities. As a result, the management of applied undergraduate colleges and universities cannot break through the framework of research-oriented colleges and universities.
- Some application-oriented undergraduate colleges blindly follow the trend in professional construction. Whatever major is hot in the society, they will set up any major, or research-oriented universities will set up any major. As a result, the teaching staff cannot keep up with them and the practical conditions are not available. Thus, the practical application ability of the cultivated students can be imagined.
- The local government's investment in research colleges and universities is far greater than that of application-oriented colleges and universities, which makes application-oriented colleges and universities lack of research funds in professional construction, and thus copy the professional Settings of other colleges and universities.

All these factors will lead to the homogenization of major setup. The homogenization of major setup refers to the tendency of different colleges and universities to be similar in major setup, lacking of characteristics and differences. This phenomenon may lead to the following problem:

- Colleges and universities repeatedly invest in similar professional fields, which may lead to the waste of educational resources, including funds, teachers and teaching facilities.
- When multiple colleges and universities produce a large number of graduates with similar majors, it may exceed market demand, resulting in employment difficulties for graduates and increasing pressure of employment competition.
- The lack of distinctive and personalized professional Settings makes it difficult for colleges and universities to highlight their own advantages in the fierce education market and reduce their competitiveness.
- If colleges and universities neglect the quality of education in pursuit of the number of majors, it may lead to a decline in teaching quality and affect the quality of talent training.

The convergence of application-oriented colleges and universities with research-based colleges in the specialty setting may lead to the ambiguity of their educational positioning and difficult to achieve successful transformation.

To solve these problems, universities, enterprises, the government and educational administration departments should work together to promote colleges and universities to carry out differentiated and distinctive specialty Settings, strengthen the planning and pertinence of specialty construction, and improve the matching degree of specialty

Settings with social needs. At the same time, application-oriented colleges and universities should strengthen internal management, improve teaching quality, and cultivate outstanding talents with innovative spirit and practical ability.

3 Requirements For New Engineering Major Setup in Application-Oriented Undergraduate Colleges in The Era of Artificial Intelligence

In the era of artificial intelligence, the rapid cross-integration of multiple disciplines is different from the traditional professional sources in the past. The new engineering major mainly comes from production practice, rather than closed research institutes or university laboratories. Therefore, the construction of new engineering majors needs the full participation of industry enterprises. The requirements of the new engineering major setup in application-oriented undergraduate colleges are mainly concentrated in the following aspects:

Deepening industry-university cooperation, establishing multi-subject cooperative education mechanism, and promoting the deep integration of education and industry. Construction of quality assurance system for new engineering majors should be established, and the main body of the assessment system should be changed to schools and enterprises.

Make industrial demand docking with industry enterprises, and find out the employment direction of new engineering majors. Specialties should be closely aligned with the needs of the new round of scientific and technological revolution and

industrial transformation, especially in intelligent

manufacturing, cloud computing, artificial intelligence, robotics and other fields.

Practice and innovation ability training should be carried out together with industry and enterprise mentors, focusing on cultivating students' practical operation ability and innovative thinking to adapt to the needs of emerging industries and the new economy.

Reform the teacher training mechanism and flow mechanism of new engineering majors in application-oriented colleges and universities, strengthen the engineering practical ability of engineering teachers through training, and implement a two-way exchange plan between teachers and industry talents.

Through these requirements, application-oriented undergraduate colleges and universities can better adapt to the needs of the era of artificial intelligence, and cultivate high- quality composite new engineering talents with international competitiveness.

4 Theoretical Basis of Differentiation Strategy

4.1 Educational Differentiation Theory

Educational differentiation holds that since students have different learning needs, interests and abilities, education should provide a variety of teaching content and methods to accommodate these differences [3]. In the setting up of new engineering majors, the

differentiation strategy means that colleges need to design specialized courses and training programs with characteristics according to students' characteristics, local industry needs and their own advantages.

In other words, the following differences should be noted in the specialty setting:

- Individual Differences: Identify and respect students' individual differences and provide personalized learning paths and support.
- Needs Differences: Analyze the specific needs of different industries and businesses and design specialized programs that meet those needs.
- Resource difference: Make use of the resource characteristics of colleges and universities to develop educational programs with comparative advantages.

4.2 Industrial Demand-Oriented Education

The industrial demand-oriented education model emphasizes that the content and process of education should be closely integrated with the actual industry, so as to cultivate talents who meet the market demand. In the new engineering major setup, this means:

- Integration of industry and education: the integration of industry knowledge and skills into curricula and teaching through school-enterprise cooperation.
- Practice-oriented: Strengthen practical teaching links, so that students learn through practical operation and project experience.
- Dynamic adjustment: Constantly adjust and update the professional setting according to the industry development trend and technological progress.

4.3 OBE philosophy

There is a close relationship between the concept of OBE (Outcome-Based Education) and the setting of new engineering majors for application-oriented undergraduates, which is reflected in the following aspects: The OBE concept emphasizes the clarity and concreteness of educational goals, and requires educational activities to be designed around predetermined learning outcomes [4]. In the new engineering major setting, this means that professional courses and teaching activities should be carried out around the goal of cultivating engineering and technical talents with practical ability and innovative spirit.

According to the OBE concept, the construction of the curriculum system should correspond to the learning outcomes to ensure that students can achieve the expected ability structure through the course learning. The curriculum system should be designed according to the latest demand of industry and technology development to realize the close combination of ability cultivation and course teaching.

OBE advocates personalized teaching, emphasizing the development of different teaching programs according to the individual differences of students. In the new engineering major setting, this means providing diverse learning paths and teaching methods to adapt to the learning needs and characteristics of different students.

Teaching evaluation under the OBE concept focuses on learning outcomes and adopts multiple and hierarchical evaluation criteria [5]. In the new engineering major setting, the evaluation method should be changed from a single examination result to a multiple evaluation that pays more attention to students' practical ability, innovative ability and professional quality.

The OBE concept emphasizes the continuous improvement of educational activities, requiring schools and teachers to reflect and improve teaching according to students' learning results. It is necessary to establish a continuous improvement mechanism to optimize the construction of the major and the implementation of teaching, so as to improve the quality of education.

Talent training mode integrating production and education:

OBE concept advocates student-centered, pay attention to the cultivation of students' practical ability and innovative ability. The new engineering major should deepen the integration of production and education, and cultivate students' engineering practice ability and practical problem solving ability through school-enterprise cooperation, internship and training.

4.4 Differentiation Strategies for New Engineering Majors in Application-Oriented Undergraduate Colleges

1) Differentiation of major positioning.

Differentiation of major positioning means that colleges and universities, according to their own characteristics, regional economic development needs and industry development trends, clearly define the direction and goals of major development, and form a distinctive professional positioning.

Regional economic analysis: In-depth analysis of regional economic structure and characteristics to determine the leading industries for professional services.

College characteristics mining: based on the historical accumulation of colleges and universities, subject advantages and teachers, to shape the professional characteristics.

Industry demand docking: Cooperate with industry enterprises to understand the industry development trend and talent needs, and realize the precise docking of professional positioning and industry demand.

2) Differentiation of curriculum system.

The differentiation of curriculum system emphasizes the construction of a distinctive curriculum system according to the professional orientation to meet the learning needs and career development goals of different students.

Core curriculum setting: Set up the necessary basic courses and professional basic courses around the core competence of the major.

Rich elective courses: Provide a variety of elective courses to meet the individual learning needs of students.

Interdisciplinary course design: Interdisciplinary course design is encouraged to promote the cross-integration of knowledge from different disciplines.

3) Differentiation of teaching methods and means.

Differentiation of teaching methods and means refers to the use of diversified teaching methods and means according to students' learning characteristics and course content to improve teaching effects.

Case teaching: Use actual cases to improve students' practical analysis ability and problem solving ability.

Flipped classroom: Through the flipped classroom model, stimulate students' active learning ability.

Technology-assisted teaching: The use of information technology, such as online education platform, virtual simulation, etc., to enrich teaching means.

4) Practice teaching and the combination of industry- university-research differentiation.

The combination of practical teaching and industry- university-research emphasizes on strengthening practical teaching links, deepening industry-university-research cooperation, and improving students' practical ability and innovation ability.

Construction of training bases inside and outside the school: Establish training bases inside and outside the school to provide students with practical operation opportunities.

Industry-university-research project cooperation: Cooperate with enterprises to carry out projects so that students can participate in the real research and development and production process.

Innovation and entrepreneurship education: carry out innovation and entrepreneurship education to cultivate students' entrepreneurial awareness and ability.

5) Differentiation of teaching staff construction.

The differentiation of teacher construction refers to the construction of a reasonable structure and a combination of professional and professional teachers according to the professional characteristics and development needs.

Dual teacher training: Strengthen the training of dual teacher training and improve the practical teaching ability of teachers.

Introduction of industry experts: The introduction of industry experts as part-time teachers to enrich the teaching content and methods.

Professional development of teachers: Teachers are encouraged to participate in professional development activities, such as academic exchanges, technology research and development.

6) Quality control and evaluation system differentiation.

The differentiation of quality control and evaluation system refers to the establishment of educational quality control and evaluation system which is adapted to the specialty characteristics.

Diversified evaluation standards: Establish diversified evaluation standards to comprehensively evaluate students' theoretical knowledge and practical ability.

Process evaluation: Strengthen process evaluation and pay attention to students' learning process and ability improvement.

Feedback and improvement mechanism: Establish effective feedback and improvement mechanism to continuously improve the quality of education and teaching.

7) Differentiation of student development support.

Student development support differentiation refers to providing differentiated student development support based on the individual needs and development goals of students.

Personalized guidance: Providing personalized academic guidance and career planning services to students.

Learning resource support: Provide rich learning resources, such as online courses, books and materials, to meet the learning needs of different students.

Student associations and activities: Support the development of student associations and academic activities, and promote the improvement of students' comprehensive quality.

5 Challenges and Countermeasures of Strategy Implementation

5.1 The Challenge of Teaching Staff Construction

Description of challenge: The new engineering major puts forward higher requirements for teachers' interdisciplinary knowledge, practical experience and innovative teaching ability, which may be difficult to meet with the existing teacher structure.

Countermeasures and Suggestions:

Strengthen teacher training and enhance teachers' interdisciplinary teaching ability.

Part-time teachers with industry backgrounds will be introduced to enrich the teaching team.

A school-enterprise cooperation mechanism will be established to promote teachers' participation in enterprise practice.

5.2 The Challenge of Teaching Resource Allocation

Challenge Description: The implementation of the new engineering specialty differentiation strategy requires a large number of teaching resources, including advanced experimental equipment, software resources and teaching platforms, and the allocation of these resources may be unbalanced.

Countermeasures and Suggestions:

Increase the investment in education and give priority to the demand of teaching resources for new engineering majors.

Use cloud computing and virtual simulation technology to improve the efficiency of resource sharing and utilization.

Cooperate with enterprises to jointly develop and update teaching resources.

5.3 The Challenge of Educational Evaluation System Reform

Challenge Description: The traditional educational evaluation system may be too focused on the assessment of theoretical knowledge, and it is difficult to comprehensively evaluate students' practical ability and innovative spirit.

Countermeasures and Suggestions:

Establish a diversified evaluation system to comprehensively assess students' theoretical knowledge, practical ability and innovative spirit.

Peer evaluation and self-evaluation should be introduced to increase the objectivity and impartiality of evaluation.

Use information technology, such as learning management systems, to improve the efficiency and accuracy of evaluations.

5.4 The Challenge of Combining Industry, University and Research

Challenge Description: The combination of industry, university and research is an important feature of new engineering education, but there may be some problems in practice, such as not close cooperation between schools and enterprises and single cooperation mode [6].

Countermeasures and Suggestions:

Establish a long-term school-enterprise cooperation mechanism to ensure the continuity and depth of cooperation.

Innovative cooperation models, such as co-construction laboratories, joint training, and customized courses for enterprises.

We will strengthen policy guidance and incentives to encourage enterprises to participate in education reform and personnel training.

5.5 The Challenge of Individualized Development Support for Students

Description of the challenge: In the process of implementing differentiation strategies, how to provide personalized development support for students with different backgrounds and needs is a problem that needs to be solved.

Countermeasures and Suggestions:

Establish a student development center to provide personalized academic guidance and career planning services [7].

Using big data and artificial intelligence technology, we analyze students' learning behaviors and needs, and provide customized learning resources and support.

The construction of student associations and interest groups will be strengthened to promote students' all-round development.

5.6 The Challenge of Equity in Education

Description of the challenge: How to ensure the fairness of education in the setting of new engineering majors and the allocation of resources, to avoid the inequality of educational opportunities caused by factors such as region, gender and family background.

Countermeasures and Suggestions:

Formulate equitable education policies to ensure that all regions and groups have access to quality educational resources.

We will increase support for vulnerable groups by providing scholarships, bursaries and other financial aid.

We will establish a monitoring and evaluation mechanism to regularly check the implementation of fairness in education.

Through in-depth analysis of the possible challenges encountered in the implementation process of the strategy, and put forward corresponding countermeasures and suggestions, this study aims to provide practical guidance for the differentiation strategy of the new engineering major setting in application-oriented undergraduate colleges, and promote the innovation of education reform and talent training mode. At the same time, through the establishment of effective supervision and evaluation mechanism, to ensure the continuous improvement and optimization of the strategy.

6 Differentiated Strategy Implementation Effect and Evaluation

According to the differentiation strategy of applied undergraduate colleges and universities developed in the previous research, the author and the corresponding team have carried out the implementation in the construction of the university's new engineering major of data science, big data technology and artificial intelligence since 2019, and recommended it to related brother colleges and universities. In order to determine whether the differentiation strategy has achieved the expected educational goals, collect data to judge the effectiveness and efficiency of educational activities, and the proportion of students achieving preset learning outcomes. According to the corresponding data, the calculation results show that the effect of differentiation strategy implementation is shown in Table 1.

Table 1. the effectiveness of the implementation of differentiation strategies

Year	Educational Goal Achievement	Curriculum Relevance	Teaching Method Appropriateness	Student Learning Experience	Teaching Effectiveness	Resource Utilization Efficiency
2019	60%	78%	average	average	average	50%
2020	65%	80%	average	average	average	55%
2021	70%	80%	good	average	average	55%
2022	75%	85%	good	average	average	70%
2023	80%	85%	excellent	good	good	79%
2024	82%	90%	excellent	excellent	average	80

- The Educational Goal Achievement has increased significantly from 60% to 82%, indicating a notable rise in the proportion of students achieving preset learning outcomes.

- Curriculum Relevance remained stable from 2019 to 2022 but improved in 2023 and 2024, indicating that curriculum content is becoming more aligned with industry needs and academic developments.
- Teaching Method Appropriateness improved from "Average" to "Excellent," suggesting that improvements in teaching methods have effectively stimulated students' interest and participation.
- Student Learning Experience reached "Excellent" in 2024, reflecting an increased satisfaction of students with the teaching process, course content, and teaching environment.
- Teacher Teaching Effectiveness reached "Good" and "Excellent" in 2023 and 2024, respectively, showing an enhancement in teachers' professional development and teaching skills.
- Resource Utilization Efficiency increased from 50% to 80%, indicating more efficient allocation and use of teaching resources.

7 Conclusion

This paper deeply discusses the strategic differentiation of new engineering major construction in application-oriented undergraduate colleges in the era of artificial intelligence. The research first analyzes the nature and unique attributes of new engineering education in applied undergraduate colleges, then focuses on the impact of AI on new engineering education, and discusses the homogenization of new engineering majors in general. Based on the theory of educational differentiation, this paper proposes a series of strategies for specialty differentiation, aiming at distinguishing specialty characteristics, innovating curriculum structure, diversifying teaching methods, and strengthening practical teaching links. These strategies aim to closely align educational supply with industry demand and train a new generation of engineers with innovative and practical abilities. Finally, this paper presents the researchers' successful experience and practices in implementing differentiation strategies through case studies, which can be used as reference for other colleges and universities. Through questionnaire survey of applied undergraduate colleges and universities that implement differentiation strategy, data is collected to judge the effectiveness and efficiency of educational activities. The data list shows that all indicators have achieved good results, indicating that the differentiation strategy proposed in this study has achieved success in practical application.

The implementation of the differentiation strategy may also face various challenges. By innovating the education and teaching management mechanism and establishing an effective supervision and evaluation mechanism [8], continuous improvement and optimization of the strategy can be ensured and better application results can be finally achieved.

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