

Analysis of the Necessity for Higher Vocational Colleges to Conduct Scientific Research and Exploration of Innovative Pathways

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Abstract: As an integral part of China's higher education system, higher vocational colleges play a significant role in talent cultivation, social services, and cultural inheritance. With the development of the times and the advancement of educational reform, the role of scientific research in higher vocational colleges has become increasingly prominent. This paper started from the necessity of conducting scientific research in higher vocational colleges, providing an in-depth analysis of its importance in improving teaching quality, promoting teachers' professional development, driving social services, and enhancing the college's core competitiveness. At the same time, addressing the existing problems in current scientific research work at higher vocational colleges, this paper proposed innovative pathways focusing on the scientific research management system, scientific research team construction, scientific research funding investment, and scientific research outcome transformation. The aim is to provide valuable references for the scientific research development of higher vocational colleges.

Keywords: Higher vocational college; Scientific research; Necessity analysis; Existing problem; Innovative pathway

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1. Introduction

Higher vocational education is one of the types of education most closely linked to economic and social development within China's education system, playing a crucial role in cultivating high-quality technical and skilled talents and serving local economic and social development. In recent years, with the continuous upgrading of China's industrial structure and the deepening implementation of the innovation-driven development strategy, higher vocational colleges are facing new opportunities and challenges. Scientific research, serving as a key support for higher vocational colleges to enhance the educational quality and strengthen the social service capability, is receiving increasing attention ^[1].

Due to the influence of historical reasons, own positioning and other factors, scientific research in higher vocational colleges is relatively underdeveloped, showing a significant gap compared to ordinary undergraduate

universities ^[2]. Currently, some higher vocational colleges still have prominent problems such as insufficient emphasis on scientific research work, incomplete scientific research management system, weak construction of scientific research teams, insufficient scientific research funding, and low efficiency in the transformation of scientific research outcomes ^[3]. These problems severely constrain the in-depth development of scientific research in higher vocational colleges and also affect the enhancement of the overall educational standards and social service capabilities.

Deeply analyzing the necessity of conducting scientific research in higher vocational colleges and exploring innovative pathways hold significant theoretical and practical importance for promoting the high-quality development of higher vocational education. This paper will start from the necessity of scientific research in higher vocational colleges, analyze its important roles in improving teaching quality, promoting teachers' professional development, driving social services, and enhancing college's core competitiveness. Combining this with the existing problems in scientific research work, corresponding innovative pathways will be proposed to provide useful references and insights for the scientific research development of higher vocational colleges, as shown in **Figure 1**.

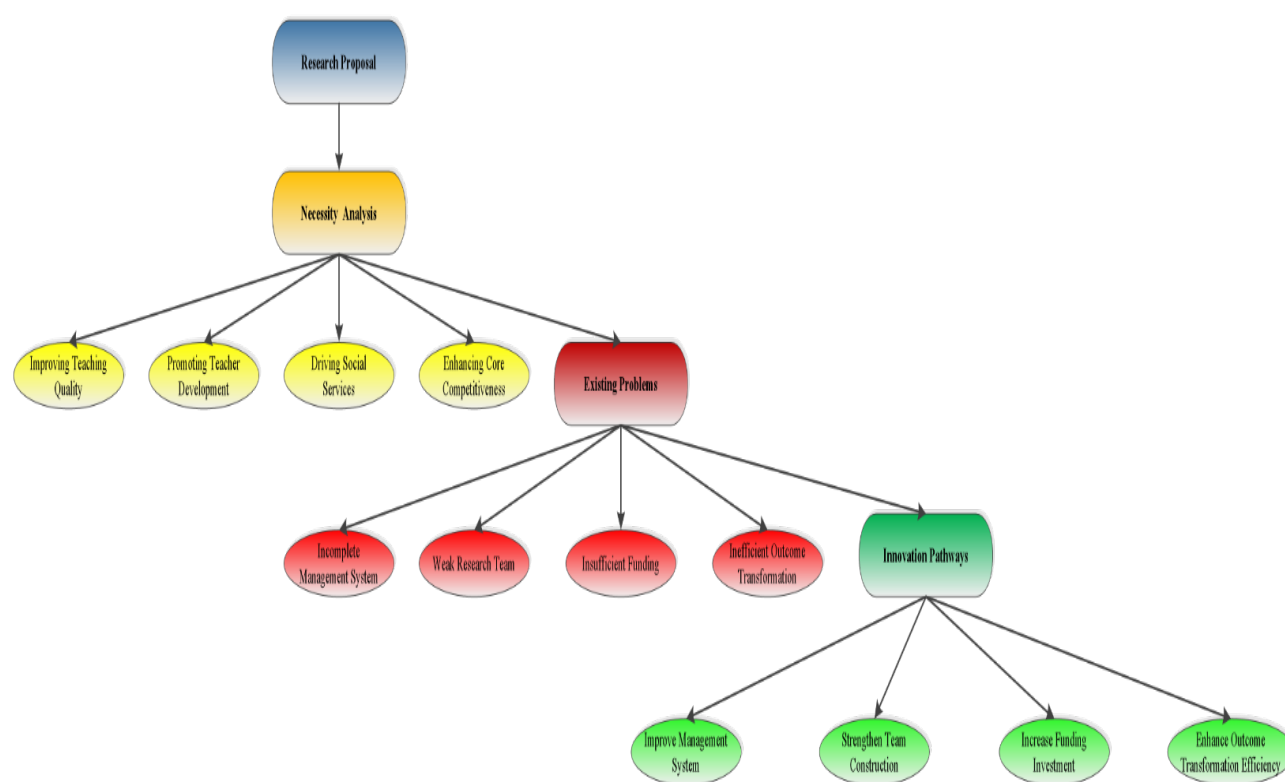


Figure 1. Technical routes.

2. Necessity analysis of scientific research in higher vocational colleges

Necessity analysis of scientific research in higher vocational colleges is shown in **Figure 2**.

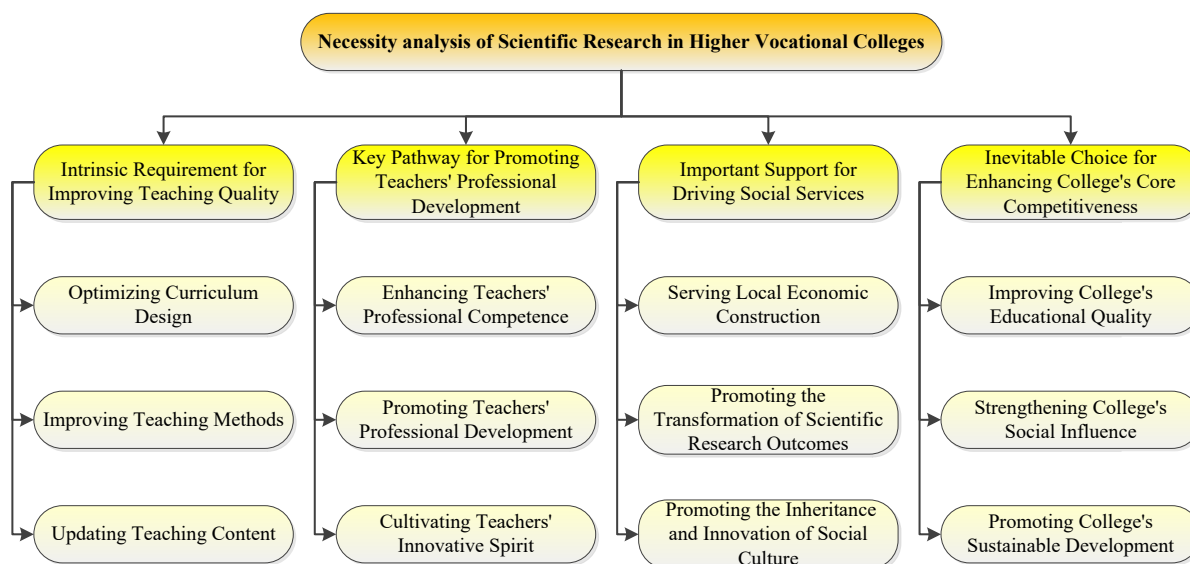


Figure 2. Necessity analysis of scientific research in higher vocational colleges.

2.1. Intrinsic requirement for improving teaching quality

2.1.1. Optimizing curriculum design

The curriculum design in higher vocational colleges needs to be closely aligned with actual industry demands and scientific research can provide a scientific basis for this. Through scientific research activities such as industry surveys and studies on technological development trends, higher vocational colleges can promptly understand new industry requirements for the knowledge and skill structure of talents, thereby optimizing the curriculum system. Integrating content on cutting-edge technologies and innovative concepts makes the curriculum more forward-looking and adaptable.

2.1.2. Improving teaching methods

Scientific research activities can encourage teachers to continuously explore new teaching methods and approaches^[4]. For instance, by participating in scientific research projects, teachers can introduce methods like project-driven teaching and case-based teaching into the classroom, enhancing students' learning interest and practical abilities. Simultaneously, the transformation of scientific research outcomes provides rich cases and project resources for practical teaching, helping to cultivate students' innovative thinking and problem-solving skills.

2.1.3. Updating teaching content

The teaching content in higher vocational colleges needs to keep pace with industry technological developments. Scientific research work enables teachers to stay abreast of the latest industry dynamics and technological outcomes and integrate them into teaching. For example, in the field of intelligent manufacturing, teachers involved in relevant scientific research projects can introduce application cases of cutting-edge technologies like artificial intelligence and big data into courses, allowing students to access the latest technological outcomes and enhancing their employability.

2.2. Key pathway for promoting teachers' professional development

2.2.1. Enhancing teachers' professional competence

Scientific research is an important means for teachers to enhance their professional competence ^[5]. By participating in scientific research projects, teachers can gain an in-depth understanding of frontier theories and technologies in their fields, broaden their knowledge horizons, and improve their academic level and professional capabilities. For example, while exploring the application of a new technology, teachers need to review extensive literature and engage in discussions with peer experts, which helps them systematically organize their professional knowledge system and enhance their professional literacy.

2.2.2. Promoting teachers' professional development

Scientific research outcomes are one of the important evaluation indicators for teachers' professional development. In higher vocational colleges, professional title evaluation, job promotion, etc., are often linked to scientific research outcomes. Engaging in scientific research allows teachers to obtain more academic outcomes, such as publishing papers, applying for patents, or winning scientific research awards, thereby providing strong support for their professional development. Furthermore, scientific research activities can provide opportunities for cooperation with enterprises, broadening their professional development space.

2.2.3. Cultivating teachers' innovative spirit

The essence of scientific research activity is innovation. During the scientific research process, teachers need to continuously explore new research methods and technical routes to solve practical problems. The cultivation of this innovative spirit and practical ability not only helps teachers achieve breakthroughs in scientific research but also allows them to integrate innovative thinking into teaching and management, thereby enhancing the college's overall educational standards.

2.3. Important support for driving social services

2.3.1. Serving local economic construction

As important bases for local talent cultivation, higher vocational colleges bear the mission of serving local economic construction ^[6]. Through scientific research, higher vocational colleges can engage in industry-academia-research cooperation with local enterprises, providing technical support and solutions to promote local economic development. For example, higher vocational colleges can conduct technical research and development, product innovation, and other scientific research projects around local leading industries to help enterprises improve production efficiency and product quality, and enhance their market competitiveness.

2.3.2. Promoting the transformation of scientific research outcomes

The transformation of scientific research outcomes is a key link for realizing their value. Scientific research outcomes from higher vocational colleges often possess strong practicality and applicability, allowing them to serve society directly. By establishing mechanisms for transforming scientific research outcomes, colleges can turn scientific research outcomes into practical productive forces, driving local economic and social development. For instance, patents developed by teachers can be transferred to enterprises, or joint outcome transformation centers can be established with companies to promote the industrial application of scientific research outcomes.

2.3.3. Promoting the inheritance and innovation of social culture

In the course of scientific research, higher vocational colleges can deeply explore local cultural resources, conducting innovative research and development using modern technological means to promote the inheritance and innovation of local culture. For example, research on the digital preservation and inheritance of traditional

local crafts can be conducted, utilizing technologies like virtual reality and augmented reality for digital display and dissemination, revitalizing these traditions in modern society.

2.4. Inevitable choice for enhancing college's core competitiveness

2.4.1. Improving college's educational quality

Scientific research is a key marker of educational quality for higher vocational colleges ^[7]. Conducting high-level scientific research can attract more excellent teachers and students, enhancing the college's reputation and prestige. Meanwhile, the accumulation of scientific research outcomes provides strong support for professional construction, curriculum construction, and faculty team construction, driving the continuous improvement of the college's overall educational level.

2.4.2. Strengthening college's social influence

Scientific research outcomes from higher vocational colleges can directly serve society and solve practical problems, thus garnering significant social attention. Through conducting scientific research activities, higher vocational colleges can establish extensive cooperative relationships with local governments, enterprises, and social organizations, enhancing their social influence. For example, hosting scientific research outcome exhibitions or technical exchange events can showcase the college's scientific research strength and educational outcomes to the public, boosting its social reputation.

2.4.3. Promoting college's sustainable development

Scientific research provides momentum for the sustainable development of higher vocational colleges. Through scientific research, higher vocational colleges can continuously explore new educational models and development pathways to adapt to changes in socio-economic development. Additionally, the transformation of scientific research outcomes can generate certain economic benefits, providing financial support for sustainable development.

3. Existing Problems of scientific research in higher vocational colleges

Existing problems of scientific research in higher vocational colleges are shown in **Figure 3**.

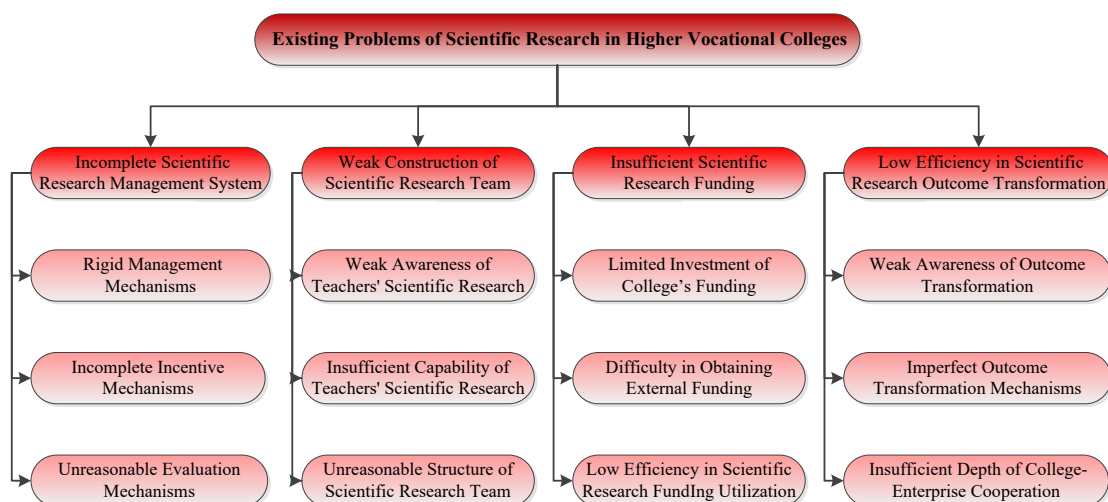


Figure 3. Existing problems of scientific research in higher vocational colleges.

3.1. Incomplete scientific research management system

3.1.1. Rigid management mechanisms

Currently, many higher vocational colleges employ traditional administrative models for scientific research management, lacking flexibility and innovation^[8]. The functional positioning of scientific research management departments is unclear, and management processes are cumbersome, leading to low efficiency. For example, the application and approval process for scientific research projects often requires reviews and signatures from multiple departments, involving cumbersome procedures and long waiting times, which dampens teachers' enthusiasm for scientific research.

3.1.2. Incomplete incentive mechanisms

Scientific research incentive mechanisms are crucial for motivating teachers, but those in many higher vocational colleges are flawed. On one hand, scientific research reward standards are often low and disproportionate to teachers' scientific research input, failing to provide effective motivation. On the other hand, incentive mechanisms lack fairness and transparency, with phenomena like "ranking based on seniority," which discourages young teachers.

3.1.3. Unreasonable evaluation mechanisms

Scientific research evaluation mechanisms in higher vocational colleges often overemphasize quantitative indicators like the number of publications and patents, neglecting the quality and practical application value of scientific research outcomes. This leads teachers to prioritize quantity over quality, and can even result in academic misconduct such as plagiarism and fraud. Furthermore, such mechanisms are not conducive to evaluating and promoting applied scientific research outcomes.

3.2. Weak construction of scientific research team

3.2.1. Weak awareness of teachers' scientific research

Some teachers in higher vocational colleges lack sufficient understanding of the importance of scientific research, believing it is the task of undergraduate university teachers, while their main duty is teaching, and that scientific research is not closely related to their professional development^[9]. This perception leads to a lack of initiative, and teachers are unwilling to invest time and effort in scientific research activities.

3.2.2. Insufficient capability of teachers' scientific research

Teachers in higher vocational colleges generally have relatively lower academic qualifications and weak scientific research foundations, lacking systematic scientific research training. Although some teachers are willing to conduct scientific research, they struggle to undertake scientific research projects independently due to a lack of scientific research methods and experience. Simultaneously, insufficient college's investment in cultivating teachers' scientific research capabilities and the absence of effective training systems hinder the improvement of their scientific research abilities.

3.2.3. Unreasonable structure of scientific research team

Scientific research teams in higher vocational colleges often revolve around individuals, lacking team cooperation spirit. Members of scientific research team frequently share similar professional backgrounds, lacking interdisciplinary and cross-professional cooperation, making it difficult to form synergistic innovation

capabilities. Additionally, the age structure within scientific research teams is often unreasonable, with a low proportion of young teachers, limiting the team's innovation capacity and sustainability.

3.3. Insufficient scientific research funding

3.3.1. Limited investment of college's funding

Higher vocational colleges primarily rely on fiscal allocations and tuition fees for funding, often facing financial constraints. Within limited fundings, priority is given to basic expenditures like teaching and student management, resulting in insufficient investment in scientific research ^[10]. For example, annual scientific research funding in some higher vocational colleges may account for only about 5% of the total budget, hardly meeting the needs of teachers engaged in scientific research.

3.3.2. Difficulty in obtaining external funding

Compared to ordinary undergraduate universities, higher vocational colleges are at a disadvantage when applying for scientific research projects and securing funding. On one hand, their relatively weaker scientific research strength makes it difficult to obtain grants from national and provincial scientific research projects. On the other hand, enterprises often prefer cooperating with undergraduate universities when choosing scientific research partners, making it harder for higher vocational colleges to acquire external scientific research fundings.

3.3.3. Low efficiency in scientific research funding utilization

Due to incomplete scientific research management systems, the use of scientific research fundings in higher vocational colleges is often inefficient. Some teachers lack planning in utilizing fundings, leading to waste. Moreover, cumbersome reimbursement processes for scientific research fundings create inconveniences, affecting the efficiency of scientific research funding utilization.

3.4. Low efficiency in scientific research outcome transformation

3.4.1. Weak awareness of outcome transformation

Some teachers in higher vocational colleges underestimate the importance of transforming scientific research outcomes, believing that publishing papers or applying for patents is sufficient, and lack the awareness to turn scientific research outcomes into practical productive forces. Meanwhile, higher vocational colleges provide insufficient promotion and guidance on scientific research outcome transformation, resulting in limited understanding among teachers about the pathways and methodologies for transforming scientific research outcomes.

3.4.2. Imperfect outcome transformation mechanisms

The mechanisms for transforming scientific research outcomes in higher vocational colleges are not yet fully established, lacking specialized transformation agencies and professionals ^[11]. Transformation involves multiple steps like technology assessment, intellectual property protection, and market promotion. However, higher vocational colleges often lack professional capacity in these areas, resulting in inefficient transformation processes. For instance, some patented technologies remain idle for long periods due to a lack of market promotion channels, failing to realize their potential value.

3.4.3. Insufficient depth of college-enterprise cooperation

College-enterprise cooperation is a vital pathway for transforming scientific research outcomes, but current cooperations between many higher vocational colleges and enterprises often remain superficial, lacking depth and stability. Some cooperations are limited to student internships and employment, with little attention paid to the college's scientific research outcomes. Furthermore, higher vocational colleges often lack initiative and proactivity in these partnerships, failing to fully leverage their advantages to promote scientific research outcome transformation.

4. Innovative pathways of scientific research in higher vocational colleges

Innovative pathways of scientific research in higher vocational colleges are shown in Figure 4.

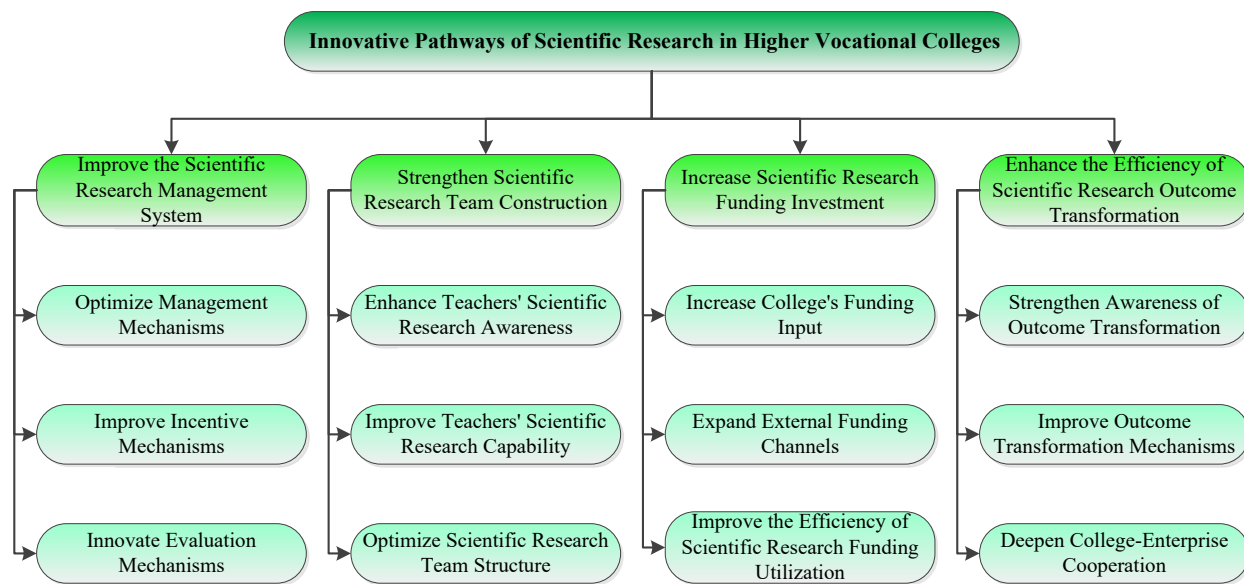


Figure 4. Innovative pathways of scientific research in higher vocational colleges.

4.1. Improve the scientific research management system

4.1.1. Optimize management mechanisms

Higher vocational colleges should further optimize their scientific research management systems, clarify the functional positioning of scientific research management departments, simplify management processes, and improve efficiency^[12]. For example, establishing a “one-stop” service mechanism for scientific research project application and approval can reduce unnecessary steps and procedures, facilitating teachers’ scientific research activities.

4.1.2. Improve incentive mechanisms

Higher vocational colleges should establish and improve incentive mechanisms for scientific research, raise the standards for scientific research awards, and increase the rewards for teachers’ scientific research outcomes. Simultaneously, they should enhance the fairness and transparency of these mechanisms, establishing a quality and contribution-oriented scientific research evaluation system to avoid “ranking based on seniority” and fully motivate young teachers.

4.1.3. Innovate evaluation mechanisms

Higher vocational colleges should innovate their research evaluation mechanisms, establishing a diversified evaluation system. Evaluation indicators should focus on the quality and practical application value of outcomes, reducing reliance on quantitative indicators such as the number of papers published or patents applied for. Furthermore, personalized evaluation standards should be developed based on the characteristics of different disciplines and majors, encouraging teachers to engage in applied scientific research.

4.2. Strengthen scientific research team construction

4.2.1. Enhance teachers' scientific research awareness

Higher vocational colleges should strengthen scientific research training and education for teachers, enhancing their understanding of the importance of scientific research through lectures, academic exchanges, etc. Additionally, scientific research work should be incorporated into faculty evaluation systems to guide active participation.

4.2.2. Improve teachers' scientific research capability

Higher vocational colleges should increase investment in cultivating teachers' scientific research capabilities, establishing systematic training systems^[13]. Inviting external experts for scientific research method training, organizing participation in academic conferences and project application workshops can help improve teachers' scientific research levels. Encouraging teachers to undertake internships in enterprises can also enhance their practical and applied scientific research abilities.

4.2.3. Optimize scientific research team structure

Higher vocational colleges should focus on building scientific research teams and optimizing their structure. Team formation should emphasize interdisciplinary and cross-professional cooperation to foster synergistic innovation. Additionally, increasing efforts to cultivate young teachers and optimize the age structure of teams will enhance innovation capacity and sustainability.

4.3. Increase scientific research funding investment

4.3.1. Increase college's funding input

Higher vocational colleges should actively seek financial support to increase their funding income. During the funding allocation process, greater investment should be directed towards scientific research, raising the proportion of scientific research funding. For instance, setting up special scientific research fundings to support teachers' scientific research projects.

4.3.2. Expand external funding channels

Higher vocational colleges should strengthen cooperation with enterprises to actively secure external scientific research funding. This can be achieved by jointly building scientific research platforms with enterprises and conducting industry-academia-research cooperation projects to attract enterprise investment. Simultaneously, teachers should be encouraged to actively apply for national and provincial scientific research projects to secure more funding.

4.3.3. Improve the efficiency of scientific research funding utilization

Higher vocational colleges should strengthen scientific research funding management to improve utilization efficiency^[14]. Implementing a scientific research funding budgeting system, requiring detailed expenditure

plans when applying for scientific research projects, ensures rational funding allocation. Simplifying the reimbursement process for scientific research fundings also provides convenience for teachers.

4.4. Enhance the efficiency of scientific research outcome transformation

4.4.1. Strengthen awareness of outcome transformation

Higher vocational colleges should enhance education on outcome transformation for teachers, raising their awareness through training and case studies. Increased promotion and publicity about outcome transformation pathways and methods can encourage teachers to turn scientific research outcomes into practical productive forces.

4.4.2. Improve outcome transformation mechanisms

Higher vocational colleges should establish robust mechanisms for transforming scientific research outcomes, setting up specialized transformation agencies staffed with professionals. Cooperating with professional intellectual property service agencies can provide services like technology assessment and intellectual property protection. Incentive mechanisms for successful transformation should also be established to reward teachers who make significant contributions.

4.4.3. Deepen cooperation between colleges and enterprises

Higher vocational colleges should further deepen their cooperation with enterprises, strengthening communication and exchange with enterprises ^[15]. Establishing joint research and development centers and internship bases with enterprises can enhance the depth and stability of cooperation. Furthermore, higher vocational colleges should fully utilize their strengths to provide technical support and solutions for enterprises, promoting the transformation and application of scientific research outcomes.

5. Conclusion

Conducting scientific research in higher vocational colleges is of great significance. It can enhance teaching quality, promote teachers' professional development, drive social services, and strengthen the college's overall competitiveness. However, current scientific research work in higher vocational colleges still faces problems such as an incomplete scientific research management system, weak scientific research team construction, insufficient scientific research funding, and low efficiency in scientific research outcome transformation. Therefore, higher vocational colleges should explore innovative pathways for scientific research by improving the scientific research management system, strengthening scientific research team construction, increasing scientific research funding investment, and enhancing the efficiency of scientific research outcome transformation. By strengthening scientific research work, higher vocational colleges can better adapt to the needs of socio-economic development and contribute more significantly to the high-quality development of higher vocational education in China.

Disclosure statement

The authors declare no conflict of interest.

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