



Research Paper

Research on the cultivation of undergraduate research ability based on the Challenge Cup competition

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Abstract: Chinese undergraduate graduates are generally found to be deficient in research, hands-on, and innovative practice abilities. Thus, it is imperative for universities to enhance the cultivation of undergraduate research competence. This paper investigates the central role of research projects in developing undergraduate research abilities and identifies the obstacles and challenges faced in this process, such as limited participation opportunities, unclear motivations, and inadequate research skills. Universities, constrained by funding, equipment, and faculty resources, often face difficulties in providing sufficient research project resources. Additionally, some undergraduates lack a profound understanding of the value of research and have limited knowledge reserves and practical experience. In response to these issues, this paper proposes the following strategies: universities should augment research project resources by establishing special funds, strengthening external collaborations, and encouraging faculty to open up research projects; enhance publicity and education to clarify motivations for participation, stimulate research interest, and improve undergraduate research competence through various means, thereby fostering independent thinking and innovative spirit.

Keywords: Undergraduate research competence, Research projects, Obstacles and challenges, Response strategies, Comprehensive quality development

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I. Introduction

At present, the majority of domestic undergraduate graduates possess a solid foundation of professional knowledge. However, they are relatively deficient in research capabilities, hands-on skills, and innovative practice abilities. Moreover, the cultivation of undergraduate research competence has not yet received sufficient attention from universities (Zou W., Yu J. Y., Mao Y. Z., 2022). It is evident that nurturing undergraduates with robust research capabilities has become one of the crucial tasks in higher education. Consequently, numerous scholars have conducted research on the development of undergraduate research competence. Some have explored the research competence of local applied undergraduates and proposed strategies to enhance undergraduate research capabilities (Qin R. L., Guan Y. L., Yu J. L., 2022). Other scholars have investigated the cultivation of undergraduate research and innovation abilities, analyzing and exploring the topic selection, talent selection, and training methods in the process of undergraduate research competence development. However, none of them have highlighted the significant role of research projects in the development of undergraduate research competence (Pu C. Z., Guo Y. F., Li C., 2022). In the exploration of undergraduate research competence development, it has been posited that research projects are an indispensable component. The research process of such projects has been emphasized, yet the potential obstacles and challenges, as well as corresponding strategies, in the context of undergraduate research competence development through research projects have not been thoroughly examined (Zhang L. C., Bao X. M., Sun L. Q., 2023).

Against this backdrop, this paper first examines the pivotal role of research projects in the development of undergraduate research competence. It identifies the various difficulties that undergraduates may encounter when participating in research projects. Finally, it proposes corresponding solutions to address the challenges faced in the strategies for undergraduate research competence development through research projects, thereby providing a reference for the cultivation of undergraduate research capabilities.

II. The core role of scientific research projects

Research projects play a pivotal role in cultivating undergraduate research competence. By integrating practice and innovation, they refine students' research capabilities and enhance their collaborative and communication skills, thereby comprehensively improving their overall quality.

2.1 Dual-Driven practice and innovation: refining research competence

Research projects serve as a valuable source for undergraduates to obtain opportunities for practical innovation. They provide a pathway for students to deeply engage in the actual work of scientific research and guide them in exploring cutting-edge issues in the field of science. Through participation in research projects, undergraduates are exposed to and master advanced scientific theories and applications. They also hone essential skills such as experimental design, data analysis, and scientific paper writing. More importantly, this process fosters their ability to think independently and solve problems, forming a solid foundation for their research endeavors. In the context of research projects, undergraduates are not only required to apply their acquired knowledge to solve practical problems but also encouraged to challenge conventional ideas and innovate by proposing unique research approaches and methods. This learning model, which combines practice and innovation, is irreplaceable in refining undergraduate research competence. It not only enhances their experimental and data processing skills but also ignites their scientific curiosity and spirit of exploration, laying a robust foundation for their future academic and professional pursuits (Zhang C., Zhang Y. Y., Zhang L. Q., 2023).

2.2 Team collaboration and communication to enhance overall quality

In research projects, teamwork is of paramount importance. It not only demands that undergraduates possess solid professional knowledge but also emphasizes the necessity of strong team spirit and excellent communication skills. Through close collaboration with supervisors and team members, undergraduates collectively tackle research challenges and advance the research work step by step. This process hones their abilities in listening to others' perspectives, articulating their own ideas, and making wise decisions, thereby significantly enhancing their overall quality and laying a solid foundation for their future careers. Moreover, teamwork in research projects plays a crucial role in cultivating undergraduates' adaptability and resilience. When confronted with difficulties and challenges, they are required to remain calm, adapt flexibly, and work with team members to identify effective solutions. Such experiences not only strengthen their psychological resilience and stress tolerance but also develop their ability to solve problems efficiently in complex and dynamic environments. Therefore, research projects serve not only as a comprehensive cultivation of undergraduate research capabilities but also as a holistic enhancement of their overall quality, providing a robust foundation for their future development.

III. Potential obstacles and challenges

Research projects, as an essential platform, play an irreplaceable role in enhancing undergraduate research capabilities and overall quality. However, undergraduates often encounter several potential barriers and challenges when participating in research projects, such as limited opportunities for involvement, unclear motivations, and inadequate research skills. A detailed analysis is provided as follows.

3.1 Insufficient participation opportunities

Although universities have generally recognized the importance of undergraduate involvement in research, in practice, due to constraints such as funding, equipment, and faculty resources, the actual opportunities for undergraduates to participate in research projects remain quite limited. Research projects require substantial funding to support the normal conduct of research activities, including necessary expenditures such as the purchase of experimental materials, acquisition and maintenance of equipment, and remuneration for researchers (Lin Z. J., Cui Y. G., Zhou Y. H., 2023). However, some universities may prioritize more urgent needs in their budget allocation, such as infrastructure construction and the recruitment of high-level talents, resulting in relatively tight funding for research projects that cannot meet the participation demands of undergraduates. Moreover, the purchase and utilization of high-end research equipment are costly and limited in quantity. This creates a certain level of competition and pressure for undergraduates when they attempt to engage in research projects. Additionally, some universities face shortcomings in faculty strength, lacking teachers with rich research experience and professional capabilities to effectively guide undergraduate research activities. The combined effect of these factors results in a significant deficiency in the opportunities for undergraduates to participate in research projects, thereby restricting their in-depth exploration and development in the field of research.

3.2 Unclear motivations for participation

The motivations of undergraduates to engage in research projects are diverse (Fang S. Q., Cai C. D., Su N., 2023), yet the ambiguous motivations of some students significantly affect their level of commitment and effectiveness in research projects. On one hand, some undergraduates may join research projects merely out of a herd mentality or in pursuit of external rewards such as scholarships or graduate school admission qualifications, without truly understanding the profound significance and value of research. They also lack a clear sense of their own research interests and directions. This blind participation often results in a lack of initiative and creativity in the project, with students merely fulfilling tasks superficially and failing to produce meaningful research outcomes. On the other hand, some undergraduates place excessive emphasis on immediate results and honors, viewing research projects as platforms to showcase their talents and abilities, while neglecting the long-term commitment and in-depth investigation required by the projects themselves. This utilitarian motivation leads to restlessness and an inability to fully immerse themselves in the world of research. Consequently, they fail to genuinely enhance their research capabilities and overall quality through the process. This lack of clarity in motivation undoubtedly poses a potential barrier to both the quality of research projects and the personal development of undergraduates.

3.3 Insufficient research competence

Due to limited knowledge reserves and relatively inadequate practical experience, undergraduates often feel overwhelmed when participating in research projects, and this deficiency in research competence poses a significant challenge. Specifically, undergraduates typically have a relatively narrow scope of professional knowledge, which may lead to a lack of in-depth understanding of cutting-edge developments and research directions in certain scientific fields. This, in turn, makes it difficult for them to propose innovative research ideas and methods in research projects, and to conduct in-depth analyses and solutions for complex problems. Moreover, compared with graduate students and research professionals, undergraduates generally have less practical experience and are less familiar with experimental operations and design. This can result in an inability to promptly and effectively address unforeseen issues that arise during experiments, thereby affecting the progress and outcomes of the experiments. Additionally, research projects often require participants to possess interdisciplinary knowledge and comprehensive skills, such as data analysis, literature retrieval, and teamwork. However, undergraduates may fall short in these areas and need to continuously learn and improve during their involvement in research projects. This not only impacts the progress and quality of research projects but may also undermine the research confidence and interest of undergraduates.

IV. Response strategies

In response to the potential barriers and challenges faced by undergraduates in research projects, the following section proposes specific strategies from three perspectives.

4.1 Increasing research project resources and optimizing allocation mechanisms

To address the issue of insufficient research project resources, universities should explore multiple avenues to raise funds, increase the number and variety of research projects, and provide more opportunities for undergraduate participation. Specific measures are as follows:

4.1.1 Establishing research special funds

Universities can set up dedicated undergraduate research funds, raising capital both within and outside the university to provide stable financial support for undergraduate research projects. These funds can support research projects independently proposed by undergraduates, as well as projects led by faculty members or research teams that include undergraduate participants. Additionally, universities should establish comprehensive fund management systems and evaluation mechanisms to ensure the fairness and effectiveness of fund utilization.

4.1.2 Strengthening collaborations with On- and Off-Campus institutions

Universities should actively forge partnerships with research institutions and enterprises both within and outside the university to jointly support undergraduate research activities. Through these collaborations, universities can access additional research project resources and funding, while also exposing undergraduates to real-world needs and demands from industry and society. This not only provides more practical opportunities and career pathways for undergraduates but also allows universities to draw on external research management experiences and models to enhance their own research management capabilities.

4.1.3 Encouraging faculty to open up research projects

Universities should encourage faculty members to open their research projects to undergraduate students, inviting them to participate in research activities. This not only offers more practical opportunities for undergraduates but also fosters interaction and collaboration between faculty and students. To further promote this initiative, universities should establish robust incentive mechanisms and evaluation systems that encourage faculty participation in undergraduate research activities and integrate such involvement into faculty performance assessments and promotion criteria.

4.2 Optimizing allocation mechanisms to ensure equal access

To ensure that undergraduates have equal opportunities to participate in research projects, universities should set reasonable project application criteria and selection standards based on students' interests, abilities, and disciplinary characteristics. The main measures include:

4.2.1 Establishing a research project information platform

Universities should create a platform for the public disclosure of research project information, where details such as project titles, research content, application requirements, and selection criteria are promptly released. This ensures that undergraduates have equal access to participation opportunities. Additionally, the platform should provide comprehensive management services throughout the project lifecycle, including application, evaluation, and conclusion, thereby enhancing the efficiency and fairness of project management.

4.2.2 Implementing diversified selection methods

Universities should adopt a diversified selection approach, incorporating methods such as interviews, written tests, and practical operations to comprehensively assess undergraduates' overall qualities and research potential. Emphasis should be placed on the scientific and equitable nature of selection criteria to avoid subjective biases and undue influences. Furthermore, a "rolling" selection mechanism can be employed, allowing for dynamic adjustments based on students' performance and contributions during the project implementation. This ensures that outstanding undergraduates can continue to be involved in research projects.

4.2.3 Promoting interdisciplinary and cross-major team collaboration

Universities should encourage undergraduates to form research teams across different disciplines and majors to jointly apply for and implement research projects. This not only broadens students' academic horizons but also fosters communication and collaboration between various disciplines. To support this initiative, universities should provide corresponding support and guarantee measures, such as offering interdisciplinary mentorship and providing access to laboratories and equipment resources.

4.3 Clarifying motivations and multidimensionally stimulating research interest

To address the issue of unclear motivations among undergraduates participating in research projects, universities and supervisors should work together to stimulate and cultivate their research interest from multiple levels and perspectives. The following practical and effective measures can be adopted:

4.3.1 Strengthening the publicity and education of research projects

It is crucial for universities to enhance the publicity and education of research projects. As the cradle of student development, universities have the responsibility to provide undergraduates with a wealth of research project information and resources. Offering introductory courses on research can provide freshmen with a macroscopic understanding of research work from the very beginning of their academic journey. Additionally, regularly organizing research lectures and seminars can further enhance undergraduates' interest and enthusiasm for research projects. Inviting renowned scholars, outstanding graduate students, or undergraduates to share their research experiences and achievements not only allows students to personally experience the charm and value of research but also inspires their determination and courage to engage in research through the power of role models. Moreover, universities should fully utilize campus media and online platforms to widely promote the importance and significance of research projects, creating a strong research atmosphere. This enables undergraduates to be constantly exposed to the appeal and value of research.

4.3.2 Leveraging the role of supervisors

The role of supervisors in research projects cannot be overstated. As the guides on undergraduates' research journey, supervisors' guidance and support have a significant impact on the cultivation of their research interest. Therefore, when selecting participants for research projects, supervisors should comprehensively understand undergraduates' expectations and goals through interviews, questionnaires, and other methods. They can then provide targeted guidance based on students' interests and characteristics. During the project

implementation, supervisors should regularly engage in face-to-face communication with undergraduates to understand their thoughts, difficulties, and challenges, and offer timely guidance and assistance. This continuous attention and guidance can help undergraduates clarify the significance and value of participating in research projects, enhance their sense of responsibility and mission, and encourage them to actively engage in research work.

4.3.3 Establishing research interest groups or clubs

Creating research interest groups or clubs is another effective way to stimulate research interest. Universities can encourage undergraduates to spontaneously form research interest groups or clubs based on their interests and provide necessary support and guarantees. These groups or clubs can conduct in-depth research and exploration around specific research topics or fields and regularly organize academic salons, practical projects, and other activities. This provides undergraduates with a platform to showcase themselves and engage in exchanges and cooperation. Through such activities, undergraduates can cultivate their research interest and innovative spirit in a relaxed and enjoyable atmosphere. They can also meet like-minded friends and partners, fostering mutual growth and progress.

4.3.4 Implementing a research credit system

Implementing a research credit system is also a practice worth promoting. Universities can incorporate research projects into the undergraduate curriculum and offer credit rewards to encourage more undergraduates to actively participate in research projects. This approach not only stimulates undergraduates' research interest but also enhances their practical and innovative abilities. Of course, a comprehensive credit recognition and conversion mechanism needs to be established during implementation to ensure the equivalence and interchangeability between research credits and course credits, avoiding issues such as unclear credit recognition or difficulties in conversion.

4.4 Systematically enhancing research competence with emphasis on independent thinking and innovative spirit

To address the issue of insufficient research competence among undergraduates, universities should establish a comprehensive training mechanism that focuses on systematic training in research methods, experimental skills, literature retrieval, and other relevant areas. Specific measures are as follows:

4.4.1 Offering relevant courses and experimental training

Universities can introduce courses and experimental training related to research projects, such as research methodology, experimental design and operation, and data analysis and processing. These courses and training sessions can equip undergraduates with fundamental research skills and methods, laying a solid foundation for their participation in research projects. Additionally, universities should focus on updating and optimizing course content to ensure alignment with the latest research technologies and methodologies.

4.4.2 Providing online learning resources and practice platforms

Universities can offer a wealth of online learning resources and practice platforms, such as online courses, instructional videos, and virtual laboratories (Gu X. Y., Su L., Chang X. H., 2023). These resources and platforms provide undergraduates with opportunities for self-directed learning and practical exercises. Universities should also strengthen the development and management of online learning resources to ensure their quality and effectiveness.

4.4.3 Establishing research assistant positions or laboratory open projects

Universities can create research assistant positions or laboratory open projects to provide more practical training opportunities for undergraduates. By participating in these initiatives, undergraduates can gain exposure to real-world research project demands and challenges, thereby enhancing their practical skills and problem-solving abilities. Universities should also establish comprehensive selection and management mechanisms to ensure the quality and effectiveness of research assistant positions and laboratory open projects.

4.5 Cultivate independent thinking and innovative spirit

While enhancing research competence, it is also essential to focus on cultivating independent thinking and innovative spirit among undergraduates. The following measures can be adopted:

4.5.1 Encouraging undergraduates to express their own ideas and insights

During the implementation of research projects, supervisors should encourage undergraduates to boldly express their own ideas and insights, allowing them to conduct exploratory attempts within a certain scope.

Even if the ideas of undergraduates are immature or flawed, supervisors should provide positive feedback and constructive guidance to help them gradually refine and enhance their thinking abilities. At the same time, universities should establish corresponding incentive mechanisms and evaluation systems to encourage undergraduates to actively participate in academic discussions and exchange activities.

4.5.2 Developing critical thinking skills in undergraduates

Universities can offer courses on critical thinking and organize debate competitions to cultivate this essential skill among undergraduates. Critical thinking enables students to think independently, identify problems, and propose solutions, which is a vital quality in research activities. Additionally, universities should focus on integrating critical thinking courses with other subjects, embedding this skill throughout the entire undergraduate education system.

4.5.3 Stimulating innovative spirit and practical abilities in undergraduates

Universities can organize innovation and entrepreneurship competitions and establish innovation practice bases to stimulate the innovative spirit and practical abilities of undergraduates. These activities provide a platform for students to showcase their talents and help them integrate theoretical knowledge with practical problems, thereby developing their problem-solving skills. Moreover, universities should emphasize the integration and permeation of innovation and entrepreneurship education with professional education, incorporating it into the undergraduate curriculum and recognizing it with corresponding credits.

V. Conclusion

In summary, research projects play a crucial and central role in the development of undergraduate research competence. However, they also face potential barriers and challenges, such as insufficient participation opportunities, unclear motivations, and inadequate research capabilities among undergraduates. To address these issues, universities should adopt comprehensive and effective strategies from multiple perspectives, including increasing research project resources, clarifying motivations for participation, and systematically enhancing research competence. The successful implementation of these strategies requires the joint efforts and cooperation of universities, supervisors, and undergraduates. Only through this collaborative approach can we ensure that undergraduates receive adequate training and development through research projects, thereby laying a solid foundation for their future academic and professional endeavors.

References

- [1]. Zou W., Yu J. Y., Mao Y. Z.. Exploring Long-term Mechanisms for Enhancing Undergraduate Research Competence [J]. *Innovation and Entrepreneurship Theory Research and Practice*, 2022, 5(18): 100-102.
- [2]. Qin R. L., Guan Y. L., Yu J. L.. Cultivation and Training of Research Competence of Undergraduates in Pharmacy Major in Local Applied Universities [J]. *Journal of Tonghua Normal University*, 2022, 43(8): 105-108.
- [3]. Pu C. Z., Guo Y. F., Li C.. Cultivating Undergraduate Research and Innovation Abilities [J]. *China Metallurgical Education*, 2022(2): 71-73.
- [4]. Zhang L. C., Bao X. M., Sun L. Q.. Practical Exploration of Research Competence Development for Undergraduates in Science and Engineering at Universities [J]. *Journal of Shangqiu Normal University*, 2023, 39(9): 99-100.
- [5]. Zhang C., Zhang Y. Y., Zhang L. Q.. The Impact of Undergraduate Research Projects on Personal Research Career Development: A Retrospective Cohort Study [J]. *Fudan Education Forum*, 2023, 21(1): 60-61.
- [6]. Lin Z. J., Cui Y. G., Zhou Y. H.. Higher Education Cost Management, Research Resource Efficiency, and Research Achievement Evaluation in Universities [J]. *China Management Accounting*, 2023(6): 58-70.
- [7]. Fang S. Q., Cai C. D., Su N.. Analysis of Undergraduates' Willingness to Participate in Scientific Research and Its Influencing Factors [J]. *Journal of Guangxi Vocational Normal University*, 2023, 35(1): 96-103.
- [8]. Gu X. Y., Su L., Chang X. H.. Application of Blended Flipped Classroom Teaching Model in Undergraduate Medical Research Design and Thesis Writing [J]. *Health Vocational Education*, 2023, 41(16): 76-79.