

Problems and Coping Strategies of Mechanical Drawing Courses in Vocational Colleges

Jinru Ma*

Engineering Training Center, Beijing Polytechnic University, Beijing 100176, China

*Corresponding author: Jinru Ma, majinru@bpi.edu.cn

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: With the economic and social development of the country, vocational education is playing an increasingly significant role in cultivating highly skilled talents. However, the mechanical drawing courses in vocational colleges still face numerous challenges in the teaching process, such as outdated textbook content, inadequate practical resources, weak teaching staff, and low student interest. This paper aims to explore these issues and propose corresponding coping strategies. The findings of this study not only provide specific improvement suggestions for vocational colleges but also emphasize the importance of these strategies in enhancing students' comprehensive abilities and promoting the development of vocational education. By addressing these challenges, this paper contributes to the enhancement of teaching quality and the overall advancement of vocational skills education.

Keywords: Mechanical Drawing courses; Mechanical drawing; Problems; Strategies

Online publication: May 28, 2025

1. Introduction

Vocational education is a critical part of the modern educational system, equipping students with practical skills to meet market demands and address employment challenges. Amidst globalization and technological progress, there is heightened emphasis on technical talent cultivation globally; this need underscores vocational education's importance due to industrial upgrades. Vocational training aligned with industry needs promotes labor market balance and economic development.

Mechanical drawing, essential in engineering design and manufacturing, facilitates communication among engineers and manufacturers while fostering students' spatial imagination, logical thinking, and practical skills. Mastery of mechanical drawing is foundational for vocational college students' future careers in related fields^[1,2]. However, current teaching practices face issues: textbook content lags behind industry trends, practical resources are insufficient, teaching staff lack comprehensive expertise, and traditional modes fail to engage student interest. These factors undermine teaching quality and impede skill development. This study analyzes these issues and proposes strategies to enhance vocational education, aiming to improve overall teaching

standards in the field.

2. Related research

Previous scholars have conducted extensive research. For example, Song *et al.* ^[3] developed online open courses for mechanical drawing in Chinese colleges via the XuetangX MOOC platform, integrating outcome-based education and diverse interactive elements since March 2018. Xu *et al.* ^[4] introduced a Unity3D-based virtual simulation system for mechanical disassembly, overcoming issues such as high costs and safety risks, which enhanced student engagement and learning efficiency through interactive simulations. Chen ^[5] examined engineering graphics teaching reform by leveraging big data and certification to boost educational quality and prepare students for professional accreditation. Zhuo *et al.* ^[6] constructed a 3D holographic digitization system for mechanical drawings, offering an intuitive platform that enriched the lifecycle management of mechanical products from design to manufacturing. Lastly, Xu *et al.* ^[7] applied smart education technology in blended teaching for engineering drawing, enhancing traditional methods and significantly improving student engagement and the informatization of teaching processes based on OBE principles. These studies provide valuable insights for this research.

3. Challenges faced

In the realm of mechanical drawing courses in vocational colleges, several significant challenges impede the effective transmission of knowledge and skills to students. These challenges, if not addressed, can hinder the overall progress and relevance of the curriculum. This chapter delves into the primary issues that need to be tackled for the enhancement of mechanical drawing education.

3.1. Lagging textbook updates

With the rapid evolution of technology, the standards and tools utilized in mechanical drawing are continuously undergoing transformations. However, textbooks employed in vocational colleges often lag behind, resulting in a substantial disconnect between the instructional content and the actual demands of the industry. For instance, some textbooks may still focus heavily on traditional manual drafting techniques while neglecting the application of modern Computer-Aided Design (CAD) software. The lag not only hampers students' acquisition and comprehension of the latest technologies but also potentially renders them less competitive in the job market. Furthermore, the cases and projects presented in textbooks tend to be overly theoretical, devoid of practical application contexts, making it difficult for students to apply their learned knowledge in real-world work environments.

3.2. Inadequate practical resources

Practical application is an integral component of mechanical drawing courses, yet many vocational colleges struggle to provide adequate practical resources. Firstly, laboratory equipment is either outdated or insufficient in quantity to cater to the needs of all students. Secondly, advanced drafting software and related hardware come at a high cost, which schools may find difficult to bear. These factors limit opportunities for hands-on experiences, thereby impacting the cultivation of students' skills. Additionally, even when equipment and software are available, a lack of sufficient training and support can hinder both teachers and students from fully utilizing these resources.

3.3. Weak teaching staff

The quality of teaching staff is one of the pivotal factors influencing the quality of mechanical drawing education. Currently, many mechanical drawing instructors in vocational colleges face the following issues: firstly, their professional knowledge is not updated in a timely manner, making it challenging for them to impart the latest technologies and standards; secondly, their teaching methods are monotonous, relying heavily on traditional lecture-based approaches that lack interactivity and practicality. These problems contribute to a suboptimal learning experience for students and fail to ignite their interest in learning.

3.4. Insufficient student engagement and interest

Traditional teaching models often revolve around the teacher as the centerpiece, emphasizing the impartation of knowledge while neglecting active student participation and interest cultivation. This model can easily render students disinterested and devoid of motivation. Especially in practical courses like mechanical drawing, students struggle to truly grasp and master the learned knowledge if they are not fully engaged in hands-on activities.

4. Coping strategies

Addressing the multifaceted challenges faced by mechanical drawing courses in vocational colleges necessitates a comprehensive and proactive approach. This chapter outlines several coping strategies aimed at enhancing the relevance, engagement, and effectiveness of these courses.

4.1. Updating teaching materials

To ensure that the content of mechanical drawing courses remains synchronized with industry demands, educational institutions should establish a mechanism for continuously updating teaching materials. Schools should form dedicated committees responsible for reviewing textbooks annually or semesterly and updating them based on the latest industry standards and technological developments. Committee members can include in-house teachers, industry experts, and student representatives. Multimedia resources such as video tutorials, online simulation software, and interactive learning platforms should be leveraged to enrich teaching methods. These resources not only provide a more intuitive learning experience but also facilitate students' understanding of complex concepts. Encouraging the development and use of electronic textbooks facilitates rapid updates and distribution. Electronic textbooks can also include links to external resources such as industry standard documents, case studies, and technical articles, thereby enhancing students' self-directed learning capabilities. Through these measures, the timeliness and practicality of teaching content can be ensured, ultimately improving students' learning outcomes and employment competitiveness.

4.2. Implementing project-based learning

Project-based learning (PBL) is an effective teaching method that stimulates students' interest and initiative by engaging them in real or simulated engineering projects. Suitable projects should be selected based on course objectives and students' ability levels. These projects can be real-world tasks sourced from enterprises or simulated engineering projects. Students should be divided into groups, with each group responsible for completing a specific project task. This approach not only exercises students' teamwork abilities but also allows them to learn problem-solving skills through practice. Teachers should provide necessary guidance and support throughout the process, regularly checking on project progress and giving timely feedback. Additionally,

industry experts can be invited to review the projects and provide professional insights. Upon completion, an exhibition should be organized for students to present their work and share experiences, which can help boost their self-confidence and presentation skills. Through PBL, students can apply their learned knowledge in practical operations, enhancing their practical abilities and innovative thinking.

4.3. Enhancing course interactivity

Traditional lecture-based teaching often lacks interactivity, making it difficult to stimulate students' interest in learning. Therefore, enhancing course interactivity is one of the crucial pathways to improving teaching. Discussion sessions should be set up in the classroom, where students can communicate around specific topics or questions. This not only promotes communication among students but also cultivates their critical thinking abilities. Introducing real engineering cases can guide students in analyzing and solving practical problems. Through case analysis, students can better understand the application of theoretical knowledge and learn to handle complex situations. Role-playing exercises, where students simulate roles such as engineers and project managers, can help them experience the work content of different positions. This method can enhance students' sense of immersion and improve their understanding of careers. Tools such as interactive whiteboards and online voting systems can be utilized to increase classroom interactivity. These tools can help teachers monitor students' learning status in real-time and adjust teaching strategies accordingly. Through these interactive methods, the classroom can become livelier and more engaging, thereby improving students' learning enthusiasm.

4.4. Integrating competitions into classroom teaching

Competitions are an effective means of testing students' skills and stimulating their interest in learning. Incorporating the topics of "Mechanical Drawing Competitions" into classroom teaching offers numerous benefits. Participating in competitions allows students to hone their drawing skills and problem-solving abilities in high-pressure environments, which is highly beneficial for enhancing their comprehensive abilities. Students who excel in competitions can receive certificates and rewards, positively impacting their future academic pursuits and employment prospects. This incentive mechanism can spark the learning enthusiasm of more students. Through classroom promotion and mobilization, more students can be made aware of and encouraged to participate in competitions, thereby expanding their influence. Schools can collaborate with competition organizers to obtain additional resource support, such as training materials and expert lectures, further enhancing teaching quality. By integrating competitions with classroom teaching, we can greatly motivate students, especially the outstanding ones, to learn more actively. Additionally, combining competitions with daily teaching provides students with more practical opportunities and room for development.

4.5. Comprehensive teacher capability enhancement

To improve the quality of the teaching staff, schools can adopt the following measures. Teachers should be regularly organized to participate in domestic and international academic exchange activities to enhance their professional expertise and teaching abilities. Industry experts should be hired as part-time teachers to bring the latest practical experience and technical knowledge into the classroom. Teachers should be encouraged to adopt innovative teaching models such as PBL and flipped classrooms to increase student engagement and enthusiasm.

5. Conclusion

This paper has systematically analyzed the primary issues confronting mechanical drawing courses in vocational colleges and proposed a multitude of practical and feasible countermeasures. The research reveals that lagging textbook updates, inadequate practical resources, a weakened teaching faculty, and insufficient student interest are the major obstacles in current teaching practices. To address these challenges, several recommendations have been suggested, including the regular review and updating of textbooks, the integration of multimedia resources, the implementation of project-driven learning and the enhancement of classroom interactivity, the incorporation of competition-based problems to bolster students' practical experience, and intensified teacher training efforts.

The findings of this study provide vital insights and serve as a crucial reference for the improvement of mechanical drawing courses in vocational colleges, potentially leading to more effective and engaging educational experiences for students, and ultimately, fostering a more skilled and prepared workforce in the technical and vocational fields.

Funding

This study received support from the Science and Technology Key Project of Beijing Polytechnic (Project Leader: Jinru Ma, No. 2024X008-KXZ).

Disclosure statement

The author declares no conflict of interest.

References

- [1] Shen L, Wang M, Li M, et al., 2007, A Web-Based System for Education of Mechanical Engineering Drawing, 2007 First IEEE International Symposium on Information Technologies and Applications in Education, Kunming, China, 264–270. <https://doi.org/10.1109/ISITAE.2007.4409284>
- [2] Shen L, Li M, 2008, Idea and Practice for Paperless Education of Mechanical Engineering Drawing, 2008 IEEE International Symposium on IT in Medicine and Education, Xiamen, China, 843–847. <https://doi.org/10.1109/ITME.2008.4743986>
- [3] Song J, Dong Y, Wang W, 2020, Construction of the Online Open Courses of Mechanical Drawing in Chinese Colleges Based on Chinese XuetangX MOOC Platform, Proceedings of the 2020 8th International Conference on Information and Education Technology (ICIET 2020), Association for Computing Machinery, New York, NY, USA, 1–5. <https://doi.org/10.1145/3395245.3395249>
- [4] Xu J, Zhu J, Gan J, et al., 2024, Development and Application of Virtual Simulation Teaching System for Mechanical Disassembly Based on Unity3D, Proceedings of the 2023 International Conference on Information Education and Artificial Intelligence (ICIEAI 2023), Association for Computing Machinery, New York, NY, USA, 669–677. <https://doi.org/10.1145/3660043.3660163>
- [5] Chen Y, 2021, Teaching Reform of Engineering Graphics Course Based on Engineering Certification under Big Data, 2021 4th International Conference on Information Systems and Computer Aided Education (ICISCAE 2021), Association for Computing Machinery, New York, NY, USA, 1165–1169. <https://doi.org/10.1145/3482632.3483107>

- [6] Zhuo L, Gu L, Zhang H, 2023, Construction of a New 3D System for Holographic Digitization of Mechanical Parts Engineering Drawings, Proceedings of the 2022 4th International Conference on Robotics, Intelligent Control and Artificial Intelligence (RICAI 2022), Association for Computing Machinery, New York, NY, USA, 657–663. <https://doi.org/10.1145/3584376.3584492>
- [7] Xu J, Tian H, Wang X, et al., 2024, Application and Practice of Smart Education Technology in Blended Teaching of Engineering Drawing Course, Proceedings of the 2024 9th International Conference on Distance Education and Learning (ICDEL 2024), Association for Computing Machinery, New York, NY, USA, 178–184. <https://doi.org/10.1145/3675812.3675838>

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.