Education Reform and Development, 2025, Volume 7, Issue 5
https://ojs.bbwpublisher.com/index.php/ERD
Online ISSN: 2652-5372
Print ISSN: 2652-5364

Optimizing Computer Vision Pedagogy: An Industry-Education Integration Approach

Yi Ren[1]*, **Lei Li**[2]

[1]Suzhou Polytechnic Institute of Agriculture, Suzhou 215008, Jiangsu, China
[2]Suzhou DCCK Technology Co. Ltd., Suzhou 215008, Jiangsu, China

**Author to whom correspondence should be addressed.*

Abstract: In the context of Industry 4.0, the use of machine vision and image technology is becoming increasingly widespread. This trend not only drives advancements across industries but also raises the bar for cultivating skilled professionals. The industry-education integration has gradually emerged as a crucial approach for vocational colleges to align with societal development. This model effectively bridges talent development with industry needs, addressing the gap between the skills taught in schools and those required by enterprises. This paper emphasizes the significance of optimizing computer vision course instruction in vocational colleges through the lens of industry-education integration. It examines the challenges in current teaching practices and proposes targeted reform strategies aimed at enhancing the quality of talent cultivation. By doing so, it seeks to produce more machine vision specialists to meet societal demands while fostering deeper collaboration between industry and academia.

Keywords: Integration of industry and education; Computer vision; Artificial intelligence

Online publication: May 29, 2025

1. Introduction

In 2019, the National Pilot Implementation Plan for the Integration of Industry and Education was released. This initiative promotes a model of educational model that combines industrial practices with educational goals. Fundamentally, it represents a form of cross-border collaboration aimed at fostering mutual benefits between industries and educational institutions. Adopting this integrated approach not only addresses the demand for talent transformation during economic transitions but also serves as a critical pathway for advancing higher education to new heights. With the rapid advancements in science and technology, image processing capabilities have significantly improved, and machine vision has become integral across various sectors. Consequently, machine vision courses in vocational colleges should align with cutting-edge technological developments, equipping students with essential knowledge and skills while preparing them for future employment opportunities. Nevertheless, traditional machine vision curricula have long been criticized for their complexity and abstraction, leading to suboptimal teaching outcomes. This highlights the urgent need for reform in conventional machine vision courses. Thus, exploring optimization strategies for the teaching model of machine vision courses based on the industry-education integration holds substantial practical significance.

2. The significance of computer vision course teaching optimization in vocational colleges based on the integration of production and education

The computer vision course offered in vocational colleges falls under the domain of artificial intelligence. As computer technology continues to advance, it has garnered significant attention from society. By definition, computer vision involves utilizing computers or cameras to replace human efforts in tracking, measuring targets, and conducting further graphic processing. This ensures that images better align with human observational methods or are transmitted to detection devices [1]. Presently, computer vision finds application across numerous sectors, including healthcare, security, and autonomous driving, among others.

The steady growth in the size of the computer market has led to a significant increase in demand for professionals specializing in computer vision. As the primary force in talent development, it is crucial to enhance the teaching methods of computer courses in vocational colleges. Under the conventional educational framework, computer vision courses in these institutions often lack widely recognized classic textbooks. The teaching process predominantly relies on foreign textbook structures, which may not fully align with domestic conditions or the specific needs of talent cultivation in our country. Moreover, computer vision education is still in its early stages. Therefore, improving instructors' proficiency in computer vision technology and establishing a high-caliber teaching team represent another critical challenge [2] that vocational colleges must address.

The fusion of industry and education represents a significant departure from conventional teaching methods, focusing instead on the deep collaboration between these two sectors. Both vocational colleges and enterprises engage in active cooperation, ranging from the establishment of talent cultivation goals and curriculum design to the execution of practical teaching components, fostering comprehensive partnerships [3]. This integration can be viewed as an advancement and refinement of the traditional school-enterprise cooperation model. Against the backdrop of production-education integration, computer vision courses can be aligned with training initiatives to develop teaching materials suited to China's specific conditions, thereby addressing the demand for specialized talent within this integrated framework. For nascent computer vision instruction, enterprise professionals often possess richer experiential knowledge and superior problem-solving capabilities compared to university educators. Vocational colleges invite highly skilled and experienced technical experts from industries to join their teaching teams. Simultaneously, leveraging the strengths of robust enterprises, efforts should focus on enhancing the foundational competencies and instructional proficiency of in-house faculty members [4].

Furthermore, the computer course should emphasize both the theoretical and engineering aspects of its teaching content, with practical instruction being a crucial component of the computer vision curriculum [5]. In the context of industry-education integration, collaborations and exchanges between vocational colleges and medium-to-large enterprises are continually strengthening. Backed by national policies, both educational institutions and companies can jointly develop a team of specialized instructors and establish a computer training center. This ensures that the talents cultivated by schools align precisely with the needs of enterprises. Simultaneously, schools also offer human resources and talent support to businesses.

3. Current situation of computer vision courses

3.1. Emphasizing knowledge over ability

In course content design, computer vision courses encompass topics such as digital image fundamentals, stereovision, and image classification. While the curriculum is diverse and comprehensive, forming a well-structured professional framework, it also results in a complex educational system. Given the extensive range of subjects and limited class hours, instructors are often constrained to focus on covering as many knowledge points as possible, making it challenging to provide detailed analysis or expansion on each topic [6]. This "surface-level" teaching approach confines students' understanding to basic concepts, preventing them from fully grasping the core theories and technologies. Moreover, during instruction, educators tend to emphasize the explanation of knowledge points, prioritizing students' familiarity with foundational theories and techniques while overlooking the development of their practical application skills.

3.2. Lack of practical content

Currently, the experimental content of the computer vision course includes topics such as fundamental digital image processing and camera calibration. While there is a wide variety of experiments, most are verification-based. These types of experiments primarily assist students in confirming theoretical knowledge and enhancing their understanding of key concepts but fall short in enabling students to fully grasp the practical application of this knowledge. Moreover, each experiment operates independently, making it challenging for students to connect the knowledge and skills acquired from different experiments into a cohesive series. This prevents them from constructing a comprehensive knowledge framework and leaves them struggling when confronted with complex, real-world problems [7]. Additionally, there is a scarcity of design-oriented experiments, depriving students of opportunities to independently devise experimental plans and engage in exploration and innovation. This limitation restrains the development of their creative thinking and capacity to address intricate problems. Consequently, even though students engage in numerous experiments, they often fail to genuinely comprehend the generation and application processes of knowledge, are unable to significantly enhance their practical skills, and struggle to meet the demands of enterprises seeking application-focused talent.

3.3. Lack of alignment with professional needs

In teaching computer vision courses, the issue of failing to align with specific professional requirements has become increasingly evident. First, the course materials often do not cater to the distinct features and needs of various majors. For instance, students specializing in big data technology are more focused on the analysis and utilization of visual data, aiming to extract valuable insights using computer vision techniques. However, the current curriculum offers uniform content that fails to address the diverse demands of students from different disciplines. Additionally, teaching methodologies have notable limitations. Typically, computer vision courses emphasize theoretical instruction, with educators relying heavily on textbooks. Even when practical sessions are included, they predominantly focus on verification-based experiments, which struggle to accommodate the varied needs of students from diverse academic backgrounds [8]. This generalized teaching approach not only fails to engage students' interest but also lacks tailored guidance for learners from different fields. Consequently, students find it challenging to connect their acquired knowledge with real-world applications relevant to their majors, impeding their professional growth and making it difficult to cultivate specialized talent suited to industry demands.

3.4. School-enterprise cooperation needs to be deepened urgently

The model of school-enterprise collaboration tends to be relatively straightforward, often revolving around student internships and corporate lectures. In some cases, schools merely dispatch students for brief internships at companies, where they rarely engage in core projects or gain profound insights into the technological development processes and real needs of businesses. Additionally, the structure of school-enterprise cooperation remains underdeveloped, making it challenging to align the interests of both parties. Universities aim to enhance students' practical skills and the research and teaching capabilities of faculty through these partnerships. Conversely, enterprises prioritize the economic advantages derived from collaboration, such as acquiring top-tier talent and resolving technical challenges. Presently, the absence of an efficient communication framework between educational institutions and businesses results in issues like information disparity and misaligned objectives during the collaborative process, thereby hindering sustained, in-depth, and stable cooperation between the two entities [9].

4. Optimization strategies of the computer vision course teaching mode under the background of industry-education integration

4.1. Update teaching concepts and establish competence orientation

Educational philosophies and concepts serve as the driving force behind teaching reforms. To implement innovative education and develop high-caliber talents, it is essential to continuously update these educational ideas. In the context of computer vision courses, the conventional teaching approach that prioritizes knowledge over skills makes it challenging for students to apply their learning flexibly in real-world situations. To address this issue, educators should transition from being mere knowledge transmitters to becoming learning facilitators who guide students. The focus during the teaching process should be on nurturing students' ability to tackle practical problems [10]. For instance, when presenting theoretical concepts, integrating real-world examples can encourage students to contemplate how they can utilize their knowledge to resolve issues in actual scenarios. Examples include the application of image recognition technology in areas such as security surveillance and vehicle monitoring.

4.2. Adjust the teaching principle, strengthen the combination of practice and profession

The computer vision course has high practical demands, yet the existing practical content may restrict the enhancement of students' skills. Consequently, it is essential to appropriately modify the teaching approach by increasing the emphasis on practical activities and expanding the proportion of hands-on courses. When designing practical projects, it is important to tailor the content based on the specific majors of students [11]. For instance, for computer science students, projects involving image classification and target tracking system development using deep learning frameworks can be assigned, with a focus on cultivating their skills in algorithm implementation and system construction. On the other hand, for electronic engineering students, the emphasis could be placed on constructing hardware platforms, such as developing machine vision inspection systems based on embedded technologies, thereby reinforcing the integration of hardware and vision systems. This differentiated approach allows for more effective, personalized instruction.

4.3. Optimize the teaching content and keep up with the industry trends

The domain of computer vision is advancing at a rapid pace, necessitating timely updates to course materials.

First, outdated and less relevant instructional content should be phased out, such as early threshold-based segmentation techniques and template-matching-driven target recognition algorithms. Second, cutting-edge knowledge that leverages powerful technologies widely applied in artificial intelligence should be integrated [12]. For instance, the latest local binary pattern series for texture description can be introduced, which plays a critical role in image feature extraction and analysis. Furthermore, staying informed about industry trends is essential, incorporating emerging convolutional neural network algorithms like the YOLO (You Only Look Once) family of object detection methods and deep learning-based image enhancement techniques used in intelligent HDR applications into the curriculum. Additionally, fostering stronger collaboration between academic institutions and industry partners is crucial. By introducing real-world project cases from enterprises, such as cargo identification and sorting in logistics, or lesion detection in medical imaging analysis, students can gain deeper insights and master core concepts through hands-on project experiences.

4.4. Innovating teaching methods to enhance effectiveness

An innovative teaching approach involves educators utilizing distinctive and creative methods and strategies within their teaching practices. This aims to stimulate students' enthusiasm for learning while improving the effectiveness of classroom instruction. It highlights the transformation of the teacher's role, moving away from the traditional image of being merely a knowledge transmitter to becoming an effective guide and facilitator for students [13]. Specifically, teachers employing innovative methods can adopt project-based teaching by selecting representative real-world enterprise projects, such as industrial visual inspection tasks. Within these projects, students engage in the entire process—from analyzing requirements, designing solutions, choosing algorithms, to implementing and testing systems—thereby developing comprehensive knowledge and application skills and enhancing teamwork capabilities. Leveraging online teaching platforms, resources like computer vision algorithm code examples, experimental demonstration videos, and online quizzes are shared to support students' self-directed learning. In face-to-face classes, students participate in discussions about challenges encountered during online learning, with teachers providing targeted practical guidance. This approach integrates the strengths of both online and offline learning environments, achieving a complementary effect.

4.5. Strengthen the development of teaching materials and integrate high-quality resources

Textbooks serve as the fundamental foundation for both teachers' instruction and students' learning. With the rapid advancement of information technology, the content and format of teaching materials continue to evolve. In particular, digital teaching materials have emerged as an inevitable outcome of the digital transformation in education. As one of the core courses, the computer vision course should focus on developing teaching materials and integrating high-quality educational resources [14]. To achieve this, firstly, school instructors and industry experts should collaborate to create textbooks for computer vision courses, incorporating real-world enterprise project examples, such as the development of visual perception systems in autonomous driving or facial recognition systems in intelligent security. Secondly, modern information technology should be utilized to develop digital textbooks. These could include embedded animations demonstrating image recognition and object detection algorithms, making complex theories more intuitive and easier to comprehend. This would not only enrich the presentation of the textbooks but also increase students' interest in learning while providing them with high-quality educational resources.

4.6. Improving teaching quality evaluation and building a diversified evaluation system

The primary mission of vocational colleges is to cultivate skilled talents. In the current context, to ensure the quality of talent development, it is essential to establish a comprehensive and scientific teaching quality assessment framework. Specifically, this involves moving away from relying solely on examination outcomes and instead adopting a multifaceted evaluation system [15]. Regarding the computer vision course, an evaluation mechanism should be constructed that incorporates multiple evaluators, diverse content areas, and varied assessment methods. The evaluation content should encompass subject-specific knowledge, such as students' understanding of theoretical concepts in computer vision courses, including algorithm principles and image processing techniques. It should also assess practical skills by evaluating students' problem-solving capabilities through project-based practices and hands-on training exercises. Additionally, teamwork competencies should be evaluated by observing students' contributions during project planning, requirement analysis, and algorithm implementation phases, which can reflect their communication and collaboration abilities. To further enhance the evaluation process, a diversified approach should be adopted, combining subjective and objective assessments, quantitative and qualitative analyses, as well as both process-oriented and outcome-focused evaluations. Moreover, the evaluation should involve multiple stakeholders, integrating assessments from instructors, student self-assessments, and peer reviews, as well as feedback from industry experts. This pluralistic approach ensures a more holistic and accurate evaluation of student performance.

5. Conclusion

In conclusion, against the backdrop of industry-education integration, computer vision instruction in vocational colleges will encounter new development prospects. These institutions should proactively answer the national appeal for integrating industry with education, continuously explore and innovate teaching methods for computer vision courses, enhance close collaboration with enterprises, and jointly establish an industry-education integrated talent cultivation ecosystem. This aims to nurture more high-quality and innovative talents capable of fulfilling the requirements of the current era.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhang X, 2025, Research on the Docking Mechanism Between Computer Courses and Industry in Higher Vocational Colleges From the Perspective of Integration of Industry and Education. Modern Vocational Education, 2025(4): 121–124.

[2] Long K, 2025, An Analysis on the Teaching Reform Practice of Basic Computer Courses in Colleges and Universities Under the Background of Integration of Production and Education. Information Systems Engineering, 2025(1): 165–168.

[3] Zhao J, Zhu Y, Feng X, et al., 2025, Reform of Teaching Models for University Computer Courses Under the Background of Deep Integration of Industry and Education. Computer Education, 2025(1): 50–54.

[4] Li X, Luo H, 2024, Research on the Reform and Practice of Machine Vision Course Teaching Under the

Background of Industry–Education Integration. Computer Knowledge and Technology, 20(36): 152–153 + 160.
[5] Zhang K, 2025, Research on Training Problems and Countermeasures of Computer Professional in Secondary Vocational Schools Under the Background of Integration of Industry and Education. Journal of Science, 2025(2): 16–18.
[6] Yang C, Peng H, Wang L, 2024, Reform and Innovation of Online and Offline Mixed Teaching Mode of "Computer Vision Application Development" Course. Journal of Anhui Electronic Information Vocational and Technical College, 23(4): 31–34.
[7] Tang Z, Zhang Z, Zhu K, et al., 2019, Research on Teaching Reform of "Image Processing and Machine Vision" Course in Local Applied Universities Under the Background of New Engineering. Journal of Liupanshui Normal University, 36(6): 106–120.
[8] Zhong X, 2024, Research on Training Model of Computer Majors in Higher Vocational Colleges Under the Concept of Integration of Production and Education. Science and Education Guide, 2024(33): 71–73.
[9] Gong S, Zhang C, Liu H, et al., 2024, Research on Optimal Practice Path of Compound Talent Cultivation System Based on Integration of Industry and Education and School–Enterprise Cooperation Under the Background of Engineering Certification. Modern Vocational Education, 2024(33): 41–44.
[10] Su N, 2019, Analysis on Talent Training Strategy of Integration of Industry and Education in Computer Application Technology Major Under the Background of "Three Education" Reform. Paper Making Equipment and Materials, 53(11): 215–217.
[11] Xie X, Baocai J, Wang H, et al., 2024, Exploration of Computer Talents Training Model in Local Universities Based on Integration of Industry and Education. Sichuan Labor Security, 2024(10): 125–126.
[12] Xu X, Liu Y, Sui T, et al., 2024, Research on Teaching Reform of Machine Vision and Image Understanding Based on Talent Training Needs. Journal of Science, 2024(31): 5–8.
[13] Zhang Z, He L, 2023, Exploration of Teaching Reform for "Machine Vision" Course in Vocational Teacher Education Institutions. Science and Technology Wind, 2023(19): 111–113.
[14] Zhang L, Shen Y, 2023, Design and Practice of Integrated Teaching Case of Computer Vision Course. Journal of Higher Education, 9(16): 47–50.
[15] Zhong M, 2022, Curriculum Reform of Undergraduate Computer Vision Based on New Engineering. China New Communications, 24(21): 134–136.

Publisher's note

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