Received: 19 May 2024 | Revised: 11 Jun. 2024 | Accepted: 18 Jul. 2024 | Published online: 25 Jul.2024

RESEARCH ARTICLE

Contemporary Education and Teaching Research
2024, Vol. 5 (7)247-252
DOI: 10.61360/BoniCETR242016500703

A Case Study of Visual Detection and Image Processing Courses under the OBE Teaching

Yuehua Cao[*,1]
[1]*Hangzhou Dianzi University Information Engineering College,China*

Abstract: This research aims to enhance students' learning outcomes and holistic development by integrating ideological and political education into visual detection and image processing courses within the framework of Outcome-Based Education (OBE). We introduce a three-in-one course objective design based on the OBE philosophy, focusing on knowledge dissemination, skill development,and quality standards. Our methodology employs a pyramid teaching approach, combining variousteaching methods and targeted objectives at different stages. To evaluate students' ideological andpolitical education outcomes, we have designed an assessment form aligned with the course's ideological and political objectives. Additionally, we highlight the contributions of scholars and educational institutions in integrating ideological and political education into technical courses. Emphasizing the pyramid teaching approach as a valuable teaching tool, we outline different teaching methods and objectives for each stage. Lastly, we summarize the achievements of this study in terms ofstudent awards, academic accomplishments, and educational reforms. This research offers an innovativeapproach to engineering education by merging technical expertise with ideological and political education under the OBE framework, ultimately enhancing students' overall learning experiences and ethical development while providing practical solutions to enhance the quality of engineering education.

Keywords: OBE;The pyramids;Teaching effectiveness

1. Introduction

Outcome-Based Education (OBE) prioritizes student-centered approaches (Fan, 2023), outcome orientation, and ongoing enhancement. In China's higher education system (Fu, 2023), the overarching objective is to nurture builders and successors of socialism, with significant emphasis placed on the philosophy of Outcome-Based Educational Approach. Likewise, in engineering certification (Zhu, 2023), the OBE teaching philosophy holds substantial significance. OBE revolves around placing students at the core, concentrating on learning outcomes, and establishing a closed loop for continuous improvement.

The current course primarily relies on traditional teaching methods, where instructors deliver theoretical lectures. (Lou, 2021) This approach results in low student engagement and unsatisfactory learning outcomes.(Yang, 2023). The main issues include:Traditional teaching focuses on classroom lectures and knowledge delivery, with students passively receiving abstract theories and complex formulas. This does not align with the OBE (Outcome-Based Education) principle of "student-centered" learning.As a result, students educated under the traditional model struggle to meet the demands of the modern era for innovative talent. Therefore, it's necessary to explore new teaching models for the "Digital Image Processing" course that align with the core principles of "New Engineering" education, catering to the need for applied and interdisciplinary talent development.

In this regard, several scholars have made significant contributions:Ying Qiang from Beijing University of Chemical Technology proposed a teaching reform guided by practical case studies

Corresponding Author: Yuehua Cao
Hangzhou Dianzi University Information Engineering College, China
Email: 540527314@qq.com

(Ying et al.,2023). Zhang Junsheng from Taiyuan University of Technology conducted research on the case-based development of the course (Zhang et al,.2023). Cai Jun from Huainan Normal University explored the design of case-based experiments (Cai & Lv, 2022).

Furthermore, many universities have integrated ideological and political education elements into the course: Cai Limei from China University of Mining and Technology designed ideological and political teaching models and content (Cai, 2023). Zhang Lihong from Shanxi University developed a comprehensive curriculum integrating ideological and political elements.(Zhang, 2022)

Based on the identified gaps in the existing literature, this study hypothesizes that integrating ideological and political education into visual detection and image processing courses within the OBE framework will significantly enhance students' learning outcomes and comprehensive development.This study is important because it provides a novel approach to engineering education, combining technical knowledge with ideological and political education. By integrating these elements within the OBE framework, the study aims to enhance students' overall learning experience and moral development. This approach not only addresses the educational challenges identified in previous research but also offers practical solutions for improving the quality of engineering education in China.

2. Main Content

Educational researchers have consistently stressed the importance of integrating the promotion of moral integrity and talent cultivation across all levels of education, spanning from basic education to vocational and higher education. The inclusion of ideological and political theory instruction in professional courses is considered essential.

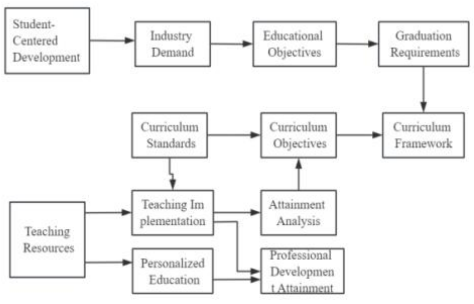
By scrutinizing the course content of visual inspection and image processing courses, identifying potential ideological and political elements therein, and incorporating the principles of Outcome-Based Education (OBE) teaching philosophy, the core tenets of OBE are merged with ideological and political elements in teaching. The teaching emphasis should revolve around what students can learn, grasp, and ultimately achieve in terms of moral education. This objective can be attained by enhancing teachers' ideological and political literacy, refining teaching content, diversifying teaching methods, and enhancing the course evaluation system. Such an approach will pave the way for the development of a student-centered intelligent teaching model.

In constructing ideological and political components within professional courses such as machine vision and image processing, it is imperative to delineate educational objectives, deeply integrate the benefits of Outcome-Based Education's backward design, and effectively design and evaluate the ideological and political aspects of machine vision and image processing courses. Through continual refinement, a new curriculum teaching framework and an intelligent classroom teaching model will be established, ultimately realizing the goal of nurturing moral integrity and fostering talents.

2.1 Designing the three-in-one course objectives under the OBE concept

Designing three-in-one course objectives under the OBE concept involves merging the requirements of emerging engineering disciplines and pertinent professional talent development programs. Adhering to the foundational tenets of OBE, which prioritize student growth, outcome-driven learning, and continual enhancement, and integrating the talent development program design framework as illustrated in **Figure 1**. Drawing from the talent development program, the 'three-in-one' course objectives for the Visual Inspection and Image Processing course are formulated, as detailed in **Table 1**. By establishing course objectives, the nexus between knowledge dissemination, skill refinement, and quality benchmarks is effectively established, culminating in an educational aim centered on the core principle of 'morality-based education and talent cultivation'.

Figure 1. Flowchart of OBE Concept Talent Development Program Design



Objective	Content
Knowledge Objectives	1. Understand the concepts of machine vision and image processing. 2. Understand the steps of image preprocessing. 3. Understand the methods and applications of digital image processing. 4. Master the steps of image preprocessing, including image enhancement and image sharpening.
Competency Objectives	1. Proficient in various steps of image processing and capable of implementing them using C language. 2. Able to independently analyze and process image processing project cases. 3. Capable of independently completing machine vision project cases.
Quality Objectives	1. Foster patriotism and achieve the goal of moral education. 2. Develop a spirit of teamwork and mutual assistance. 3. Cultivate a rigorous attitude and ignite a sense of national responsibility.

Table 1 ."Trinity" Objective Curriculum System

2.2.Designing the pyramid structure teaching method

Based on the OBE educational concept, the curriculum content of visual inspection and image processing is designed in a pyramid structure, and the design of ideological and political elements in the curriculum is completed. Through the study of machine vision and image processing courses, the aim is to enhance students' innovative practical abilities and provide meaningful references for teaching models related to cultivating students' practical innovation abilities in STEM disciplines. Therefore, based on the characteristics of this course, a pyramid structure is proposed under the OBE concept, incorporating ideological and political elements. The pyramid follows a progressive mode, with each level building upon the previous one, departing from the traditional single-mode teaching, integrating theory, projects, practice, emotions, and outcomes. The specific arrangement of the pyramid structure is illustrated in **Figure 2.**

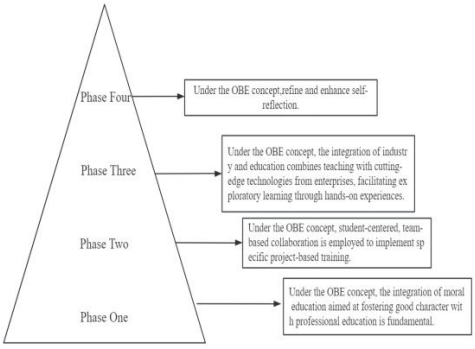


Figure 2. Pyramid Structure

2.2.1 Stage One: Under the OBE concept, integrate the ideological and political education with the fundamental purpose of moral education and professional education.

(1) Use 2-4 class hours to introduce the course with algorithm integration into ideological education:

Image reading and grayscale processing (the beauty of the colorful world.

Image filtering and enhancement (the purity of the mind).

Image edge detection and binarization (the simplicity and clarity).

Image restoration and segmentation (the courage to innovate).

(2) Introduce project-based teaching with the "lane recognition algorithm" case.

(3) Design project tasks of varying difficulty levels, allowing students to choose freely.

The outcomes meet Knowledge Objectives 1 and 3 in **Table 1**.

2.2.2 Stage Two: Under the OBE concept, focus on students and implement project-based training through teamwork.

Deeply integrate projects into students' daily lives and society, actively involving them in exploring and solving problems using knowledge. Help students clarify correct values, life views, and career perspectives, inspiring them to contribute to the nation's prosperity through enhancing their own abilities. Employing project-based teaching methods, emphasize engineering applications and conduct teaching in the form of team or group projects. With students at the center, they work collaboratively to complete tasks, aiming to combine theory with practical teaching, fully tap into students' creative potential, and enhance their comprehensive problem-solving abilities. Throughout the project completion process, teachers strategically cultivate students' abilities to work independently, think imaginatively, innovate, and communicate effectively in teamwork.

The outcomes meet Objectives 1, 2, and 3 in **Table 1**.

2.2.3 Stage Three: Under the OBE concept, integrate production and education, combining teaching with enterprise technology foresight, and engage in exploratory learning.

(1) Utilize the school's existing robotics laboratory as a platform, inviting enterprises to join. The school provides venue and equipment, while the enterprise offers technology. Both parties collaborate to conduct technical training and talent development. Teachers and students participate in technical research and development alongside the training, learning advanced technologies.

(2) Employ production technicians and managers from enterprises as part-time teaching staff. Based on the production-education integration teaching plan, they carry out teaching activities during production. Relevant teachers from the school participate in technical training guidance and student internship supervision.

(3) Before school-enterprise cooperation, both sides conduct inspections and selections. They examine each other's technical capabilities, legal representatives (or investors), registered capital, equipment, and management. The school should provide necessary information and inspection results to the enterprise.

The outcomes meet Objectives 1, 2, and 3 in **Table 1**.

2.2.4 Stage Four: Under the OBE concept, continuously improve and assess outcomes.

Construct a diverse evaluation system according to students' different needs and learning goals, integrating formative assessment and problem generation to form a relatively fair and reasonable multi-dimensional course evaluation system. Continuously reflect on the process evaluation, results evaluation, and practical effectiveness evaluation of the first three stages, adjust teaching progress and methods promptly, and establish a mechanism for continuous improvement. Based on the evaluation score proportion, consider practicality and ease of operation in the reform of machine vision and image processing technology.

2.3 Course Evaluation Form

Design evaluation criteria based on the achievement of ideological and political education goals. Utilize the ideological and political education points from the evaluation criteri to promptly understand students' ideological states, as shown in **Table 2**.The evaluation criteria are designed to assess the achievement of ideological and political education goals by examining various aspects of students' development. This includes evaluating their demonstration of core socialist values like patriotism, dedication,and integrity, assessing their understanding of political issues and governance systems.

The percentage of scores	Assessment Points	Evaluation Methods
Attendance (10%)	Sense of responsibility and attitude towards learning	Check attendance for the first stage of Xiwopin cour
Classroom performance(10%)	Adherence to discipline, In novation awareness,Social	Attendance record and poi nts for the first stag
Experimentalskills (30%)	Teamwork, innovation awar eness, social responsibility, craftsmanship, continuous improvement, and striving for excellence.	The second stage involves project case feedback, group presentation rankings, etc., with Xiwu live broadcasting on site
Integration of Industry and Education (20%)	Teamwork,innovation aware ness,social responsibility, cr aftsmanship, continuous im provement, striving for exc ellence, patriotism, and se nse of achievement.	The third stage involves th e integration of industry and education, combining teaching with cutting-edge technologies in enterprise s, and conducting explorat ory learning
Comprehensive assessment (30%)	Innovative consciousness, s ocial responsibility, craftsm anship, pursuit of excellen ce, striving for progress, p atriotism, sense of achieve ment.	The first stage, the second stage, the third stage: gr aded tests for each stage.

Table 2.Evaluation Form based on Course Ideology and Politics

2.4 Establishing and improving the ideological and political case library

Curriculum-based ideological and political education is not simply the combination of "curriculum" and "ideological and political education". They are not mechanically assembled but organically integrated. How can we avoid the superficial integration of ideological and political content with professional knowledge? How can we grasp the timing, effectiveness, and extent of curriculum-based ideological and political education? How can we smoothly guide students from "professional competence" to "spiritual maturity"? It requires delving deep into the value essence contained in the ideological and political elements of the discipline, precisely imparting them, rather than indiscriminately or forcibly inserting them. Adopting various methods such as case-based teaching, independent inquiry, heuristic teaching, and situational experiential teaching to stimulate students' subjective initiative, encourage them to raise questions, cultivate their objective and dialectical thinking, strengthen their pursuit of truth, and enhance their ability to judge right from wrong through empirical exploration and rational analysis.

3. Educational Outcomes

The teaching achievements are highlighted in seven aspects: student competition awards, academic achievements, educational reform projects, teacher honors, student enrollment, student projects,and recognition of teaching quality.Guiding students to win numerous provincial and national awards in various competitions, publishing papers and obtaining patent authorizations, leading or participating in multiple educational reform projects, winning the Outstanding Instructor Award, significantly increasing course popularity, students independently completing multiple projects applied in practice, and receiving corresponding rewards and recognition for excellent teaching achievements.

3.1 Student Competition Awards

Guiding students through various competitions, including the "Siemens Cup" Intelligent Manufacturing Challenge, Mechanical Innovation Design Competition, Intelligent Robot Creative Competition, Engineering Training Comprehensive Ability Competition, Intelligent Robot Creative Competition, National College Student Computer Design Competition, and National College Student Intelligent Car Competition, resulted in remarkable achievements. These achievements include winning

provincial and national awards, such as second prizes, first prizes, and third prizes, demonstrating the effectiveness of the guidance provided in enhancing students' competitive capabilities and showcasing their talents on both provincial and national platforms.

3.2 Published two papers:

Two papers were published: "Design and Implementation of an Intelligent Vehicle System Based on EdgeBoard" in Modern Electronics Technology, Volume 45(18) in 2022, and "Experimental Study on Autonomous Positioning of Unmanned Vehicles Based on Multi-sensor Fusion" in Modern Electronics Technology, Volume 40(14) in 2017. Additionally, two patents were granted: one for an Intelligent Car, Control System, Control Method, Intelligent Terminal of Computer Equipment (CN113734194B, January 20, 2023), and another for a Forest Fire Source Detection System, Method, Storage Medium, Equipment Based on Unmanned Aerial Vehicle (CN114200471B, August 23, 2022).

3.3 Leading or Participating in Multiple Educational Reform Projects

Led or participated in multiple educational reform projects, including those at the national, provincial, and university levels.

3.4 Teacher's Personal Honors

In 2021, received the Outstanding Guidance Teacher Award at the 3rd Zhejiang Province College Student Intelligent Robot Creative Competition. In 2022, received the Outstanding Guidance Teacher Award at the 17th National College Student Competition.

3.5 Student Enrollment Situation

The enrollment for the course has doubled from 150 students to 300 students, transitioning from an elective course in automation to one in mechanical engineering. This significant increase in enrollment indicates a growing interest and recognition of the course, reflecting its relevance and appeal to students seeking education in mechanical engineering.

3.6 Student Projects

Students have independently completed over a dozen projects that intertwine image processing with ideological and political education. These initiatives have been instrumental in graduation projects, postgraduate entrance examinations, and professional endeavors.

3.7 Recognition for Outstanding Courses

Acknowledged for exceptional courses in visual detection and image processing technology during the academic years of 2022-2023 and 2023-2024.

Conclusion

Based on the Outcome-Based Education (OBE) framework, this study integrates ideological and political education into visual detection and image processing courses and conducts a comprehensive analysis and discussion on this integration. Through exploration of course objective design, improvement of teaching methods, and establishment of evaluation systems, the study summarizes as follows:

Firstly, we emphasize the importance of classroom teaching in cultivating students' ideological and political literacy and technical capabilities. Leveraging the OBE concept, we propose student-centered teaching methods and course objective designs to focus on developing students' comprehensive abilities and moral character.

Secondly, addressing the issues with traditional teaching methods, we propose a series of innovative teaching reform measures, including the pyramid teaching method, case-based experimental design, ideological and political education models, to enhance students' learning outcomes and educational quality.

Furthermore, we highlight the importance of interdisciplinary collaboration by engaging in research and teaching activities with other fields to broaden students' perspectives and deepen their understanding of technological development and societal issues.

Finally, we summarize the achievements and contributions of the study, including student competition awards, educational reform projects, academic achievements, highlighting the practical significance and insights for improving the quality of engineering education.

Figure 3 presents a comparison of universities based on their OBE teaching models, enrollment figures, pass rates, competition award rates, and key advantages. Beijing University of Chemical Technology employs the Practical Case Method with a focus on student-centered learning, Huainan Normal University emphasizes Case-based Experimental Design along with enhanced hands-on ability, and Taiyuan University of Technology adopts Case Library Construction with a similar student-centered approach. China University of Mining and Technology integrates an Ideological and Political Teaching Model, fostering student-centered learning coupled with independent learning. Shanxi University also focuses on student-centered teaching with Ideological and Political Case Teaching and encourages independent learning. Hangzhou Dianzi

University, Information Engineering College stands out with a Pyramid Ideological and Political Case Teaching Model, enhancing both hands-on ability and independent learning while maintaining a strong student-centered approach.

University	OBE Teaching Model	Enrollment	Pass Rate	Competition Award Rate	Advantages
Beijing University of Chemical Technology	Practical Case Method	150	70%	10%	Student-centered
Huainan Normal University	Case-based Experimental Design	120	75%	16%	Student-centered Enhanced hands-on ability
Taiyuan University of Technology	Case Library Construction	100	80%	10%	Student-centered
China University of Mining and Technology	Ideological and Political Teaching Model	120	85%	21%	Student-centered Independent Learning
Shanxi University	Ideological and Political Case Teaching	80	85%	20%	Student-centered Independent Learning
Hangzhou Dianzi University, Information Engineering College	Pyramid Ideological and Political Case Teaching Model	160	95%	50%	Student-centered Enhanced hands-on ability Independent Learning

Figure 3 Effectiveness Analysis

In conclusion, this study provides new perspectives and methods for integrating ideological and political education into engineering education, contributing to beneficial exploration and practices for nurturing engineering talents with comprehensive qualities and innovative abilities.

Acknowledgement

This research was funded by:

General Plan Project of Zhejiang Provincial Education Science Planning for the Year 2024 (2024SCG008)

2024 Higher Education Research Project of Zhejiang Association of Higher Education (KT2024158)

Conflict of Interest

The author declares that she has no conflicts of interest to this work.

References

Ying, Q., Hu, W., & Li, R. (2023). Teaching reform of the digital image processing research course guided by practical case studies. *Journal of Higher Education*, *9*(36), 33–36.

Zhang, J., He, Y., & Zhang, X. (2023). case-based construction research of the digital image processing course under the background of new engineering. *Electronic Components and Information Technology*, *07*(01), 246–248.

Cai, J., & Lv, Z. (2022). Experimental teaching design and case studies of digital image processing. *Industrial Control Computer*, *35*(01).

Cai, L. (2023). Exploration of ideological and political teaching in the digital image processing course. *University Education*, *2023*(08), 86–88.

Zhang, L. (2022). Exploration and practice of ideological and political teaching in the digital image processing course. *University Education*, *2022*(08), 32–34.

Lou, C. (2021). Focus objectives, difficult issues, and key directions for ideological and political education in curriculum development in the new era. *Journal of Xinjiang Normal University (Philosophy and Social Sciences Edition)*, *42*(05), 96–104.

Yang, X. (2023). Design of ideological and political education teaching cases for “digital image processing” course. *Computer and Information Technology*, *31*(04), 199–121.

Fan, K. (2023). Experimental teaching reform of digital image processing course aimed at cultivatinginnovative ability under the background of new engineering. *Computer Education*, *2023*(07), 29–34.

Fu, X. (2023). Research on ideological and political education in curriculum construction under the perspective of industry-education integration - Taking OpenCV image processing technology as an example. *Computer Knowledge and Technology*, *19*(18), 123–125.

Zhu, Y. (2023). Application ideas and practices of understanding learning in the construction of “remote sensing digital image processing” course under the background of information. *Journal of Beijing Normal University (Natural Science Edition)*, *59*(03), 497–502.

How to Cite: Cao, Y. (2024). A Case Study of Visual Detection and Image Processing Courses under the OBE Teaching. *Contemporary Education and Teaching Research,* 05(07),247-252.
https://doi.org/10.61360/BoniCETR242016500703