

Project-Based Teaching Reform and Process-Oriented Assessment for an Electronic Product Fabrication Practicum: A Case Study in a Higher Vocational College

Yonghong Chen, Guoqi Zhang

School of Information Engineering, Jiangsu College of Engineering and Technology, Nantong, China
Email: chenyh@jcet.edu.cn, guoqizhang@jcet.edu.cn

How to cite this paper: Chen, Y. H., & Zhang, G. Q. (2026). Project-Based Teaching Reform and Process-Oriented Assessment for an Electronic Product Fabrication Practicum: A Case Study in a Higher Vocational College. *Creative Education*, 17, 841-852.

<https://doi.org/10.4236/ce.2026.175053>

Received: March 24, 2026

Accepted: May 25, 2026

Published: May 28, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

In higher-vocational programmes in electronics and information technology, a two-week intensive practicum commonly suffers from three weaknesses: projects that are poorly aligned with real workplace tasks, coarse process control, and assessment drawn from a narrow base of evidence. This paper reports a systematic reform of the Electronic Product Fabrication Practicum built around three design choices. First, a three-stage project sequence comprising Basic Assembly, Unit Debugging, and Comprehensive Troubleshooting is designed to align with students' competency development within the short practicum cycle. Second, a TBL-PDCA (Team-Based Learning combined with Plan-Do-Check-Act) model is embedded throughout the workflow, coupling group collaboration with continuous process-quality control. Third, a process-oriented assessment system is anchored on three types of evidence: physical artifacts, structured forms, and measurement data. The reform was piloted with the 41 students of Electronics Class 2 (Cohort 2023) at Jiangsu College of Engineering and Technology; the class mean was 80.94, the pass rate was 95.12%, 75.61% of students scored 80 or above, and the documented pre-power-on self-check rate was 100% among accepted submissions with available forms. These results are reported as descriptive evidence from one cohort, supported by process records on workmanship, measurement discipline, and logical fault diagnosis, rather than as causal evidence of improvement. The scheme offers a reusable reference for short-cycle practicum courses of similar form.

Keywords

Electronic Product Fabrication Practicum, Project-Based Teaching, Process-Oriented Assessment, Higher Vocational Education, TBL-PDCA

1. Introduction

As electronic information products iterate at an increasing pace, industry places ever-higher demands on assembly quality, measurement discipline, and the ability to trace and diagnose faults. For higher-vocational practicum courses on electronic product fabrication, the teaching objective is no longer limited to circuit assembly and producing a finished product; the emphasis has shifted to the comprehensive practical competencies students develop during project implementation, including disciplined assembly, quantitative testing, fault analysis, and documentation. For a 48-hour course delivered as two intensive weeks, a central question for curricular reform is how project-based teaching can achieve task progression, controllable processes, and evidence-based assessment simultaneously.

Prior work has addressed the restructuring of practical course systems (Qiao & Wang, 2021; Zhang et al., 2021), the implementation of project-based teaching (Wang, 2015; Yin, 2016), and process management with skill assessment (Meng, 2019; Tang, 2024), offering useful references for reform in electronics practica. Most of these studies, however, address project design, instructional organisation, or assessment reform separately, rather than as an integrated scheme in which these elements advance in concert. For the short-cycle, 48-hour intensive practicum in particular, the existing literature does not adequately address the practical pain points of a fast pace, dense tasks, highly variable student preparation, difficult process control, and fragmented assessment evidence. A systematic and operable solution that combines progressive projects, closed-loop processes, and grounded assessment is therefore in short supply.

Starting from this observation, and guided by both the course standard and the occupational competencies expected on the job, this paper proposes an integrated reform of the Electronic Product Fabrication Practicum. First, a progressive project system comprising Basic Assembly, Unit Debugging, and Comprehensive Troubleshooting is constructed to match the pace of competency growth within a short cycle. Second, TBL-PDCA is embedded throughout the entire process: team-based learning helps address differences in students' baseline abilities through collaboration, while the PDCA cycle provides closed-loop quality control. Third, a process-oriented assessment system is built around three kinds of evidence, namely physical artifacts, structured forms, and measurement data, thereby making the teaching process traceable, diagnosable, and improvable. Drawing on the grades and process records of the 41 students in Electronics Class 2 (Cohort 2023), the remainder of the paper details the progressive project design, the TBL-PDCA teaching arrangement, the assessment system, and the observed results.

2. Course Positioning and Problem Diagnosis

2.1. Course Positioning

The Electronic Product Fabrication Practicum is a pivotal course in electronics and information programmes, marking the transition from foundational theory

to job-oriented practice. It is typically scheduled after Fundamentals of Electrical Engineering, Analog Electronics, and Digital Electronics, and carries 48 contact hours and 2 credits. Rather than producing a single deliverable, the course requires students to complete a full cycle of operations within a short time frame: component identification, assembly and wiring, parameter measurement, fault diagnosis, and standardised handover.

The course is aligned with the core competencies of the Electronic Equipment Assembler occupation and covers the typical tasks of assembly, commissioning, inspection, and basic maintenance, targeting the intermediate-level standard for “must-know” knowledge and “must-do” skills in the Chinese national occupational skill framework. From an implementation standpoint, assessment should not be confined to whether the finished product realises its intended function. It should also examine whether students can independently verify components against the bill of materials, perform pre-assembly checks, measure values at specified test points, reason about faults, and organise records. Testing logs, fault-analysis forms, and project-retrospective forms therefore serve both as student deliverables and as the principal evidence on which course attainment and process-oriented assessment are judged.

2.2. Problem Analysis from Classroom Records and Observation

This subsection presents a needs analysis for the course reform, based on the course standard, prior classroom observations by the teaching team, and an initial review of process records generated during implementation. The analysis is used to identify recurring problems in task progression, record keeping, troubleshooting practice, and classroom operation; implementation outcomes are evaluated separately in Section 7. Four issues stand out.

1) *Project tasks are not well aligned with workplace competencies.* Prior teaching observations suggested that practicum tasks had often relied largely on simple circuit verification and assembly-by-diagram. Under teacher-led demonstration, students can reproduce basic operations; once step-by-step instructions are withdrawn and replaced by a bill of materials or a functional block diagram in the style of real engineering work, many students struggle to form a coherent testing and troubleshooting strategy. They continue to follow fixed procedures and cannot readily adapt debugging methods to the fault actually observed.

2) *Process-oriented records are incomplete, and quality control is noticeably downstream.* Existing teaching materials reflect final grades and portions of the learning trajectory, but the completeness and normativity of the various process records remain insufficient. In the absence of standardised record forms and stage-by-stage check-points, it is difficult for instructors to locate the specific step at which a student loses marks, and the diagnostic function of process-oriented assessment is hard to realise.

3) *The rigour of debugging and troubleshooting practice needs to improve.*

Classroom observation reveals recurrent problems at the level of operational details: solder bridges on surface-mount IC pins, polarity-reversed components, omission of pre-power-on checks, and incorrect choice of RC parameters. In diagnosing faults, many students habitually swap components and repeatedly power the board on, lacking a disciplined approach that uses measurement data to localise the cause. Without a standardised troubleshooting procedure, the exercise readily degenerates into blind trial and error.

4) *A short-cycle intensive practicum amplifies differences in baseline preparation.* With 48 contact hours compressed into two weeks, the pace is rapid and the task load dense, so pre-existing gaps in student preparation quickly surface. From classroom performance and process records, weaker students are not wholly unable to operate equipment; rather, they repeatedly err in transitioning between stages, filling in records, and handling rework, with a cumulative effect on overall outcomes.

Subsequent improvements, then, cannot stop at swapping project topics or adding rubrics. The reform must answer three questions simultaneously: how should projects be sequenced, how should the process be managed, and how should outcomes be assessed?

3. Reform Approach and Project Design

3.1. Overall Approach and Integrated Design

Addressing the three questions posed above, the teaching team restructured the course holistically against the stated course objectives. Projects are arranged along a competency progression: Basic Assembly, Unit Debugging, and Comprehensive Troubleshooting. Each project follows a closed-loop workflow: Simulation, Assembly, Testing, Troubleshooting, and Retrospective. TBL-PDCA is adopted throughout to couple team collaboration with continuous process-quality control. Structured forms and physical artifacts serve as the evidence base for process-oriented assessment. Together these form an integrated “project-workflow-management-assessment” reform package.

3.2. Progressive Project Design

Following the competency path from Basic Assembly through Unit Debugging to Comprehensive Troubleshooting, the course is organised into three progressive projects, shown in **Table 1**.

The three projects follow an overall progression from basic workmanship, through surface-mount practice, to comprehensive independent work. Project 1 concentrates on component identification, through-hole soldering, and pre-power-on checking. Project 2 introduces waveform measurement, SMD soldering, and fault localisation. Project 3 steadily reduces instructor prompting, requiring students to complete assembly, testing, and troubleshooting on their own. This ladder-like design lowers the entry barrier to a comprehensive practicum and matches the natural rhythm by which technical skills develop.

Table 1. Progressive project design.

Project context	Core task	Hours	Main equipment and materials	Student deliverables	Acceptance criteria
Project 1: Basic assembly and measurement	Assembly and adjustment of a DC regulated power supply	14	Soldering station, multimeter, discrete-component kit, bill of materials	Assembled power supply; component-inspection log; daily workstation checklist	Pre-power-on check completed; output voltage meets specification; solder-joint appearance acceptable; records complete
Project 2: SMD assembly and commissioning	Assembly and commissioning of a 555-triggered sequential LED circuit	14	Soldering station, oscilloscope, SMD practice board, EDA/simulation software	Assembled LED module; key waveform captures; fault-analysis form	LED cycles at the designed tempo; pin-3 waveform broadly correct; SMD joints pass inspection; student can account for observed faults
Project 3: Comprehensive assembly and troubleshooting	Comprehensive exercise driven by a bill of materials and a functional block diagram	20	Multimeter, oscilloscope, comprehensive training kit, functional block diagram, task sheet	Task-analysis sheet; test report; project-retrospective form	Independent completion of assembly, testing, and troubleshooting; reasonable choice of test points; complete submission of report and retrospective

3.3. Closed-Loop Teaching Workflow

If the sole criterion of success is whether a finished board powers on, students readily neglect workmanship details and testing records. To prevent this, each project is organised around the same five-step flow: Simulation, Assembly, Testing, Troubleshooting, and Retrospective. The 14-hour projects follow the schedule of **Table 2**; the 20-hour comprehensive project lengthens the assembly and troubleshooting stages accordingly.

Table 2. Closed-loop teaching workflow (14-hour project).

Stage	Suggested time	Instructor task	Student deliverable	Quality-control point
Simulation	2 h	Demonstrate circuit function and key measurement points; clarify practicum requirements	Simulation screenshot or list of key test points	Student can articulate supply, input, output, and key measurement points
Assembly	6 h	Demonstrate key operations; patrol and correct solder quality and 5S workstation discipline	Assembled board; reconciled bill of materials	Test before soldering; build sub-unit before whole board; strict safety compliance
Testing	2 h	Guide point-by-point measurement; insist on measurement-grounded evidence	Test record form; key parameter data	Key indicators retain raw values; “OK” without evidence is not accepted
Troubleshooting	2 h	Introduce typical faults; guide a logical diagnostic sequence	Fault-analysis form	Full record under “symptom-evidence-judgement-action”
Retrospective	2 h	Explain common problems; schedule remediation	Project-retrospective form; corrective-action list	Categorise problems, causes, and improvements

4. Implementation: TBL-PDCA Process Management

Team-based learning (TBL) mitigates two chronic problems of an intensive practicum, namely uneven baseline preparation and the instructor's inability to deliver one-on-one coaching, by pairing stronger and weaker students, rotating roles, and enforcing whole-group participation. The Plan-Do-Check-Act (PDCA) cycle governs quality across the entire practicum, moving corrective action upstream into the operation itself to preserve disciplined and high-quality training. Combined as TBL-PDCA, the two embed team collaboration throughout the workflow: small groups plan, execute, check, and improve in unison, delivering efficiency through collaboration and controllability through process management.

4.1. TBL Group Roles and Operational Forms

Students are organised into groups of three to four, with baseline ability and dexterity deliberately mixed. Role assignments are shown in **Table 3**. Roles are rotated, not fixed, so that each student in turn takes on equipment-and-component handling, workmanship, testing, and quality inspection, avoiding over-specialisation in a single familiar task.

Table 3. Group roles and associated forms.

Role	Main responsibilities	Associated forms	Assessment focus
Group leader	Claim equipment; coordinate progress; organise group presentations	Group role sheet; progress log	On-time task completion; adequate coordination
Workmanship officer	Ensure soldering quality, layout discipline, and overall workmanship	Process acceptance form	Reliable soldering; reasonable layout; low rework
Test engineer	Parameter measurement; waveform capture; data entry	Test record form	Truthful and complete data; sensible choice of measurement points
Quality inspector	Pre-power-on checks; 5S at the workstation; cross-inspection; document collation	Daily workstation checklist; cross-inspection log	Pre-power-on check; workstation tidiness; disciplined records

Beyond the role-specific forms listed above, the Fault Analysis Form is a universal record for the troubleshooting stage. Every student completes one during diagnosis, either individually or collaboratively, and it serves as the central evidence of the student's diagnostic reasoning and remedial work. Together with the role-based forms it constitutes a complete evidence base for process-oriented assessment.

The value of TBL collaboration rests on two effects. First, mixed-ability grouping combined with role rotation produces genuine mutual help within each group, mitigating the wide variance in student preparation characteristic of short, intensive practica. Second, process-step cross-checks, record verification, and peer review of outcomes, all conducted at the group level, advance individual skills and team collaboration in parallel.

The four types of forms have complementary functions: the Group Role Sheet records collaboration; the Daily Workstation Checklist assesses compliance with operational standards; the Process Acceptance Form controls stage-by-stage quality; and the Fault Analysis Form structures diagnostic reasoning. Together they allow instructors to pinpoint where a student is struggling and give students a concrete basis for group-level retrospectives.

4.2. PDCA at the Lesson Level

In this course, PDCA is not a rhetorical label but is realised in the specific stages of every session. Before class, the emphasis is on preview and preparation; during class, on assembly and acceptance; at the end of class, on retrospective and remediation. The corresponding expectations and evidence types are given in **Table 4**.

Table 4. PDCA process-control schedule.

Stage	Timing	Instructor task	Student task	Forms and evidence
P (Plan)	Before class	Release micro-lectures, operational focus points, and self-assessment questions; state safety requirements	Preview content; complete self-assessment; prepare tools	Platform activity log; task sheet
D (Do)	First half of class	Demonstrate operations; patrol and correct; use good/bad solder-joint contrasts to inculcate discipline	Assemble, test, and record following the specified workflow	Bill-of-materials reconciliation; test record form
C (Check)	Second half of class	Stage-by-stage acceptance; spot-check critical solder joints and measurement points; enforce power-off before probing, then power-on	Self-check and cross-check; explain any problems found	Process acceptance form; cross-inspection log
A (Act)	End of class and weekend	Consolidate issues; deliver targeted instruction; schedule remediation; update the teaching case library	Record corrective actions; complete rework and retrospective	Fault-analysis form; project-retrospective form

PDCA operates on three nested levels. The per-session loop surfaces and corrects problems within the same lesson. The per-project loop feeds defect data back into the design of the next project. The class-wide loop drives instructors to update workmanship focus points, fault cases, and assessment standards, sustaining continuous improvement.

5. Assessment System: Process-Oriented and Comprehensive

5.1. Assessment Structure and Rationale

The grade register records five equally weighted components, namely Project 1, Project 2, Project 3, everyday performance, and a final comprehensive assessment, each at 20%. From an instructional standpoint this consolidates into everyday 20%, projects 60%, and comprehensive assessment 20%, as summarised in **Table 5**.

Table 5. Course grade structure.

Module	Weight	Rationale
Everyday performance	20%	Attendance, preview activity, workstation 5S, classroom discipline, and attitude
Projects 1 - 3	60%	Corresponds to the three core training activities: basic assembly, SMD commissioning, and comprehensive troubleshooting
Comprehensive assessment	20%	Examines the capacity to complete assembly, testing, and troubleshooting independently with reduced prompting

The weighting reflects a layered assessment intent: the everyday component constrains safety and day-to-day discipline; the three projects deliver the bulk of training; and the final assessment verifies that students can complete a comprehensive operation on their own under reduced prompting.

5.2. Project Scoring Rubric

To avoid scoring only on whether the finished product works, the course decomposes a project grade across five kinds of evidence: component inspection, soldering and assembly, functional testing, fault analysis, and documentation and 5S. Using the DC regulated power-supply project as an example, the rubric is given in **Table 6**.

Table 6. Project scoring rubric, example (100 points).

Top-level indicator	Points	Observables	Deduction examples
Component inspection and preparation	15	Identification; polarity; reconciliation against BOM; inspection log	2 points per missed inspection item; 3 points per parameter misjudgement
Soldering and assembly quality	30	Joint formation; bridges/cold/missing joints; layout discipline	3 points per cold joint; 5 points per solder bridge; 5 points for obviously crowded layout
Functional and indicator testing	25	Pre-power-on check; output voltage/waveform/functional indicators against specification	5 points when a key indicator exceeds tolerance; 20 points when no output
Fault analysis and rectification	15	Completeness of “symptom-evidence-judgement-action” in the fault record	3 points per missing analytic step; 5 points when the conclusion lacks evidence
Documentation and 5S	15	Test records; workstation tidiness; tools returned; safe operation	2 points per missing record field; 5 points per soldering-without-power-off; 3 points for disordered tools

5.3. Operational Indicators and Scoring Consistency

To make the interpretation of the process records reproducible, three improvement indicators were operationalised as observable criteria rather than as general impressions. The criteria used in document review and classroom observation are summarised in **Table 7**.

Table 7. Observable criteria for interpreting process records.

Indicator	Observable criteria	Main evidence source
Workmanship	Solder joints are well formed; no visible bridges, cold joints, or missing joints; component polarity and orientation are correct; layout and wiring are neat; workstation 5S requirements are met	Physical artifacts; Process Acceptance Form; Daily Workstation Checklist
Measurement discipline	Pre-power-on checks are signed or ticked; required test points are measured; raw voltage, resistance, or waveform values are recorded with units; instrument range, grounding, and probe use are appropriate; entries such as “OK” without data are avoided	Test Record Form; Process Acceptance Form; instructor spot checks
Logical fault diagnosis	Fault records include the complete “symptom-evidence-judgement-action” chain; conclusions are linked to measured data; at least one alternative cause is excluded when appropriate; the board is re-tested after corrective action	Fault Analysis Form; Project Retrospective Form; repaired artifact

Primary scoring of artifacts and forms was conducted by the course instructor who taught the class, because scoring had to be linked to on-site acceptance and remedial guidance. To reduce single-rater bias, a second teaching-team member double-checked borderline or incomplete submissions and spot-checked representative project forms against the rubric before final scores were entered in the grade register; disagreements were resolved by returning to the observable criteria in the scoring rubric.

6. Ideological and Political Education and Resource Building

6.1. Integrated Ideological-Political Education

In the classroom, ideological-political education is not delivered as separate exhortation but is woven into real practicum scenarios: assembly, testing, and team collaboration. Inside the PDCA cycle, contrasting well-formed and defective solder joints cultivates a craftsmanship ethos of steady refinement; strict enforcement of pre-power-on checks internalises safety awareness and a sense of professional responsibility. Group cross-checks and outcome presentations, combined with role rotation and mutual evaluation, develop teamwork. Case studies on domestically produced components and on the electronics supply chain foster students' identification with their industry and an attachment to the broader national context in which their work sits.

6.2. Information Resources and Process-Data Support

Before class, the learning platform delivers short video lessons, self-assessment questions, and workmanship cards; preview activity is logged as evidence. In class, EDA simulations support the practicum, while structured forms, including some in paper format, capture test data, fault analyses, and cross-check outcomes for subsequent portfolio review. After class, instructors consolidate process records into individual student portfolios, providing a traceable and objective basis for process-oriented assessment.

7. Implementation Results and Reflection

7.1. Methods: Study Design, Data Sources, and Statistical Coverage

This study adopts a practice-oriented single-case classroom-study design. The cohort consisted of all 41 students in Electronics Class 2 (Cohort 2023) at Jiangsu College of Engineering and Technology, and the teaching implementation took place in the second semester of the 2024-2025 academic year. The data sources included the course grade register, physical artifacts, Daily Workstation Checklists, Process Acceptance Forms, Test Record Forms, Fault Analysis Forms, Project Retrospective Forms, and instructor classroom-observation notes. The analysis combined descriptive statistics for grades and record completion with document review of process forms against the observable criteria listed in [Table 7](#). Total-score statistics used all 41 students in the register; component-level statistics used the available valid records for each item, and missing component records caused by absence or incomplete submission were not imputed but were reported as valid-record counts.

The grade register records Project 1, Project 2, Project 3, everyday performance, the comprehensive final assessment, and the total score; each of the five components contributes 20% of the overall grade. Because of occasional student absences, the number of valid records is 39 for Project 1, 39 for Project 2, 37 for Project 3, and 40 for the comprehensive assessment; everyday performance has 41 valid records.

7.2. Grade Distribution and Competency Attainment

Overall grade statistics show a class mean of 80.94, a median of 87.20, a pass rate of 95.12%, and 75.61% of students scoring 80 or above. Alongside these grades, the archived artifact/form packages provide limited but verifiable process evidence: complete packages were available for 39/41 students in Project 1, 39/41 in Project 2, and 37/41 in Project 3. Among accepted submissions with available forms, the required pre-power-on self-check was documented in all cases. These indicators are used as evidence of record availability and safety-compliance implementation, not as direct measures of learning gain.

The three project means were 84.26, 84.44, and 84.05 for Projects 1, 2, and 3 respectively, and the comprehensive assessment mean was 87.45. Because the projects differed in task type, scaffolding, and difficulty, these scores are reported only as descriptive background and are not treated as a stage-by-stage progression curve. The interpretation of competency attainment therefore relies mainly on process-record review against the observable criteria in [Table 7](#). The reviewed process records provide descriptive qualitative evidence of more disciplined diagnostic reasoning within the project sequence. In representative reviewed examples from Project 1 and Project 3, students' diagnostic language shifts from generic descriptions such as "component damaged" or "circuit broken" toward more specific, data-grounded statements, such as "pin 3 of U1 measures 0 V; root cause is a cold solder joint at R2". This pattern illustrates stronger alignment with the "symptom-evidence-judgement-action" diagnostic chain, while remaining de-

scriptive rather than inferential.

On the whole, the available grades and process records indicate that most students met the basic technical requirements of the course and produced usable evidence in operational discipline, data recording, and fault analysis, thereby broadly attaining the stated course objectives and the intermediate-level competency requirement for the Electronic Equipment Assembler occupation.

7.3. Limitations and Continuous Improvement

Two limitations should be acknowledged. First, the practice covers a single class, and the process forms remain largely paper-based, which limits the efficiency of aggregation, querying, and traceability.

The current paper archive does not support reliable class-level statistics for rework frequency or for the percentage of Fault Analysis Forms containing a fully complete “symptom-evidence-judgement-action” chain. For this reason, the present paper reports record-package completion and pre-power-on self-checks as the verifiable process metrics, while rework frequency and fully complete fault-analysis chains are treated as priority indicators for future digital tracking.

Second, evaluation is dominated by in-house instructors, with limited participation from industry experts, and the alignment between course tasks and real workplace scenarios can still be tightened. Future work will pursue three improvements: i) digitise the Daily Workstation Checklist, the Process Acceptance Form, and the Fault Analysis Form, constructing a queryable and auditable process database; ii) extend the study to cross-class and cross-semester comparative designs, strengthening quantitative validation of the reform; and iii) co-develop comprehensive practicum tasks with industry engineers, grounded in actual work processes and occupational skill standards, in order to increase the authenticity and workplace relevance of the assessment.

8. Conclusion

This study optimises a 48-hour intensive practicum on electronic product fabrication by restructuring the project system along a progression from Basic Assembly, through Unit Debugging, to Comprehensive Troubleshooting, embedding TBL-PDCA in classroom organisation, aligning the course with the Electronic Equipment Assembler skill standard, and building an evidence-driven, process-wide assessment system. In this single-cohort case, the available grades and process records document finer-grained process management, a broader assessment evidence base, and broadly consistent project outcomes, without supporting a causal pre-post claim. The work offers practical experience for project-based delivery of short-cycle electronics practica, and future extensions are well-suited to richer process-data capture and controlled comparative designs.

Acknowledgements

The authors thank the teaching team and the students of Electronics Class 2 (Co-

hort 2023) for their participation in the course pilot.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- Meng, Y. (2019). The “Four Alignments” in Developing a Skill-Assessment Item Bank for the Higher-Vocational Applied-Electronic-Technology Programme. *Journal of Changsha Social Work College*, 26, 102-104. (In Chinese)
- Qiao, J. P., & Wang, F.C. (2021). Teaching Reform of “Electronic Product Fabrication and Commissioning” Based on the CDOC Model. *Popular Science & Technology*, 23, 135-138. (In Chinese)
- Tang, M. (2024). *A Study on Teaching Design and Practice of “Electronic Product Installation and Commissioning” in Secondary Vocational Schools Based on the TBL-PDCA Philosophy*. Master’s Thesis, Guangdong Polytechnic Normal University. (In Chinese)
- Wang, M. (2015). Reform and Practice of Electronic-Product Assembly and Commissioning Practicum Projects in Higher-Vocational Colleges. *Information Technology and Informatization*, No. 2, 15, 21. (In Chinese)
- Yin, W. X. (2016). An Exploration of Application in Higher-Vocational Electronic-Product Assembly Practicum Teaching. *China Training*, No. 12, 112-113. (In Chinese)
- Zhang, J. Q., Li, J. K., & Fang, X. K. (2021). Reform and Practice of the CDIO-Based Practical Course System for Higher-Vocational Applied Electronics Programmes. *Electronic Test*, No. 23, 131-132. (In Chinese)