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Short Paper

The Implementation of the Project-Based Learning Teaching Method in China: Insights from Ganzhou Polytechnic

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Abstract

This quantitative study adopted a descriptive-correlational design to explore the relationship between the implementation of Project-Based Learning (PBL) and student learning engagement, surveying 214 E-Commerce, Internet Marketing, and Live E-Commerce majors at Ganzhou Polytechnic. The results indicated that PBL aligns well with higher vocational education philosophy, and students were generally satisfied with its implementation, with the highest recognition for its relevance to career and personal development. The mean scores for PBL's context, teacher cognitive support, and teacher emotional support were 4.12, 3.91, and 3.86, respectively; peer collaboration scored the highest (3.96) among student learning engagement dimensions, reflecting a sound collaborative learning atmosphere. All PBL implementation dimensions were found to have moderate, positive, and significant correlations with student learning engagement ($p < 0.001$), with teacher cognitive support showing the strongest correlation ($r = 0.755$), proving it to be the key driver of PBL-based learning engagement. The study also identified deficiencies in PBL practice, including insufficient curiosity arousal, inadequate one-on-one teacher guidance, low digital accessibility of teachers, and weak student critical reflection. It is recommended that vocational colleges optimize PBL instructional

design, strengthen personalized teacher support, standardize digital communication, deepen industry-university collaboration, and advance peer cooperation, while investing in teacher professional development and practical training infrastructure upgrading. Future research should further examine the long-term impact of optimized PBL on students' comprehensive competence and its interdisciplinary application in more vocational disciplines.

Keywords – Project-Based Learning, teaching method, student learning engagement, vocational education, curriculum reform

INTRODUCTION

Constructivist theory, first proposed by the eminent Swiss psychologist Jean Piaget around 1927, has been subsequently elaborated by researchers, including Kornberg, Sternberg, Katz, and Vygotsky, leading to continuous enrichment of its conceptual framework. However, the core concept of constructivist theory can be summed up as student-centered, emphasizing students' active exploration of knowledge, active discovery, and active construction of the meaning of what they have learned. In the information age, with the rapid development of technology, the constructivist theory has been continuously accepted, thus becoming the main guiding ideology for scholars at home and abroad to deepen the teaching reform (Pan, 2000). According to the constructivist teaching idea, the project-based learning (PBL) teaching method is a typical representative.

Since the 1990s, China has been exposed to project-based learning (PBL) for over three decades. Relevant research has roughly followed three main lines: "advantage demonstration - practice model - subject/grade-level implementation". PBL emphasizes students' hands-on ability and self-construction of knowledge and skills, ultimately fostering talents that meet the requirements of the times (Hu, 2024). English courses integrated with PBL have gained popularity among many teachers and students, with significant improvements in teaching outcomes and student participation (Zheng, 2023; Lu, 2021). The adoption of PBL helps enhance students' practical abilities, cultivate their teamwork awareness, improve their problem-solving skills, and strengthen their innovative thinking (Fang, 2023; Du & Xun, 2022). The selection of projects, goal setting, and design of steps in PBL are the key factors determining its effectiveness, calling for the delegation of teaching authority to teachers and the upgrading of practical training conditions (Huang, 2022). The combination of PBL with the "instrumentality + humanism" of vocational Chinese language has verified its dual value in knowledge transformation and quality growth (Wen, 2021). Through action research, it was found that PBL can effectively enhance students' algorithmic thinking and soft professional skills, but it places higher demands on teachers' cross-disciplinary integration capabilities (Yu, 2021).

This research focuses on the implementation of PBL courses in higher vocational colleges, systematically evaluating the learning outcomes of students after implementing the project-based teaching method for this course, and examining the important factors influencing the development of students' comprehensive qualities and their mechanisms of action. By combining quantitative analysis with practical suggestions, it provides a new perspective for global research on the implementation of PBL courses.

METHODOLOGY

Research Design

This study used a descriptive correlational method with a quantitative approach. The descriptive aspect was used to summarize the current status of project-based learning implementation, student engagement, and comprehensive quality among higher vocational students. The correlational aspect examined the relationships between these variables without manipulating any factors, enabling predictions about one variable based on knowledge of another (Song et al., 2025). This design was appropriate for determining the operability and practicality of applying project-based learning in teaching contexts.

Participants

The study was conducted at Ganzhou Polytechnic, a higher vocational college in Jiangxi Province, China. The questionnaire selected students in different majors, who come from E-commerce-related majors, such as E-Commerce, Internet Marketing, and Live E-Commerce. All the students were over 18 years old, in the age group between 18 and 25 years old. To determine the number of respondents from the total population of higher vocational students, the researcher used total enumeration in the selection of the respondents, with 214 students.

Research Instrument

A researcher-made five-point Likert Scale questionnaire was the main instrument in this study. The questionnaire was utilized to identify the students' comprehensive quality towards the project-based learning teaching method in terms of: implementation of the project-based learning teaching method, student learning engagement, and students' comprehensive quality. Each dimension contained different quantities of indicators, which will be rated in a 5-point rating scale, from "strongly agree" to "strongly disagree," was used to assess efficacy.

The questionnaires were content validated by the three experts in different fields. One professor was based in the Philippines and taught research and statistics at a private university, while the two other validators were professors from China, and both were

connected with a university of science and technology. The researcher used the Cronbach Alpha Reliability Test, followed by a pre-test involving 30 students to assess its clarity and dependability. The Cronbach's Alpha values of Project-Based Learning Teaching Method, Student Learning Engagement, and Students' Comprehensive Quality are 0.983, 0.987, and 0.987, respectively, indicating that the questionnaire exhibited strong internal consistency. Cronbach's Alpha of 0.98 should not be automatically interpreted as problematic. Instead, it reflects very high internal consistency, which is desirable in many research contexts, particularly in high-stakes measurement. While extremely high values may suggest possible redundancy, this is not inherently negative and must be evaluated alongside theoretical justification, item content, and additional validity evidence (Uedufy, 2025; Frost, n.d.). Therefore, a high alpha value is best understood as an indicator of strong reliability rather than a flaw in the instrument.

Data Collection

The final standardized questionnaires were distributed to the selected 214 participants, with strict assurances of respondent anonymity and confidentiality to mitigate biases associated with self-reported data. Quantitative data were collected through Wenjuanxing Forms. The collected data from the respondents were systematically organized, tallied, and tabulated to facilitate more effective interpretation and analysis.

Data Analysis

The collected data were analyzed using weighted means for descriptive statistics and Spearman's rho correlation analysis for inferential statistics.

Ethical Considerations

This study was conducted under the ethical protocol of the College of Arts, Sciences, and Education, Trinity University of Asia. All prospective respondents were first given a comprehensive briefing that explained the research purpose, procedures, and their role in the investigation. They were explicitly informed that participation was strictly voluntary and that they could withdraw at any stage without penalty. To ensure transparency, the researcher described in plain language how data would be collected, stored, and analyzed, so that respondents understood exactly what their involvement entailed. Each participant then received an informed-consent letter outlining these details and confirming their agreement to take part. Finally, every precaution was taken to maintain confidentiality: all data were anonymized, personal identifiers were removed, and access to raw data was restricted to the research team, thereby safeguarding the privacy of every respondent throughout the study.

RESULTS

Table 1 presents the assessment of the implementation of the project-based learning teaching method of the student respondents in selected higher vocational colleges of China. As presented in Table 1a, the overall mean for assessment by the students on the implementation of project-based learning teaching method in terms of "Context" is 4.12, with a verbal interpretation of "Agree/Satisfied". The highest-rated indicator #4, "It will help me when I go to work in the corporate world or in my personal development" (mean = 4.16), suggests that students perceive the project-based learning as highly relevant and directly applicable to their future careers and personal growth. While all indicators received a weighted mean that falls within the "Agree/Satisfied" range, the indicator #1, "Piqued my curiosity and made me want to find out more," scored the lowest with a mean of 4.06. This indicates that while students find the project valuable and challenging, its initial presentation or design may not be fully optimized to trigger a strong innate sense of wonder and curiosity. To improve this, instructors could focus on enhancing the inquiry-launch phase of the project. This approach shifts the student's role from executing a task to investigating an intriguing problem, thereby more effectively sparking curiosity.

Table 1a. Assessment of Students on the Implementation of Project-Based Learning Teaching Method in terms of Context

Indicator	Mean (*M*)	Verbal Interpretation
1 Piqued my curiosity and made me want to find out more	4.06	Agree/Satisfied
2 A challenge for my current knowledge and experience	4.13	Agree/Satisfied
3 Has significant market value and is worth the effort I put into it	4.12	Agree/Satisfied
4. It will help me when I go to work in the corporate world or in my personal development.	4.16	Agree/Satisfied
OVERALL MEAN	4.12	Agree/Satisfied

Note. 4.21-5.00 (Strongly Agree/Very Satisfied) | 3.41-4.20 (Agree/Satisfied) | 2.61-3.40 (Moderately Agree/Fair) | 1.81-2.60 (Disagree/Rather Dissatisfied) | 1.00-1.80 (Strongly Disagree/Very Dissatisfied)

As presented in Table 1b, the overall mean for assessment by the students on the implementation of project-based learning teaching method in terms of "Teacher Cognitive Support" is 3.91, with a verbal interpretation of "Agree/Satisfied". Worthy of mentioning is indicator 4, "My teacher made me fully aware of the goals of the visual design project," which achieved a weighted mean score of 3.99, interpreted as a good effect. It is worth mentioning that the high score reflects the effectiveness of the teacher in clearly communicating the project goals, which is essential for aligning student efforts with the desired outcomes of the visual design project. Indicator number 8, which refers to "My often work one-on-one to guide me in designing or operating my visual design

projects", got the lowest average mean score of 3.63, verbally interpreted as "Agree/Satisfied". Although this score is 3.63, it got the lowest weighted mean, and it also belongs to the higher scale level. It means that students generally agree or are satisfied with the one-on-one guidance provided by their teacher, reflecting an overall positive perception of this aspect of the teaching approach. Teachers could explore strategies to enhance one-on-one guidance, such as allocating more time for individual consultations, tailoring feedback to specific student needs, or providing additional resources for independent project work.

Table 1b. Assessment of Students on the Implementation of Project-Based Learning Teaching Method in terms of Teacher Cognitive Support

Indicator	Mean (*M*)	Verbal Interpretation
1 My teacher gave me full guidance on choosing a topic for my visual design project	3.90	Agree/Satisfied
2 My teacher made me fully understand the background of the visual design program and its value	3.97	Agree/Satisfied
3 My teacher made me clearly understand the relationship between the visual design program and the subject's body of knowledge	3.96	Agree/Satisfied
4 My teacher made me fully aware of the goals of the visual design project	3.99	Agree/Satisfied
5 My teacher guided me to set milestones and tasks for the visual design project	3.96	Agree/Satisfied
6 My teacher pointed me in the direction of solving problems in the design or operation of visual design projects	3.96	Agree/Satisfied
7 My teacher inspired me to think deeply about the practical issues of visual design projects	3.89	Agree/Satisfied
8 I often work one-on-one to guide me in designing or operating my visual design projects	3.63	Agree/Satisfied
OVERALL MEAN	3.91	Agree/Satisfied

Note. 4.21-5.00 (Strongly Agree/Very Satisfied) | 3.41-4.20 (Agree/Satisfied) | 2.61-3.40 (Moderately Agree/Fair) | 1.81-2.60 (Disagree/Rather Dissatisfied) | 1.00-1.80 (Strongly Disagree/Very Dissatisfied)

As presented in Table 1c, the overall mean for assessment by the students on the implementation of project-based learning teaching method in terms of "Teacher Emotional Support" is 3.86, with a verbal interpretation of "Agree/Satisfied". This indicates that students generally feel supported by their teacher on an emotional level during the implementation of project-based learning. The indicator "My teacher encouraged me to voice my confusion in the design or operation of the program." obtained the highest mean score of 3.99, signaling that teachers successfully create a psychologically safe space in which students feel comfortable revealing their

uncertainties. The indicator "I can always contact the teacher via WeChat, QQ or email." recorded the lowest mean of 3.51. Although still within the "Agree/Satisfied" range, this score is noticeably lower, indicating room for improvement in perceived accessibility.

Table 1c. Assessment of Students on the Implementation of Project-Based Learning Teaching Method in terms of Teacher Emotional Support

Indicator	Mean (*M*)	Verbal Interpretation
1 My teacher piqued my interest in visual design projects	3.93	Agree/Satisfied
2 My teacher encouraged me to venture into challenging visual design projects	3.95	Agree/Satisfied
3 My teacher encouraged me to voice my confusion about the design or operation of the program	3.99	Agree/Satisfied
4 My teacher is very concerned about the progress of my visual design project	3.91	Agree/Satisfied
5 I can always contact the teacher via WeChat, QQ, or email	3.51	Agree/Satisfied
6 My teacher recognizes my project design or operation promptly	3.84	Agree/Satisfied
7 My teacher encouraged and supported me when I was frustrated	3.89	Agree/Satisfied
OVERALL MEAN	3.86	Agree/Satisfied

Note. 4.21-5.00 (Strongly Agree/Very Satisfied) | 3.41-4.20 (Agree/Satisfied) | 2.61-3.40 (Moderately Agree/Fair) | 1.81-2.60 (Disagree/Rather Dissatisfied) | 1.00-1.80 (Strongly Disagree/Very Dissatisfied)

Table 2 presents the assessment of the student learning engagement of the student respondents in selected higher vocational colleges of China. As presented in Table 2a, the overall mean for assessment by the students on their learning engagement in terms of "Cognitive Inputs and Reflections" is 3.88, with a verbal interpretation of "Agree/Satisfied". This indicates that students are positively engaged in the cognitive processes essential for Project-Based Learning. It is noteworthy to mention that the indicator #8, "I think through the content of the visual design project to decide on specific learning tasks," received the highest mean score of 4.00, categorized as "Agree/Satisfied". This reflects that students are actively and strategically planning their approach to the project. The indicator #5 "I reflect on issues in the design and operation of visual design programs" received the lowest mean score of 3.51. While this is still within the "Agree/Satisfied" range, this indicates a relative weakness in critical reflection.

Table 2a. Self-Assessment of Students on their Learning Engagement in terms of Cognitive Inputs and Reflections

Indicator	Mean (*M*)	Verbal Interpretation
1 I compare the different solutions and select the best one	3.93	Agree/Satisfied
2 I incorporate ideas or concepts from different disciplines in my designs	3.95	Agree/Satisfied
3 I combined my own ideas with the course content to come up with a visual design project	3.99	Agree/Satisfied
4 During the design process, I thought about possible alternatives	3.91	Agree/Satisfied
5 I reflect on issues in the design and operation of visual design programs	3.51	Agree/Satisfied
6 I set milestones for learning as I work on visual design projects	3.84	Agree/Satisfied
7 I transformed my learning style to meet the requirements of the curriculum	3.89	Agree/Satisfied
8 I think through the content of the visual design project to decide on specific learning tasks	4.00	Agree/Satisfied
OVERALL MEAN	3.88	Agree/Satisfied

Note. 4.21-5.00 (Strongly Agree/Very Satisfied) | 3.41-4.20 (Agree/Satisfied) | 2.61-3.40 (Moderately Agree/Fair) | 1.81-2.60 (Disagree/Rather Dissatisfied) | 1.00-1.80 (Strongly Disagree/Very Dissatisfied)

As presented in Table 2b, the overall mean for assessment by the students on their learning engagement in terms of "Seeking Help from Teachers" is 3.87, with a verbal interpretation of "Agree/Satisfied". This indicates a positive but moderate level of engagement in seeking expert help. Indicator number 1, "I interacted with a professional faculty member regarding the course learning content," the mean score is 3.89. This suggests that students, on average, agree or are satisfied with their interactions with professional faculty members regarding course content. Indicator number 2, "I communicate with corporate engineers on project design and operation," the mean score is 3.85. This also indicates that students, on average, agree or are satisfied with their communication with corporate engineers related to project design and operation.

As presented in Table 2c, the overall mean for assessment by the students on their learning engagement in terms of "Seeking Help from Classmates" is 3.96, with a verbal interpretation of "Agree/Satisfied". This indicates that the PBL methodology has successfully fostered a supportive learning community where students feel comfortable leveraging each other as resources. Two indicators share the highest mean of 3.99: "I often help guide other students in the design or operation of their projects" and "I often discuss visual design projects with other students". These scores demonstrate robust reciprocal peer learning and collaborative discourse, which are repeatedly linked to heightened engagement and achievement. The single lowest indicator is "I discuss with

team members issues in the design and operation of visual design projects" (mean = 3.91). Though still "Agree/Satisfied," it is marginally lower than the others. Possible reasons include uneven team dynamics or limited time for discussion.

Table 2b. Self-Assessment of Students on their Learning Engagement in terms of Seeking Help from Teachers

Indicator	Mean (*M*)	Verbal Interpretation
1 I interacted with a professional faculty member regarding the course learning content	3.89	Agree/Satisfied
2 I communicate with corporate engineers on project design and operation	3.85	Agree/Satisfied
OVERALL MEAN	3.87	Agree/Satisfied

Note. 4.21-5.00 (Strongly Agree/Very Satisfied) | 3.41-4.20 (Agree/Satisfied) | 2.61-3.40 (Moderately Agree/Fair) | 1.81-2.60 (Disagree/Rather Dissatisfied) | 1.00-1.80 (Strongly Disagree/Very Dissatisfied)

Table 2c. Self-Assessment of Students on their Learning Engagement in terms of Seeking Help from Classmates

Indicator	Mean (*M*)	Verbal Interpretation
1 I discuss with team members issues in the design and operation of visual design projects	3.91	Agree/Satisfied
2 I ask other students for help when I'm in trouble	3.98	Agree/Satisfied
3 I often help guide other students in the design or operation of their projects	3.99	Agree/Satisfied
4 I often discuss visual design projects with other students.	3.99	Agree/Satisfied
OVERALL MEAN	3.96	Agree/Satisfied

Note. 4.21-5.00 (Strongly Agree/Very Satisfied) | 3.41-4.20 (Agree/Satisfied) | 2.61-3.40 (Moderately Agree/Fair) | 1.81-2.60 (Disagree/Rather Dissatisfied) | 1.00-1.80 (Strongly Disagree/Very Dissatisfied)

Table 3 presents the relationship between the implementation of project-based learning teaching method and student learning engagement of the student respondents in selected higher vocational colleges of China. As presented in Table 3, the relationship between Project-Based Learning Teaching Method Context and Student Learning Engagement, Teacher Cognitive Support and Student Learning Engagement, Teacher Emotional Support and Student Learning Engagement, Spearman's Rho is reported as 0.566, 0.755 and 0.604 respectively, the associated p-value is less than .001, which is less than the commonly used significance level of 0.05, suggesting a moderately positive correlation between the each two variables.

Table 3. Spearman's Rho Correlation Analysis between the Implementation of Project-Based Learning Teaching Method (Context, Teacher Cognitive Support, Teacher Emotional Support) and Student Learning Engagement

		Project-Based Learning Teaching Method Context	Teacher Cognitive Support	Teacher Emotional Support
Student Learning Engagement	Spearman's Rho	0.566	0.755	0.604
	P-value	< .001	< .001	< .001

DISCUSSION

The primary purpose of this study is to find out the relationship between the implementation of the project-based learning teaching method and student learning engagement. According to the survey data, the students have good evaluations of the implementation of the project-based learning teaching method, and there is also a positive correlation between the variables.

As can be seen from Table 1a, students highly value PBL's career and personal development relevance (Mean=4.16). It was supported by the study of Zhang (2022), which reported that Project-based learning helps students practice complex real-world project management and solve practical problems. Furthermore, according to Ghosheh Wahbeh et al. (2021), identified the role of project-based language learning in cultivating students' life skills. From Table 1a, the relatively lower score for curiosity arousal (Mean = 4.06) underscores a key area for improvement. According to the existing research results, Bartlett et al. (2024) pointed out that curiosity plays a crucial role in enhancing learning and memory, so educators need to pay attention to it. Moreover, Rakedzon and Van Horne (2021) cultivated scientific curiosity and questioning skills through projects, and the results showed that using question-based questioning in scientific research could promote more active participation and exploration among students, which might be beneficial for their future scientific research and thinking.

As shown in Table 1b, Students rated the clarity of project goals highly (Mean=3.99). This result can be confirmed by Shekh-Abed (2025), who states that in project-based learning, measuring self-awareness and cognitive skills is crucial for evaluating the effectiveness of the learning process, which helps to enhance project outcomes and lays a more solid foundation for future academic and career success. However, the lower score for one-on-one guidance (Mean=3.63) highlights a need for improvement. Scholars' research pointed out that it is very important to provide a one-on-one dialogue channel between lecturers and students. In addition, one-on-one guidance was provided to individuals and teams deemed necessary (Zhang, 2022). Similarly, Mehta (2020), based on project-based learning, suggests that, to attract students, teachers can spend more time on one-on-one teaching and guide students' learning journey.

As presented in Table 1c, creating an environment where students feel safe voicing confusion (Mean=3.99) is a noted strength. This result can be supported by Dobson and Dobson (2021), who demonstrate that encouraging students to develop their own voice by increasing their participation and active listening is effective. Khoudri et al. (2023) point out that whenever teachers notice students feeling confused, they should encourage or train learners to speak, enhance their autonomy, and prepare them for challenges after graduation. However, the lowest score for teacher accessibility via digital channels (Mean=3.51) indicates an area for improvement. Moreover, Reis et al. (2020) presented a case study of a student team that sent all task deadlines to the teacher via email. The teacher always provided detailed explanations to the students and always strived to guide them. This project-based teaching and learning approach may have a special impact on students and, in turn, on civil society.

As analyzed in Table 2a, students also recognized the value of actively planned project tasks (Mean=4.00). This result can be significantly supported by Karan and Brown (2022), who indicated that the PBL teaching strategy enhanced students' understanding and improved their processing abilities. Meanwhile, from Table 2a, the weakness in critical reflection (Mean=3.51) highlighted an area for development. This finding can be significantly supported by Hussein (2021), who studied the reflection reports submitted by students participating in project-based learning tasks in engineering education, driving students to better solve the problems or difficulties they encounter.

As shown in Table 2b, students agreed that they engaged moderately with faculty (Mean 3.89). According to Yan (2023), Zeng (2023), Yang (2024), etc., all emphasize the guiding and helping role of teachers in project-based teaching. In Table 2b, the lowest score reflects the lower engagement with corporate engineers (Mean=3.85). According to Lavado-Anguera et al. (2024), project-based learning helps students to cultivate practical operational skills, and the engineers' working environment is higher because they need to interact with professionals. Communicating with engineers enhances students' skills and increases the added value of the overall teaching model.

Regarding seeking help from classmates in Table 2c, the students appreciated the peer collaboration (Mean=3.99). This finding can be significantly supported by Luan et al. (2023), who pointed out that help from classmates can boost students' learning confidence and promote more active learning. Further, Rehman et al. (2024) underscore PBL's pivotal role in promoting active learning and student engagement; this approach advocates its adoption as a forward-thinking educational strategy. However, the slightly lower score for team discussions (Mean=3.91). This finding aligns with Amerstorfer et al. (2021), who indicated that students' academic engagement depends on multiple factors, which are related to the learners' personal characteristics, teachers, teaching methods, peers, and other features in the learning environment.

As shown in Table 3, according to the Spearman's Rho correlation analysis, the project-based learning teaching method context, teacher cognitive support, and teacher emotional support in the project-based learning teaching method significantly affect student learning engagement. Some scholars' research confirms this view. Almulla (2020) explored the effectiveness of the project-based teaching method and regarded it as a way to attract students to participate in learning. The project-based teaching method can promote the sharing and discussion of knowledge and information, thereby increasing students' engagement. Further, these findings are consistent with Morrison et al. (2021) who introduced that the teachers' support findings were personal and caring, they challenged students and provided responsive guidance and advice, responding directly to students' interests while retaining high standards and expectations; and from the analysis saw that teachers' caring in an environment of high expectations was crucial for student success. Similarly, Rehman et al. (2024) pointed out that in project-based teaching, teacher support or classroom teaching skills influence students' beliefs, emotions, and motivation towards mathematics, and it significantly affects their academic performance and engagement.

CONCLUSIONS

Project-Based Learning (PBL) has become a transformative force in the reform of higher vocational education in China. It challenges the existing teaching model and redefines the way of cultivating applied skills. This study indicates that the effective implementation of PBL depends on multiple interrelated techniques across three fundamental dimensions: a) In terms of the implementation of PBL, make the teaching environment align with the needs of career development. Provide clear cognitive guidance through goal communication, and create an emotional support atmosphere that encourages open expression of uncertainty. At the same time, seek spaces to enhance curiosity stimulation, personalized guidance, and digital accessibility; b) In terms of student learning engagement: by formulating strategic task plans to stimulate active cognitive participation, promoting interaction with teachers and industry professionals, fostering strong cooperative relationships characterized by mutual assistance and in-depth discussions, and providing opportunities to enhance critical reflection and the depth of team problem-solving; c) In terms of the relationship dynamics: a significant and positive connection was successfully established between the implementation of PBL and student learning engagement in the learning process. Among them, the teacher's cognitive support proved to be the most crucial factor in promoting active learning. This study also indicates that those educators and students who actively advocate for flexibility and collaboration are crucial for fully realizing the potential of project-based learning (PBL). These integrated strategies enable PBL to thrive in vocational education, with key factors including responsible participants, targeted support mechanisms, and a collaborative ecosystem, all of which are essential elements for success. The fundamental aspect lies in establishing a student-centered, practice-oriented teaching method that values both skill development and comprehensive growth.

The research results of Ganzhou Polytechnic indicate that the sustainability of project-based learning in vocational education depends on the synergy of instructional design, teacher support, and student participation. All of these require the school to make commitments in terms of resource allocation and continuous improvement. Specifically, tailored optimization of project-based learning implementation, comprehensive teacher support, and deep student learning engagement can improve the efficiency of talent cultivation. The participating students are aware of the importance of project-based learning in enhancing practical techniques and teamwork. They display different advantages in various aspects: some are good at work-related content, some are skilled in teamwork, and the guidance of the teachers is highly appreciated for its well-defined goals. It is worth noting that vocational schools are designed to nurture talent that meets the requirements of the industry. The future of PBL rests in fulfilling unmet demands, encouraging innovative thinking, and cultivating lifelong learning skills that are frequently neglected in traditional teaching methods. Although practicality and collaboration are inherently advantageous, all organizations aspire to further strengthen these capabilities. Therefore, new approaches such as inquiry-based design, individualized instruction, and deepened integration with industry must be adopted to ensure project-based learning maintains a comparative advantage in current and future reforms.

Whether or not educational reform is underway, vocational colleges should look beyond PBL's present strengths to improve its implementation by making learning practically relevant, keeping students engaged through enhancing the educational experience, and simultaneously resolving existing shortcomings: insufficient stimulation of curiosity and insufficient support for critical reflection. Thus, PBL can more naturally bridge vocational education and industry demands, cultivate talents who are equipped with professional skills as well as transferable abilities, and thereby truly advance the high-quality development of modern vocational education in China.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the recommendations below are put forward to enhance the effectiveness of Project-Based Learning (PBL) implementation and further improve student learning participation in higher vocational colleges.

For PBL Instructional Design

Enhancing the Inquiry-Launch Stage: Addressing the relative weakness in stimulating inquiry, instructors should redesign the project introduction phase. Instead of presenting a defined task, projects should be launched using provocative questions, real-world dilemmas, or surprising data that frame the project as an engaging question to be investigated, thereby shifting the student role from receptive executors to active investigators.

Integrate Structured Feedback Mechanisms: Cultivating critical reflection, an identified area of weakness, structured reflective practices must be formally embedded into the PBL cycle. This can be mandated through guided reflective journals, post-phase debriefing sessions, or final presentations that specifically demand students to analyze challenges, failures experienced, and lessons learned, rather than merely describing the process.

For Teacher Support and Development

Strengthen Individualized Guidance: Given that one-on-one guidance scored lowest in cognitive support, institutions should provide teachers with the necessary resources and time to deliver more personalized feedback. This may include scheduling dedicated consultation periods, training teachers in differentiated instruction techniques, and establishing clearer formative assessment criteria throughout the program cycle.

Establish and Promote Clear Digital Communication Protocols: To enhance teachers' perceived accessibility, it is essential to establish clear and responsive communication channels. Teachers should publish their availability on platforms such as WeChat or QQ and commit to standardized response times (e.g., replying within 24 hours on weekdays). Short workshops for both teachers and students on productive virtual communication would also be beneficial.

For Industry Integration and Peer Learning

Deepen Industry Interaction: To move beyond moderate engagement with corporate engineers and instead strengthen cooperation with industrial partners to make it more systematic and comprehensive. This can be achieved by inviting engineers as project clients or consultants, incorporating mandatory virtual or physical check-ins with professionals, and aligning project briefs more closely with real-world business challenges.

Facilitate Advanced Peer Collaboration: While peer help-seeking is a strength, the slightly lower score for internal team discussions is for enhancing collaborative depth. Instructors can implement team contracts, provide training on productive feedback and dispute resolution, and design specific tasks that clearly require interdependent work and knowledge sharing to alleviate problems such as social apathy and uneven participation.

For Institutional Policy

Investing in Teacher Training: Given that teacher cognitive support is the strongest predictor of engagement, sustained teacher development is crucial. Institutions should regularly conduct training on PBL pedagogy, interdisciplinary course design, and

approaches to provide cognitive and emotional support to better prepare teachers for their facilitative role.

Upgrade Practical Training Conditions: According to relevant literature, the effectiveness of PBL depends on adequate resources. The institution should prioritize upgrading software tools, providing necessary access to equipment, and creating adaptable learning spaces that support collaboration projects, thus addressing the gaps in both technical proficiency and practical implementation.

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DECLARATIONS

Conflict of Interest

No conflicts of interest exist with the author that might be deemed significant to the article's content.

Informed Consent

Informed consent was obtained from all participants involved in the study.

Ethics Approval

Approval to conduct the study was obtained from the local ethics committee and the administrator of the campus.

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