ISSN 2773-9368 (Online)
Rangsit Journal of Educational Studies
Vol.12, No.2, pp.130-148, July-December 2025

Factors Influencing College Students' Satisfaction with Project-Based Learning: A Case Study of Colleges in Guangxi, China

* Honghong Chen

Graduate School of Human Sciences, Assumption University, Bangkok, Thailand

*Corresponding author, E-mail: honghongchen2001@163.com

Received 2025-07-25; Revised 2025-11-04; Accepted 2025-11-10;
Published online: 2025-12-22

Abstract

This study utilizes a three-phase, mixed-methods approach informed by the Instructional Design and Implementation (IDI) model to explore the factors affecting student satisfaction with project-based learning (PBL) in a vocational college in South China. It specifically investigates the roles of learning motivation, emotional engagement, learning presence, and learning engagement. The research was conducted in three sequential phases: (1) an initial phase that assessed baseline levels and predictors of satisfaction through validated instruments administered to 90 students; (2) a four-week instructional intervention involving a subset of 30 students, which was designed with structured project phases, authentic tasks, and collaborative learning; and (3) a post-intervention phase that evaluated changes. Quantitative results from the initial phase, analyzed using multiple linear regression, identified emotional engagement, learning presence, and learning engagement as significant predictors of satisfaction, whereas learning motivation did not emerge as a significant factor. Following the intervention, paired samples t-tests revealed statistically significant improvements ($p < .001$) across all constructs, including motivation. Notably, the data indicated a 46.2% increase in learning satisfaction scores post-intervention. The findings suggest that emotional, cognitive, and behavioral engagement are more critical to student satisfaction in vocational PBL than motivation alone, and that a well-structured IDI can substantially enhance both engagement and satisfaction.

Keywords: *Project-Based Learning, Student Engagement, Emotional Engagement, Learning Presence, Learning Satisfaction, Instructional Design, Vocational Education*

1. Introduction

Project-Based Learning (PBL) has gained widespread recognition as a student-centered instructional approach that fosters active learning, collaborative problem-solving, and interdisciplinary skill development (Pazildzhanova, 2024). By engaging learners in authentic tasks through teamwork, reflection, and real-world application, PBL supports deeper learning and personal agency. This approach is particularly relevant in vocational education, where the objective is to develop practical competencies alongside theoretical understanding to meet labor market demands (Riyanti, 2024).

The global shift toward student-centered pedagogy has challenged the limitations of traditional teacher-centered instruction, which, while effective in knowledge transmission, often fails to cultivate autonomy, critical thinking, or applied problem-solving skills (Weimer, 2013; Susman et al., 2024). Advances in digital technologies have further accelerated this transformation, enabling flexible, personalized, and interactive learning environments (Song et al., 2012; Kalalo et al., 2023).

In China, vocational education institutions are central to national strategies aimed at addressing employment pressures and enhancing industrial competitiveness (Wolf, 2011; Cai, 2020). Through mechanisms such as curriculum reform and school-enterprise collaboration, these institutions aim to align graduate skills with industry needs (Morris et al., 2018). Despite policy support, however, the implementation of PBL in Chinese vocational settings remains uneven. Structural barriers—such as traditional pedagogical beliefs, limited instructional resources, and teacher training gaps—continue to hinder effective practice (Chen & Zhao, 2022). These challenges impact students' psychological experiences, including their motivation, emotional investment, and participation in learning.

Although individual constructs such as motivation and engagement have been extensively studied, their combined effects on learning satisfaction in vocational PBL contexts are not well understood. Existing research suggests that motivation may exert indirect effects mediated by task relevance or perceived value (Huang, 2021). while emotional engagement is strongly linked to persistence and enjoyment (Skinner & Belmont, 1993). The concept of learning presence—drawn from the Community of Inquiry (CoI) framework—captures metacognitive awareness, self-regulation, and cognitive/social connectedness (Shea & Bidjerano, 2010), and is essential in sustaining engagement in collaborative settings.

Building on this literature, the current study examines the relationships among learning motivation, emotional engagement, learning presence, and learning engagement in shaping student satisfaction with PBL. Conducted in a vocational college in Guangxi, South China, the research was situated within a specifically designed PBL instructional context. The study employs a three-phase, mixed-methods design guided by the Instructional Design and Implementation (IDI) framework. This approach not only investigates the predictive effects of key psychological factors on learning satisfaction but also evaluates the impact of a structured, four-week PBL intervention—comprising authentic tasks such as "Emotional Shield: Enhancing the E-Commerce User Experience" and "Smart Workshop: Arduino-based Environmental Monitoring"—on enhancing student outcomes. By integrating quantitative surveys and qualitative interviews, this research seeks to advance the theoretical understanding of satisfaction in applied learning contexts and provide practical, evidence-based strategies for improving PBL implementation in vocational education.

2. Objectives

The objectives of this study are threefold. First, it aims to assess the current levels of students' learning motivation, emotional engagement, learning presence, and learning engagement. Second, it seeks to examine the significant impacts of these factors on learning satisfaction. Based on the findings, the study intends to design and implement an

appropriate Intervention Design and Implementation (IDI) to enhance these key factors. The effectiveness of this intervention will be evaluated by identifying significant differences in the variables between the pre- and post-intervention phases. Finally, to gain deeper contextual insights, qualitative interviews will be conducted to explore students' perceptions of the factors influencing their satisfaction and their personal experiences with the IDI.

3. Literature review

3.1 Learning Motivation

Learning motivation is a foundational construct that initiates and sustains students' engagement in achieving academic goals. It encompasses both intrinsic drivers (e.g., curiosity and interest) and extrinsic incentives (e.g., grades and career aspirations) (Filgona et al., 2020; Orakcı & Dilekl, 2022). Motivation is closely associated with academic persistence, self-regulation, and satisfaction (Gjedia, 2015; Felea & Roman, 2023).

In vocational education, motivation is vital for preparing students with relevant skills. Project-based learning (PBL) enhances motivation by offering authentic, collaborative tasks. However, inconsistent motivation may arise from poor project design or perceived irrelevance (Rizki et al., 2023). Prior studies suggest that motivation often influences satisfaction indirectly, mediated by task value and engagement (Huang, 2021).

3.2 Emotional engagement

Emotional engagement refers to learners' affective responses—such as interest, enjoyment, or anxiety—during academic activities (Skinner & Belmont, 1993). It plays a critical role in sustaining attention, persistence, and meaningful learning experiences (Ulmanen et al., 2016; Gutman & Schoon, 2018). Emotional engagement has been linked to improved academic outcomes across educational contexts, including online and vocational learning (Saucedo & Pietrocola, 2021; Xu, 2023).

In PBL environments, emotional engagement is especially salient due to the real-world nature of projects. Students who are emotionally invested are more likely to collaborate effectively and reflect deeply. Understanding and supporting emotional engagement is essential for improving satisfaction in vocational education.

3.3 Learning Presence

Learning presence refers to students' active regulation of their learning through metacognitive awareness, emotional investment, and peer interaction (Shea & Bidjerano, 2010; Akyol & Garrison, 2011; Whiteside, 2015). It is proposed as an extension of the Community of Inquiry (CoI) framework, complementing cognitive, social, and teaching presence (Garrison et al., 1999; Cleveland-Innes & Campbell, 2012).

Research shows that learning presence enhances deep learning, community building, and satisfaction in both online and face-to-face learning contexts (Rourke & Kanuka, 2009; Swan et al., 2009). In PBL, where students collaborate, plan, and reflect, learning presence is especially relevant to sustaining engagement and accountability.

3.4 Learning Engagement

Learning engagement is a multidimensional construct comprising behavioral, emotional, and cognitive participation in learning tasks (Wang & Yang, 2024). It reflects the depth and quality of students' involvement beyond mere attendance or task completion.

Engaged students exhibit higher self-efficacy, deeper learning, and better academic outcomes (Bell, 2023; Lu & Rameli, 2024). In vocational PBL, engagement is driven by relevance, interaction, and collaboration. Enhancing engagement requires tasks that promote autonomy, problem-solving, and teamwork.

3.5 Learning Satisfaction

Learning satisfaction is the learner's cognitive and emotional appraisal of their educational experience. It is widely used as a proxy for instructional effectiveness and is influenced by motivation, engagement, feedback, and content relevance (Chen et al., 2019; Huang, 2021).

In both online and face-to-face contexts, satisfaction correlates with interactivity, communication, and perceived usefulness (Lee et al., 2021; Xu et al., 2024). In vocational education, satisfaction depends on the authenticity of projects and quality of feedback. Improving satisfaction requires both pedagogical design and attention to learners' psychological experiences.

3.6 Project-Based Learning in Vocational Education Contexts

Project-based learning (PBL) has shown substantial promise in vocational education settings, where students benefit from experiential learning aligned with workplace expectations. Several empirical studies have highlighted the impact of PBL on students' engagement, motivation, and learning satisfaction in vocational contexts. For example, PBL-based instruction has been shown to significantly enhance vocational students' engagement and satisfaction by situating learning within authentic, real-world project contexts(Viswambaran & Shafeek, 2019). Similarly, a literature review confirmed that PBL promotes problem-solving ability, critical thinking, and multidimensional engagement—including affective and behavioral dimensions—but also highlighted that its successful implementation depends heavily on instructional design and teacher support (Megayanti et al., 2020).

A recent study demonstrated that vocational students In a blended PBL environment showed improved technical competencies, active participation, and higher learning satisfaction(Chen & Huang, 2024). The motivational benefits of PBL in vocational high school settings have been validated, with evidence showing improvements in both learning motivation and problem-solving ability among hospitality majors (Chiang & Lee, 2016). These findings underscore the psychological relevance of PBL in vocational education, especially through mechanisms that promote emotional engagement and applied learning.

However, while these studies emphasize the positive outcomes of PBL, relatively few have examined the underlying psychological pathways—such as learning presence, emotional engagement, and behavioral effort—that contribute to student satisfaction. This

study addresses that gap by systematically investigating how these psychological factors interact to predict learning satisfaction with PBL among students at vocational and technical colleges in South China, thereby extending and contextualizing the existing literature on engagement and satisfaction within applied higher education settings.

3.7 Conceptual Framework

Based on the reviewed literature and theoretical underpinnings, this study proposes a conceptual framework that integrates four psychological constructs—learning motivation, emotional engagement, learning presence, and learning engagement—as predictors of learning satisfaction in vocational project-based learning environments. The framework is also grounded in three established theories: the Technology Acceptance Model (TAM), the Community of Inquiry (CoI) framework, and Emotional Engagement Theory. This model guides both the hypothesis formulation and the design of the instructional intervention evaluated in this study.

The construct of learning motivation was derived from TAM, where motivation is conceptualized as an internal psychological driver influenced by students' perceptions of task usefulness(Davis, 1989). Learning presence was informed by the Community of Inquiry (CoI) framework, which emphasizes metacognitive awareness, self-regulation, and cognitive-social engagement(Garrison et al., 1999). Emotional engagement, as defined in the foundational model, refers to learners' affective responses such as interest, enjoyment, and frustration (Skinner & Belmont, 1993). In one established model, learning engagement is defined as comprising behavioral, emotional, and cognitive components that reflect students' active participation(Fredricks et al., 2004).

These four constructs were treated as independent variables (IVs), while learning satisfaction served as the dependent variable (DV) (see Figure 1). Based on the theoretical framework and empirical literature, the following hypotheses were formulated:

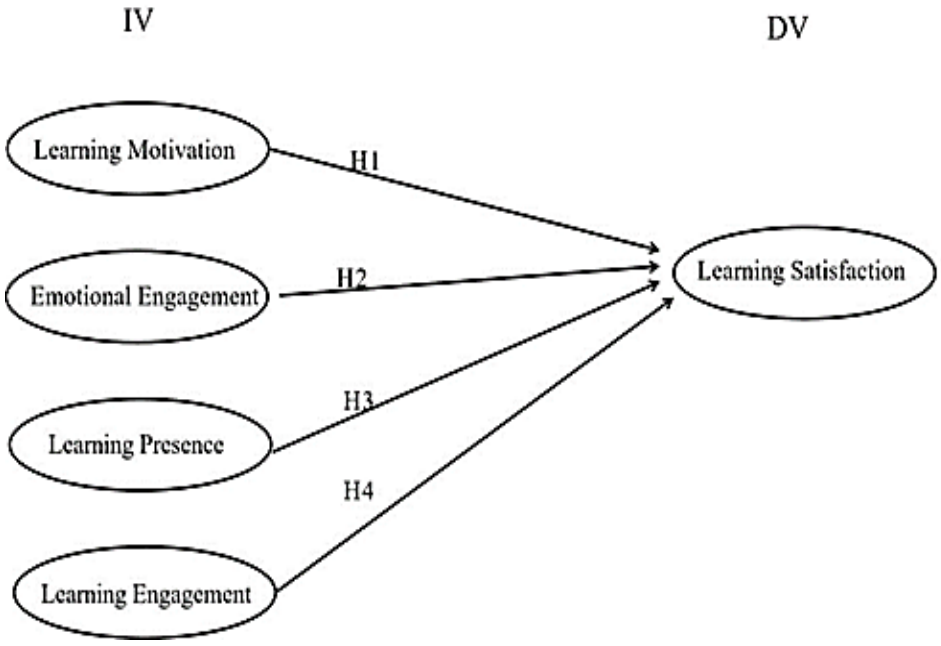

Figure 1: Conceptual framework

H1: Learning motivation has a significant influence on learning satisfaction.
H2: Emotional engagement has a significant influence on learning satisfaction.
H3: Learning presence has a significant influence on learning satisfaction.
H4: Learning engagement has a significant influence on learning satisfaction.
H5–H8: There is a significant difference between learning motivation, emotional engagement, learning presence and learning engagement at pre and post IDI.

4. Methodology

4.1 Research Design

To assess both the relationships among psychological constructs and the effectiveness of a targeted instructional strategy, the study adopted a three-stage Instructional Design and Implementation (IDI) model: pre-IDI, IDI, and post-IDI phases. The total duration of the evaluation was nine weeks, with the intervention lasting four weeks during the central phase.

The intervention was structured around four project-based tasks designed to reflect authentic workplace challenges and align with students' vocational fields. These tasks included:

(1) "Code Exchange: Logistics Sorting and Value Re-shaping"→learning motivation
(2) "Emotional Shield: Enhancing the E-Commerce User Experience"→emotional engagement
(3) "System Sentinel: E-Commerce Role Simulation and Development Planning"→learning presence
(4) "Smart Workshop: Arduino-based Environmental Monitoring"→learning engagement

Each project was designed to promote emotional, cognitive, and behavioral engagement through collaboration, problem-solving, and iterative reflection. Students worked in small groups under instructor facilitation, progressing through defined project stages involving problem identification, task execution, peer feedback, and final presentation.

The IDI model emphasized structured Instructional phases to foster sustained engagement, learning presence, and emotional investment. This approach allowed for the integration of theoretical constructs into practical learning activities, providing a robust context for evaluating changes in psychological variables and overall satisfaction.

4.2 Participants

The study involved 90 second-year students enrolled at a vocational and technical college in Guangxi, South China. A multi-stage sampling strategy was employed to ensure disciplinary and departmental diversity, thereby enhancing the representativeness of the sample. Second-year students were selected because they had already participated in multiple PBL activities within their curriculum and were at a formative stage in developing applied competencies—making them highly suitable for investigating satisfaction and engagement in vocational PBL contexts.

In accordance with the general recommendation of having at least 10 observations per variable in regression analysis, the minimum required sample size for this study was 50, based on five key variables in the conceptual framework(Hair et al., 2013). To enhance statistical power and representativeness, the final sample was expanded to 90 students. Guided by established principles of stratified sampling and proportional allocation methods (Cochran, 1977),the sampling process ensured methodological rigor. as show in (1).

$$\text{Sample Size}=\frac{\text{Total Number in the Stratum}}{\text{Total Number in the Population}}\times\text{Total Sample Size} \quad (1)$$

Therefore, the sample sizes of the three departments are 30, 31, and 29 respectively (as shown in Table 1). From this group, a subsample of 30 students was purposively selected to participate in the instructional intervention. Selection criteria included prior PBL experience, willingness to engage in collaborative activities, and availability throughout the four-week IDI phase. This smaller group size allowed for intensive facilitation, weekly feedback, and meaningful reflection.

Table 1: Student Population and Randomly Selected Sample by Department (N = 264, n = 90)

Student's department	The total number of current students	Research population randomly selected
Department 1	88	30
Department 2	90	31
Department 3	86	29
Total	264	90

In addition, qualitative research employed purposive sampling to select interview participants, ensuring the collection of rich, diverse qualitative data.

Student participants were drawn from the 30 students who completed the entire instructional intervention. Sampling followed the principle of maximum variation, with comprehensive screening based on prior academic performance (high, medium, low), subject background, and voluntary willingness to participate in the intervention. Ultimately, 8 students were selected for interviews. This approach aimed to maximize coverage of diverse student learning experiences and perceptions.

Teacher participants comprised four mentor teachers who fully engaged in the design and implementation of the Instructional Design and Implementation (IDI) model. Each possessed over three years of project-based learning (PBL) teaching experience, serving as key informants who contributed valuable practical insights and professional judgment to the research.

4.3 Instruments

4.3.1 Quantitative Instruments

This study adopted the questionnaire survey method to collect quantitative data, aiming to measure five core variables: learning motivation, emotional investment, learning presence, learning engagement and learning satisfaction. The questionnaire design referred to the widely recognized mature scales in this field and was appropriately

contextualized and adapted for the specific context of project-based learning (PBL) in Chinese higher vocational colleges. All items were measured using a five-point Likert scale, ranging from "strongly disagree" (1 point) to "strongly agree" (5 points). Before the finalization of the questionnaire, three experts in the field of education were invited to evaluate the content validity of the items. The results of the "Project with Objective Consistency Index" (IOC) used showed that the scores of all retained items were higher than the acceptable standard of 0.67. In addition, the study also conducted a pre-test involving 30 students to assess the reliability of the scale. The pretest results indicated that the Klenbach α coefficients of all constructs ranged from 0.734 to 0.972, suggesting that the scale had satisfactory internal consistency (Nunnally & Bernstein, 1994). The following table provides a detailed account of the sources, item compositions and examples of each measuring tool:

Table 2: Research Variable Measurement Scale Information

Variables	Sample Item	Reference
Learning Motivation	I think project-based learning in class is valuable.	Hwang et al.(2013)
Emotional Engagement	I like communicating with my teacher.	Yin et al.(2024)
Learning Presence	The instructor clearly communicates important course goals.	Lin et al. (2017)
Learning Engagement	I am interested in the work at the project based learning.	Lin et al. (2017)
Learning Satisfaction	I am satisfied with project-based in class.	Sun et al.(2008)

In subsequent multiple linear regression analyses, certain items were removed to optimize model structure and enhance statistical power. The final statistical analysis was conducted based on the filtered valid items.

4.3.2 Qualitative Instruments

Qualitative data were collected through semi-structured interviews with the sample of 8 students and 4 teachers described in Section 4.2. Interview transcripts were processed using the systematic thematic analysis method proposed by Braun and Clark (2006). The analysis process comprised: (1) repeated reading of transcripts to familiarize with content; (2) generating initial codes; (3) exploring themes through code consolidation; (4) reviewing and refining themes; (5) defining and naming themes. Through continuous comparison, researchers inducted codes and themes to identify recurring patterns and novel insights regarding participants' affective and cognitive experiences within the PBL project. This process deepened understanding of how the intervention influenced learners' cognition and engagement. The core themes extracted from the analysis provided critical contextual insights for the quantitative findings.

4.4 Data Analysis Methods

The data analysis was conducted in two sequential phases, aligning with the pre- and post-intervention stages of the study and incorporating both quantitative and qualitative methods to ensure methodological triangulation.

4.4.1 Pre-Intervention Quantitative Analysis

In the pre-intervention phase, quantitative data collected from 90 participants were analyzed using multiple linear regression (MLR). This analysis aimed to examine the predictive effects of four independent variables—learning motivation, emotional engagement, learning presence, and learning engagement—on the dependent variable, learning satisfaction. The MLR analysis enabled the identification of significant predictors contributing to students' satisfaction with project-based learning (PBL).

4.4.2 Post-Intervention Quantitative Analysis

Following this, a structured four-week instructional program was implemented with a subsample of 30 students. To evaluate the effectiveness of the intervention, paired-sample t-tests were conducted to compare pre- and post-intervention scores for the four psychological constructs and learning satisfaction. Effect sizes (Cohen's d) were calculated to assess the magnitude of change. Statistical significance was set at $p < 0.05$.

All quantitative analyses were conducted using Jamovi version 2.5.6, an open-source statistical software widely used in educational research (*Jamovi*, 2021). This platform was employed for both the multiple regression and t-test procedures.

4.4.3 Qualitative Analysis

The interview data were analyzed using systematic thematic analysis, following the six-stage process proposed by Braun and Clarke (2006). The interviews were analyzed using Nvivo 15 software. For details, see the separate subsection in the Results section (refer to 5.4 Qualitative Findings).

5. Results

5.1 Results of Pilot Test

Table 3: Cronbach's Alpha (Pilot Sample, n=30)

Variable	Cronbach's Alpha	Strength of association
Learning Motivation	0.925	Excellent
Emotional Engagement	0.734	Acceptable
Learning Presence	0.969	Excellent
Learning Engagement	0.903	Excellent
Learning Satisfaction	0.972	Excellent

Note Cronbach's Alpha>0.7

A pilot test was conducted with 30 participants to evaluate the internal consistency of the five measurement scales. As shown in Table 2, all constructs demonstrated acceptable to excellent reliability, with Cronbach's alpha values ranging from 0.734 to 0.972. Learning motivation, learning presence, learning engagement, and learning satisfaction achieved "excellent" reliability, while emotional engagement reached the "acceptable" threshold.

5.1 Pre-Intervention Multiple Linear Regression Results

A multiple linear regression analysis was conducted to examine the predictive effects of learning motivation, emotional engagement, learning presence, and learning engagement on students' learning satisfaction (N = 90). The model was statistically significant, $F(4, 85) = 103$, $p < 0.001$, with an adjusted $R^2 = 0.829$, indicating that approximately 82.9% of the variance in learning satisfaction could be explained by the four predictors.

Table 4: Multiple Linear Regression: Predictors of Learning Satisfaction (n = 90)

Variables	t-value	p-value	Stand. Estimate (β)	R^2
Learning Motivation	0.414	0.679	0.0377	0.829
Emotional Engagement	3.150	0.002	0.2646	
Learning Presence	5.014	<0.001	0.4735	
Learning Engagement	2.450	0.016	0.2079	

Note * P<0.05; T>1.98 T<-1.98

Among the independent variables, emotional engagement ($\beta = 0.265$, $p = 0.002$), learning presence ($\beta = 0.47$, $p < 0.001$), and learning engagement ($\beta = 0.208$, $p = 0.016$) were significant positive predictors of learning satisfaction. In contrast, learning motivation did not have a statistically significant effect ($\beta = 0.038$, $p = 0.679$). These results partially supported hypotheses H2, H3, and H4, but not H1.A multicollinearity test showed acceptable variance inflation factors (VIF < 5.0), indicating that no multicollinearity issues were present. Standardized residuals met assumptions of normality and homoscedasticity.

5.3 Post-Intervention Paired Samples t-Test Results

Paired samples t-tests were conducted to evaluate changes in the four psychological variables and learning satisfaction before and after the instructional intervention (N = 30).

Table 5: Paired Samples T-Test Results and Percentage Change in Learning Satisfaction (n = 30)

Variable	Pre-Mean	Post-Mean	t-value	p-value	Cohen's d
Learning Motivation	2.26	3.92	-8.72	<0.001	-1.593
Emotional Engagement	2.64	3.83	-4.30	<0.001	-0.785
Learning Presence	2.48	3.65	-5.05	<0.001	-0.923
Learning Engagement	2.95	3.84	-4.07	<0.001	-0.743
Learning Satisfaction	2.49	3.64	-4.36	<0.001	-0.797

Note 1.d > 0.8 = Large effect, 2. * P<0.01.

Paired-samples t-tests demonstrated that the intervention significantly enhanced all variables ($p < .001$), exhibiting large effect sizes. Specifically, the mean score for learning motivation increased from 2.26 to 3.92 (t= -8.72). Critically, the mean score for learning satisfaction rose from 2.49 to 3.64, representing a 46.2% increase ($t = -4.36$, $p < .001$, Cohen's $d = 0.797$). These findings robustly support hypotheses H5 through H8.

5.4 Qualitative Findings

Analysis of the interview data yielded four key themes regarding the drivers of PBL satisfaction.(see figure 2)

Theme 1: Positive Perceptions of Interactive and Authentic Learning Activities

Both students and teachers emphasized the attractiveness of interactive, practical, and real-world aligned tasks. Students frequently mentioned hands-on operations (e.g., operating lathes, soldering circuit boards), case analyses, and group discussions as highly satisfying. As one student noted:

"In mechanical processing courses, being able to operate lathes and milling machines by hand and turn things on the drawings into real objects is particularly fulfilling." (Student 1, Pre-IDI)

Teachers also highlighted that project presentations, role-playing, and collaborative tasks stimulated motivation and a sense of achievement.

Theme 2: Emotional and Behavioral Engagement Through Collaboration

Students reported that PBL fostered a strong sense of teamwork, mutual support, and shared responsibility. Many described the experience as:

"like playing an interesting mission game" (Student 1, Post-IDI), where group cooperation enhanced both learning and emotional investment. One student shared:"Our group helps each other. When problems arise, we solve them together. It feels like what we have learned suddenly comes alive." (Student 1, Post-IDI)

Teachers reinforced this by designing differentiated roles and encouraging peer assistance to ensure inclusive participation.

Theme 3: The Need for Structured Guidance and Teacher Support

A recurring suggestion from students was the desire for more detailed project planning and timely instructor feedback. Several students expressed the need for:

"More detailed project planning guidance before the project starts, such as the key points of each stage and possible difficulties encountered." (Student 1, Post-IDI)

Teachers acknowledged the importance of personalized support and formative feedback to help students navigate challenges and stay motivated.

Theme 4: Resource Accessibility and Real-World Relevance

Students consistently called for more practical equipment, extended operation time, and industry involvement. Suggestions included:

"We hope to buy more equipment so that we can practice more thoroughly." (Student 1, Pre-IDI)

"It would be even better if we could invite some experts from enterprises to share real cases." (Student 1, Pre-IDI)

Teachers also recognized that resource constraints and time allocation were challenges in implementing high-quality PBL.

Figure 2: Word Cloud of the Interview

The qualitative findings reveal that student satisfaction in PBL is closely tied to authentic task design, collaborative interaction, structured teacher guidance, and adequate resource support. These elements align with the quantitative constructs of emotional engagement, learning presence, and learning engagement, and help explain why these factors emerged as significant predictors of satisfaction. The voices of students and teachers provide a rich, contextualized understanding of how a well-structured PBL environment—such as the one implemented in the IDI phase—can enhance both engagement and satisfaction.

6. Discussion

The findings of this study offer several important insights into the psychological factors influencing student satisfaction with project-based learning (PBL) in vocational education settings. The quantitative results from the pre-intervention phase revealed a clear hierarchy of predictors: emotional engagement, learning presence, and learning engagement were significant direct predictors of learning satisfaction, while learning

motivation did not exert a statistically significant effect. This finding resonates with Huang(2021), who suggested that motivation often influences satisfaction indirectly, mediated by task value and engagement, rather than acting as a direct determinant. This indicates that in the context of vocational PBL, the experience of learning—characterized by affective involvement, self-regulatory behaviors, and active participation—holds more immediate sway over student satisfaction than initial motivational dispositions alone.

The lack of a direct effect from learning motivation presents an interesting challenge to conventional assumptions often underpinned by models like the Technology Acceptance Model (TAM) (Davis, 1989). A plausible explanation is that in vocational education, extrinsic motivations (e.g., grades, career prospects) provide the initial impetus but are insufficient to sustain satisfaction throughout the demanding PBL process unless accompanied by sustained emotional investment and cognitive presence. This is further illuminated by our qualitative data and aligns with observations by Chen & Huang(2024), who found that authentic task contexts are crucial for stimulating and sustaining deep engagement. As one student vividly described, working on projects like "Emotional Shield: Enhancing the E-Commerce User Experience" made their learning feel alive, noting, "It feels like what we have learned suddenly comes alive" (Student 1, Post-IDI). This underscores that emotional connection and social co-construction of knowledge are critical in translating effort into satisfaction.

The significant predictive power of emotional engagement reinforces the foundational work of Skinner & Belmont (1993) and more recent studies by Gutman & Schoon (2018), which highlight the fundamental role of emotional engagement in sustaining attention and academic persistence. Concurrently, the role of learning presence as a key predictor corroborates the assertions of Shea & Bidjerano (2010), who conceptualized learning presence as the exercise of self-regulation in regard to metacognition, motivation, and efficacy, and deemed it essential for success in online and blended environments. Our study demonstrates its critical relevance in face-to-face, collaborative PBL as well. Students' desire for "more detailed project planning guidance... and possible difficulties encountered" (Student 1, Post-IDI) highlights how such structured instructional support—which Megayanti et al. (2020) identified as a key factor for successful PBL implementation—fosters the metacognitive awareness and self-regulation that define learning presence, thereby enhancing satisfaction.

The post-intervention results robustly validate the efficacy of the instructional design. The significant improvements across all constructs, with large effect sizes (see Table 5), demonstrate that a well-structured PBL intervention can systematically enhance the very factors that drive satisfaction. This finding is consistent with Viswambaran & Shafeek (2019), who concluded that PBL significantly enhances vocational students' engagement and satisfaction by situating learning within authentic project contexts. The notable improvement in learning satisfaction (Cohen's d = 0.797) indicates that the synergistic enhancement of emotional, cognitive, and behavioral dimensions through the IDI model had a profound positive impact. This lends further support to the multidimensional model of engagement proposed by Fredricks et al. (2004), whereby the combined influence of behavioral, emotional, and cognitive components leads to more positive academic outcomes.

These findings contribute to a more nuanced understanding of student engagement in PBL, advocating for a model that moves beyond a focus on task completion to one that intentionally cultivates an emotionally resonant and metacognitively supportive learning environment. The study demonstrates that sustained satisfaction in collaborative, applied learning settings depends not merely on the initial desire to learn (motivation) but on feeling emotionally invested, cognitively supported, and behaviorally active throughout the process.

From a practical standpoint, this study offers concrete implications for instructional design in vocational education:

(1) Design for Emotional Resonance through Authentic Tasks: Integrate real-world projects, such as "Smart Workshop: Arduino-based Environmental Monitoring," that connect to students' career identities. This aligns with studies like Chiang & Lee (2016), which validated the motivational benefits of PBL in vocational settings.

(2) Scaffold for Learning Presence: Explicitly build in structured reflection points, clear project milestones, and metacognitive prompts based on the principles of Shea & Bidjerano (2010) to develop students' self-regulation and sense of control over complex project work.

(3) Foster a Collaborative Community of Inquiry: Strengthen the teacher's role as a facilitator providing ongoing formative feedback, echoing the importance of teaching and social presence within the Community of Inquiry framework (Garrison, Anderson, & Archer, 1999).

In conclusion, this discussion affirms that fostering deep learning satisfaction in vocational PBL requires a holistic pedagogical approach that integrates motivation, emotion, presence, and behavior. By strategically designing learning environments that support learners' emotional involvement, reflective presence, and active behavioral engagement, educators can create more meaningful and effective experiences that not only boost immediate satisfaction but also better prepare students for the complexities of the modern workforce.

6. Conclusion

This study examined the psychological factors influencing student satisfaction with project-based learning (PBL) in a vocational education context, employing a sequential mixed-methods design grounded in established theoretical frameworks. Drawing on constructs such as learning motivation, emotional engagement, learning presence, and learning engagement, the research provides empirical insights into how students experience and respond to PBL environments designed to foster active, collaborative learning.

Quantitative findings revealed that emotional engagement, learning presence, and learning engagement were significant predictors of learning satisfaction, whereas learning motivation, although conceptually relevant, did not demonstrate a statistically significant direct effect. This suggests that affective and cognitive-behavioral components of engagement play a more immediate role in shaping satisfaction than initial motivational dispositions. Following a structured four-week instructional intervention based on the Instructional Design and Implementation (IDI) model, all measured variables showed significant improvements, with learning satisfaction yielding the largest effect size. These results were triangulated with qualitative data, which provided deeper contextual

understanding of learners' emotional responses, cognitive efforts, and perceptions of instructional design.

From a theoretical perspective, this study extends existing models of engagement by integrating emotional and presence-based constructs into the analysis of student satisfaction. While prior studies have often treated motivation and engagement as separate or sequential phenomena, the current findings highlight the interdependence of emotional investment, active participation, and reflective self-regulation in vocational PBL settings. The results affirm the relevance of the Community of Inquiry (CoI) framework and offer support for expanding its application beyond online learning contexts into vocational classrooms. Furthermore, the limited predictive power of learning motivation alone underscores the need to revisit traditional assumptions within models such as the Technology Acceptance Model (TAM), especially when applied to practice-based, team-oriented instructional environments.

In terms of practical implications, the findings offer clear guidance for educators and instructional designers in vocational education. To enhance learning satisfaction, it is essential to move beyond merely increasing students' motivation at the outset. Instead, educators should design learning environments that are emotionally engaging, cognitively demanding, and socially collaborative. Embedding structured reflection, peer interaction, and continuous feedback throughout project cycles can help sustain learners' emotional and cognitive engagement. Moreover, teacher training programs should incorporate competencies related to emotional facilitation and presence-building, as these are shown to play a critical role in shaping students' overall learning experiences.

Despite these contributions, several limitations must be acknowledged. First, the post-intervention analysis was conducted with a relatively small subsample (n = 30), which may limit the generalizability of the effect size estimates. Second, the study relied on self-reported data, which may be subject to social desirability and recall biases. Third, the research was conducted in a single regional context in South China, and findings may not be directly transferable to other educational systems or cultural settings without further validation.

To address these limitations, future research should consider larger and more diverse samples across institutional types and geographic locations. Comparative studies could explore how engagement dynamics differ across academic disciplines, cultural contexts, or instructional modalities (e.g., online vs. face-to-face PBL). Longitudinal research may also provide insight into the sustainability of engagement and satisfaction over time, particularly in relation to learners' academic outcomes and professional competencies. Furthermore, future studies should explore the role of external factors—such as peer influence, institutional culture, and digital tools—in shaping the interplay between emotional, cognitive, and behavioral engagement.

In conclusion, this study highlights that fostering learning satisfaction in vocational PBL environments requires a comprehensive pedagogical approach that supports learners' emotional involvement, reflective presence, and active engagement. By integrating these dimensions into curriculum and instructional practice, educators can design more meaningful and effective learning experiences that align with the evolving demands of vocational education in the 21st century.

7. Acknowledgement

The author would like to thank the faculty members from a vocational college in Guangxi for their valuable assistance during the data collection and instructional design phases of this study. Their support contributed significantly to the successful implementation of the project.

8. References

Akyol, Z., & Garrison, D. R. (2011). Assessing metacognition in an online community of inquiry. *The Internet and Higher Education*, *14*(3), 183-190. https://doi.org/10.1016/j.iheduc.2011.01.005

Bell, B. (2023). Online Learner Engagement in Higher Education: Part 2–Practice. *International Journal of Educational Spectrum*, *5*(2), 231-258. https://doi.org/10.47806/ijesacademic.1302115

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.

Cai, Y. (2020). School-enterprise Cooperation in Tourism Education of "Dual System". *2020 Conference on Educational Science and Educational Skills (ESES2020)(pp.19-24).*

Chen, H., & Huang, J. (2024). PBL-based vocational education blended learning activity design research. *Education Reform and Development*, *6*(1), 88-95.

Chen, L., & Zhao, Q. (2022). The ecological turn of talent training in vocational education–Based on the perspective of Feinberg's technological holism. *Tsinghua Journal of Education*, *43*(4), 132-139.

Chen, R.-Y., Ruan, L., & Tu, J.-F. (2019). To Explore the Learning Satisfaction and Learning Effecting of Computer Certification. 2019 IEEE 2nd International Conference on Knowledge Innovation and Invention (ICKII),

Chiang, C.-L., & Lee, H. (2016). The effect of project-based learning on learning motivation and problem-solving ability of vocational high school students. *International Journal of Information and Education Technology*, *6*(9), 709-712.

Cleveland-Innes, M., & Campbell, P. (2012). Emotional presence, learning, and the online learning environment. *The International Review of Research in Open and Distributed Learning*, *13*(4). https://doi.org/10.19173/irrodl.v13i4.1234

Cochran, W. (1977). Sampling techniques. 3rd editionJohn Wiley & Sons. *Inc. New York. pp*.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3). https://doi.org/10.2307/249008

Felea, M. I., & Roman, A. F. (2023). Learning Motivation of Students. *Educatia 21，* (25), 299-304. https://doi.org/10.3332/ecancer.2013.ed21

Filgona, j., Sakiyo, J., D.M.Gwany, & A.U.Okoronka. (2020). Motivation in Learning. *Asian Journal of Education and Social Studies*, *10*(4), 16-37. https://doi.org/10.9734/ajess/2020/v10i430273

Fredricks, J., Blumenfeld, P., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, *74*(1), 59-109. https://doi.org/10.3102/00346543074001059

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2-3), 87-105. https://doi.org/10.1016/S1096-7516(00)00016-6

Gjedia, R. (2015). Teaching and Learning Motivation. *European Journal of Social Sciences Education and Research*. https://doi.org/10.26417/EJSER.V3I2.P113-122

Gutman, L. M., & Schoon, I. (2018). Emotional engagement, educational aspirations, and their association during

secondary schoo. *Journal of adolescence*, *67*(2018), 109-119. https://doi.org/10.1016/j.adolescence.2018.05.014

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2013). *Multivariate data analysis: Pearson new international edition PDF eBook*. Pearson Higher Ed.

Huang, C.-H. (2021). Using PLS-SEM Model to Explore the Influencing Factors of Learning Satisfaction in Blended Learning. *Education Sciences*, *11*(5). https://doi.org/10.3390/educsci11050249

Hwang, G.-J., Yang, L.-H., & Wang, S.-Y. (2013). A concept map-embedded educational computer game for improving students' learning performance in natural science courses. *Computers & Education*, *69*, 121-130.

Jamovi. In. (2021). (Version 2.5.6) [Computer Software]. jamovi.org. https://www.jamovi.org

Kalalo, D., Katuuk, D., Lengkong, J., & Rotty, V. N. J. (2023). Innovative 21st Century Learning Through PAKEM Learning Management. *Tadbir : Jurnal Studi Manajemen Pendidikan*, *7*(1). https://doi.org/10.29240/jsmp.v7i1.6966

Lee, Z.-J., Chen, Y., & Lee, C.-Y. (2021). An intelligent approach for learning satisfaction. 2021 IEEE International Conference on Computer Science, Electronic Information Engineering and Intelligent Control Technology (CEI),

Lin, Y. S., Chen, S.-Y., Su, Y.-S., & Lai, C.-F. (2017). Analysis of students learning satisfaction in a social community supported computer principles and practice course. *Eurasia journal of mathematics, science and technology education*, *14*(3), 849-858. https://doi.org/10.12973/ejmste/81058

Lu, Q., & Rameli, M. R. M. (2024). A Systematic Literature Review of Empirical Studies on Learning Engagement in Educational Settings. *Sains Humanika*, *16*(3), 61-75. https://doi.org/10.11113/sh.v16n3.2126

Megayanti, T., Busono, T., & Maknun, J. (2020). Project-based learning efficacy in vocational education: Literature review. IOP Conference Series: Materials Science and Engineering,

Morris, D., Leal, X., & Göbel, H. (2018). Promoting university-business cooperation in developing countries: evidence from Central Asia. *International Journal of Innovation and Regional Development*, *8*(3). https://doi.org/10.1504/ijird.2018.097207

Nunnally, J., & Bernstein, I. (1994). Psychometric Theory 3rd edition (MacGraw-Hill, New York). In.

Orakcı, Ş., & Dilekl, Y. (2022). Motivation in Online Learning. In S. C. a. B. Boukareva (Ed.), *Cases on Global Innovative Practices for Reforming Education* (pp. 104). IGI Global. https://doi.org/10.4018/978-1-7998-8310-4.ch009

Pazildzhanova, R. T. (2024). Project-based learning as an innovative approach to developing practical skills and professional competences in students of technical universities. *International Journal of Pedagogics*, *4*(10), 143-148. https://doi.org/10.37547/ijp/Volume04Issue10-24

Riyanti, D. (2024). The implementation of Project-based Learning in higher education: Students and lecturers' perspectives. *English Language Teaching Educational Journal*, *6*(3), 162-171. https://doi.org/10.12928/eltej.v6i3.9012

Rizki, V. Y., Ervina, I., & Handayani, d. P. K. (2023). Gambaran Motivasi Belajar pada Siswa SMP Negeri 1 Sukowono. *Jurnal Psikologi*, *1*(1). https://doi.org/10.47134/pjp.v1i1.1941

Rourke, L., & Kanuka, H. (2009). Learning in Communities of Inquiry: A Review of the Literature. *Journal of Distance Education / Revue de l'éducation à distance*, *23*(1), 19-48.

Saucedo, K. R. R., & Pietrocola, M. (2021). Emotional Engagement in the Application of Experimental Activities with Young Children. In *Contributions from Science Education Research*. https://doi.org/10.1007/978-3-030-74490-8_20

Shea, P., & Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Computers & Education*, *55*(4), 1721-1731. https://doi.org/10.1016/j.compedu.2010.07.017

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, *85*(4), 571-587. https://doi.org/10.1037//0022-0663.85.4.571

Song, Y., Wong, L.-H., & Looi, C.-K. (2012). Fostering personalized learning in science inquiry supported by mobile technologies. *Educational Technology Research and Development*, *60*(4), 679-701. https://doi.org/10.1007/s11423-012-9245-6

Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education*, *50*(4), 1183-1202.

Susman, K., Vošnjak, M., & Pavlin, J. (2024). Evaluating the Development of Pre-Service Primary School Teachers' Competences in the Context of a Student-Centred Science Visits Course. *Education Sciences*, *14*(11). https://doi.org/10.3390/educsci14111219

Swan, K., Garrison, D. R., & Richardson, J. C. (2009). A constructivist approach to online learning: the

Community of Inquiry framework. *In Payne, C. R. (Ed.) Information Technology and Constructivism in Higher Education: Progressive Learning Frameworks. Hershey, PA: IGI Global*, 43-57.

Ulmanen, S., Soini, T., Pietarinen, J., & Pyhältö, K. (2016). The anatomy of adolescents' emotional engagement in schoolwork. *Social Psychology of Education*, *19*, 587-606. https://doi.org/10.1007/s11218-016-9343-0

Viswambaran, V. K., & Shafeek, S. (2019). Project based learning (PBL) approach for improving the student engagement in vocational education: an investigation on students 'learning experiences & achievements. 2019 Advances in Science and Engineering Technology International Conferences (ASET),

Wang, Y., & Yang, S. (2024). A Study on the Influence of Emotional Intelligence on Academic Satisfaction Among Chinese College Students: The Mediating Effect of Learning Engagement and the Moderating Effect of Social Support. *Journal of Educational Research and Policies*, *6*(10), 79-85. https://doi.org/10.53469/jerp.2024.06(10).20

Weimer, M. (2013). *Learner-centered teaching: Five key changes to practice.* (2nd ed.). Jossey-Bass.

Whiteside, A. L. (2015). Introducing the Social Presence Model to Explore Online and Blended Learning Experiences. *Journal of asynchronous learning networks*, *19*(2), n2. https://doi.org/10.24059/olj.v19i2.453

Wolf, A. (2011). Review of Vocational Education. *London:DfE*.

Xu, Q. (2023). A Systematic Literature Review of Online English Learning Engagement. *Journal of Linguistics and Communication Studies*, *2*(4), 1-13. https://doi.org/10.56397/jlcs.2023.12.01

Xu, R., Bautista, A., & Yang, W. (2024). Learning satisfaction with online teaching video cases among pre-service preschool teachers in China. *Early Education and Development*, *35*(1), 77-95. https://doi.org/10.1080/10409289.2023.2214163

Yin, X., Zhang, J., Li, G., & Luo, H. (2024). Understanding Learner Satisfaction in Virtual Learning Environments: Serial Mediation Effects of Cognitive and Social-Emotional Factors. *Electronics*, *13*(12). https://doi.org/10.3390/electronics13122277