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Optimizing Project-Based Flipped Learning in Chinese TVET English: Key Elements, Student Satisfaction, and Admission Pathway Effects

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Abstract

In the 21st century, TVET students are expected to engage actively and autonomously in exploring subjects, using acquired skills to address real-world problems. Throughout this process, they reinforce their disciplinary knowledge as well as essential 21st-century skills, which are significant for their employability. This study seeks to optimize Project-Based Flipped Learning (PjBFL) in Chinese TVET English learning. The research identified 14 key elements for this PjBFL framework before the actual classroom implementation. A purposive sampling was employed and 109 questionnaires were collected from 3 classes of mechanical engineering students. The quantitative data were analyzed using the One-Way ANOVA and Kruskal-Wallis H Test. The study found that student satisfaction with PjBFL was high, notably in expectations, ownership, autonomy, behavioral engagement, perceived quality, and value. However, moderate satisfaction with prior knowledge highlights the need for better alignment with curriculum demands and project needs. Additionally, the study revealed that admission pathways influence student experiences significantly, with high school graduates entering through the Spring Admission Categorized Exam showing the lowest scores compared to their peers. This underscores the necessity for tailored teaching strategies and adaptive support. Future efforts should focus on customized project designs, adaptive scaffolding, and emotional engagement to ensure all students are equitably engaged.

Keywords: Project-Based Learning, Flipped Classroom, TVET, English Learning, Key Elements, Student Satisfaction, Admission Pathways

Introduction

Characteristics of 21st Century Education

With information technology at its forefront, the 21st century witnesses a rapid cycle of knowledge renewal, compelling industries to innovate and compete vigorously for advancement. Education in this era undergoes unprecedented transformations, particularly under the influence of the internet. Traditional lecture-based classrooms struggle to keep pace with contemporary developments; hence, the focus of learning shifts from merely

acquiring knowledge to cultivating abilities. Students are now expected to engage actively and autonomously in exploring subjects, using acquired skills to address real-world problems. Throughout this process, they reinforce essential 21st-century skills such as communication, collaboration, and critical thinking (Chu et al.,2021), laying a lifelong foundation for learning in a rapidly evolving digital society.

Technical Vocational Education and Training (TVET)

The competency-based nature of 21st-century education (Chappell et al., 2020) is even more pronounced in TVET, where the aim is to develop practical skills. According to UNESCO, TVET, characterized by an emphasis on *employability* (Adams, 2019), serves as a bridge between foundational knowledge and job competence. Vocational courses typically align directly with specific job skills, addressing both industry requirements and market demands. Beyond serving an ever-evolving labor market, the TVET students also bear the hallmark of change. Notably, the generation born after 2000 has grown alongside electronic devices and often exhibits a strong dependency on and fascination with smartphones (Zheng & Zang, 2021). Additionally, vocational institutions often draw students from diverse backgrounds, including varied academic achievements, work experiences, and economic conditions. These characteristics of network-era learning and the diversity of student demographics necessitate flexible and differentiated teaching strategies to ensure that all students benefit from education.

English Learning in Chinese TVET

The 21st-century education highlights the demands for professionals to solve complex and real-world problems. This is particularly true in TVET where hands-on skills and industry liaison are underscored to prepare graduates for the dynamic challenges of the modern workforce. This demand to navigate real-world problems not only refers to vocational disciplines but also affects English language learning, where authenticity is highly required to motivate students.

On the other hand, given the globalized context, English proficiency is no longer just an academic requirement but a critical skill for employment. According to the Ministry of Education of the People's Republic of China (2020), there is a need to cultivate skilled professionals with international perspectives, who can handle cross-cultural communication and understand international norms. This would be beneficial for TVET graduates to get prepared for both local and global job markets.

These challenges in English teaching call for innovative strategies, since the current traditional education often struggles with fragmented knowledge and a lack of practical application (Zeng et al., 2024), and results in low student engagement in English learning of TVET (Chua & Islam 2021; Musa & Rahim 2024). In other words, traditional teaching methods that rely heavily on passive learning and rote memorization fail to meet the needs of today's learners, particularly in a vocational context where practical skills and real-world application are paramount.

Project-based Flipped Learning (PjBFL)

In response to these challenges, project-based flipped learning (PjBFL) emerges as a promising pedagogical approach. It is a combination of project-based learning (PjBL) and flipped

classroom mode (FCM), aligning closely with the educational goals of TVET in the 21st century. PjBL challenges students with real-world problems, encouraging inquiry and collaboration that deepen understanding and internalization of knowledge, ultimately enhancing practical skills and achieving project outcomes (Apriyanti et al., 2021). FCM, a key component of blended learning, expands the space of teaching and learning both online and offline by shifting traditional lectures to pre-class video sessions. Students independently engage with content online to understand concepts, while teachers provide personalized guidance and feedback. Classroom time is maximized for reinforcing knowledge and applying skills (Singh et al., 2017). As a teaching strategy and mode, the PjBFL can be applied across various disciplines, with teachers acting as guides, transforming traditional passive learning into active exploration, thereby boosting student engagement, initiative, and in-depth learning.

Significance of This Study

Despite the growing recognition of PjBFL's potential, its adoption in Chinese TVET institutions is still in its early stages and holds considerable promise. While the proliferation of Massive Open Online Courses (MOOCs) and Small Private Online Courses (SPOCs) since 2012 has laid a foundation for integrating innovative pedagogy into Chinese education (He, 2020), Wang (2020) argues that project-based language learning in China remains under-explored, particularly within TVET settings.

This gap is further exacerbated by the diverse backgrounds of TVET students. Vocational colleges enroll a large number of graduates from secondary education, as well as veterans, migrant workers, and those seeking re-employment. The ones from secondary education further differ from admission pathways. This diversity and varying English proficiency levels necessitate a student-centered, differentiated teaching approach (Xiao et al., 2021), which PjBFL is well-suited to provide.

Moreover, the unique institutional context of Chinese TVET presents both opportunities and challenges for PjBFL implementation. On one hand, the English learning objectives outlined in the *Standards for English Curriculum in Higher Vocational Education (2021)* emphasize the development of linguistic thinking and autonomous learning, in response to the demand for higher-order skills and deep learning. Traditional methods such as rote translation or basic listening and speaking practices are insufficient to achieve these objectives. The Standards (2021) also require the creation of teaching tasks that simulate real-world scenarios in industries and enterprises to enhance students' practical application of language skills, through approaches like PjBL and FCM. On the other hand, TVET students' passive learning habits (Lee & Wallace, 2018) and lower English proficiency levels may pose significant barriers to the implementation of innovative approaches. Therefore, there is an urgent need for localized studies to explore how PjBFL can be effectively adapted to the Chinese TVET English learning context.

Therefore, applying and researching PjBFL in vocational English education is crucial. It can significantly enhance the effectiveness of instructional applications. This study aims to address the following research questions:

RQ1: What are the key elements of implementing a project-based flipped English classroom in TVET?

RQ2: How satisfied are TVET students with project-based flipped English learning?

RQ3: How do different admission pathways affect TVET students' satisfaction with project-based flipped English learning?

This study seeks to address these critical gaps by exploring PjBFL as an innovative approach tailored to meet diverse TVET student needs in China. By investigating its implementation, the findings will help provide actionable insights, leading to improved educational practices, benefiting students' employability and adaptability in a competitive workforce, and offering policymakers reflections to seek educational inclusivity and equity.

Literature Review

Underpinning Theory

Piaget (1976) emphasizes that intelligence adaptation relies on internal coordination, shaped by continuous interactions between individuals and their environments. Knowledge develops and stabilizes through self-organization, with conceptual changes arising from experiential learning (Ackermann, 2001). In constructivist theory, Piaget highlights learners' active roles in knowledge exploration, a principle foundational to both PjBL and FCM. In PjBL, students take an active role in linking theory and practice (Lopera et al., 2022). FCM, on the other hand, shifts theoretical learning to pre-class activities, allowing classroom time for practical application and fostering student inquiry (Cho et al. 2021; Howell 2021).

Vygotsky (1978) introduces the idea that cognitive development is rooted in social interaction. Learning happens through communication and collaborative activities, with the Zone of Proximal Development (ZPD) illustrating the gap between a learner's current abilities and potential growth with assistance (Shabani et al., 2010). Both PjBL and FCM facilitate efficient learning through collaborative efforts, as shown by Rahmat (2023), who demonstrated that group work enhances understanding and negotiation skills among students.

Bishop and Verleger (2013) advocate for active learning models rooted in the theories of Piaget and Vygotsky, underscoring the significance of social environments and interactions in personal development. Their work stresses that understanding is built through exploration and collaboration rather than passive information absorption.

Project-based Flipped Learning (PjBFL)

Project-based Learning (PjBL) in English Learning

Project-based learning (PjBL) engages students in the active, collaborative application of knowledge, fostering deep understanding through critical thinking. In English learning, projects span various vocational fields, such as product development or video creation, linking education to real-world contexts (Apriyanti, 2021). Key elements of effective PjBL include centrality, driving questions, constructive investigation, autonomy, and realism (Thomas, 2000). Students exercise independence by constructing, presenting, and revising their projects (Sukerti et al., 2018).

Research highlights several PjBL components: Marwan (2015) emphasizes both ICT's support and teacher influence for meaningful learning; Villalba (2022) examines blogging for collaborative learning. PjBL boosts motivation, content acquisition, skills, and autonomy, enhancing English proficiency (Sukerti et al. 2018; Imbaquingo & Cárdenas 2023).

Flipped Classroom (FCM) in English Learning

The flipped classroom model reverses traditional teaching by moving lectures to pre-class, allowing in-class time for interactive activities. Pre-class sessions involve independent study through materials such as mini-videos. Experts often segment FCM into three phases: before, during, and after class (Greenfield & Hibbert 2017; He 2020; Hao et al. 2024). Success depends on students' self-direction, as they set goals, plan, monitor, and evaluate their learning.

Evidence from various disciplines, including English as A Foreign Language (EFL) courses, shows FCM improves academic performance over traditional classrooms (Lee & Wallace 2018; Akuffo et al. 2019; He 2020). It also enhances engagement through personalized learning at one's own pace and tailored feedback (Singh et al. 2017; Lee & Wallace 2018). In China, students generally accept FCM, though some struggle to adapt immediately (He, 2020). This aligns with observations that East Asian students, accustomed to passive learning, may initially find active learning challenging (Lee & Wallace, 2018).

PjBFL and its Challenges

Implementing Project-Based Learning (PjBL) and Flipped Classroom (FCM) offers educational benefits but comes with challenges. A significant issue is the increased workload for educators and students, potentially reducing strategy effectiveness. Akuffo et al. (2019) noted that the intensive preparation for FCM can overwhelm educators, while students may struggle with pre-class preparation and active in-class participation. Similarly, Gunawan et al. (2022) highlighted that PjBL's focus on independent work may frustrate students unfamiliar with self-direction. Addressing these issues involves proper workload management and fostering students' time management and autonomy skills (Macías, 2023).

Another challenge is the educator's dual role as facilitator and expert. Effective PjBL and FCM implementation requires teachers to balance designing curriculum and providing tailored feedback. Zarouk et al. (2020) stressed that successful facilitation relies on teachers' ability to guide learning and manage projects. However, Hussein (2021) pointed out that many educators need more training, especially in technology integration and differentiated instruction, which can impact student outcomes.

Technological accessibility also poses a barrier, particularly in under-resourced areas. Listiqowati and Ruja (2022) observed that FCM success depends on reliable digital access. Limited resources can create educational disparities, necessitating equitable solutions to support all learners (Tariq, 2024).

Cultural and institutional factors complicate adopting PjBL and FCM. In East Asia, students used to lectures may resist PjBL and FCM's self-directed methods (He 2020; Lee & Wallace 2018). Educators face constraints like rigid curricula, hindering full integration (Chua & Islam, 2021). Overcoming these challenges requires cultural shifts towards active learning and professional development for teachers.

American Customer Satisfaction Index (ACSI)

The American Customer Satisfaction Index (ACSI) relies on customer interviews as fundamental inputs for its multi-equation econometric model, developed by Professor Claes Fornell. The ACSI model is structured as a causal framework that includes latent-factor indices

to capture the key drivers of customer expectations, perceived quality, and perceived value. As a crucial metric, the ACSI evaluates customer satisfaction. Within this framework, the core elements—customer expectations, perceived quality, and perceived value—collectively influence customer satisfaction.

In this study, student expectations are correlated with satisfaction and are instrumental in predicting learning outcomes and behavioral intentions (Warshaw & Davis, 1985). Perceived quality acts as a significant mediator of student satisfaction, encompassing aspects like teaching quality, instructional design, and resources (Choe et al., 2019). The perceived value measures the cost-effectiveness of the time and effort students invest in PjBFL, substantially affecting their satisfaction and engagement levels (Ledden et al., 2007) Furthermore, the overall student satisfaction with PjBFL should relate to learning outcomes and ongoing learning intentions（Hok et al., 2021).

Prior Knowledge, Ownership and Autonomy, and Behavioral Engagement

Recent research ACSI model has largely focused on measuring satisfaction levels. However, from a constructivist viewpoint, learning is a gradual process that builds on prior experiences. In TVET, students' limited English proficiency and the complexity of project-based flipped learning significantly impact their confidence and behaviors in learning. Li and Wang (2021) support this idea, finding a strong link between prior learning experiences and learner satisfaction.

According to Xiao et al. (2021), challenges such as insufficient self-directed learning ability and difficulty in managing the learning process are prevalent in online education. Chen and Zhou (2009) highlighted that students' autonomy is reflected in their ability to select goals, create plans, allocate time, manage tasks, and achieve these plans. The entire self-directed learning process involves self-guidance, self-motivation, and self-monitoring (Chen & Zhou, 2009). These personal attributes significantly impact the effectiveness of college students' online learning (Li et al., 2009). The greater the learners' experience of autonomy, the stronger their sense of achievement, which naturally enhances their satisfaction.

In China's vocational colleges, passive self-efficacy in college English classes (He, 2020) highlights a gap between perceived autonomy and actual engagement, suggesting that ownership and autonomy do not always lead to active involvement. To enhance PjBFL, it is essential to incorporate factors like prior knowledge, ownership, autonomy, and behavioral engagement into the ACSI model for a deeper understanding of student satisfaction.

Relationship between Admission Differences and PjBFL

China's vocational colleges primarily enroll recent graduates selected through exams, including those from Spring Admission Categorized Exams (both high school and secondary vocational school graduates), and those from the National College Entrance Examination. Despite slight variations in their educational backgrounds, factors such as educational level, knowledge composition, age, maturity, and social experience are generally similar (Wang & Lei, 2021), allowing the use of the same teaching strategies within the classroom. However, students exhibit differences in self-efficacy. High-school graduates from the Categorized Exam

demonstrate the highest perceived information processing, self-efficacy, and learning abilities in network-based learning, outperforming the other two (Huang et al., 2017).

Self-efficacy notably influences motivation; thus, variations in student backgrounds significantly impact classroom satisfaction. The flipped session of PjBFL requires students to independently manage their time, track progress, complete pre-study, and consolidate learning, while students use the in-class session to collaboratively explore, solve problems, and continuously refine their projects. Both two sessions demand significant self-motivation and resilience (Chen & Zhou, 2009), which is also influenced by self-efficacy.

Given these factors, student background diversity affects the experience and satisfaction with project-based flipped learning. When assessing satisfaction with this approach, it is essential to consider student diversity alongside dimensions like prior knowledge, ownership and autonomy, and behavioral engagement.

Methodology

Research Design

This study adopted a mixed research method.

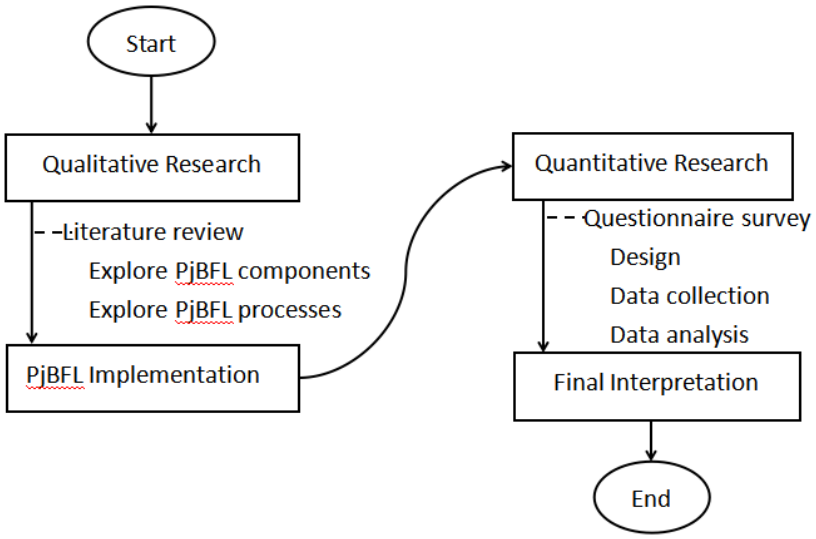

Fig. 1: Research Design

It began with a qualitative phase, wherein an extensive literature review was employed to explore essential elements of project-based flipped English learning in the TVET context. This is the foundation of the next research phase, providing an implementation framework. Based on these qualitative findings, the PjBFL implementation was organized and put into action. In the quantitative phase, data leading to student satisfaction were collected by using a questionnaire. The data analysis contributed to the final interpretation and laid a foundation for future teacher practices (Fig.1).

Qualitative Exploration for Implementation Foundation

A total of 20 articles were meticulously selected from Web of Science (WOS), SCOPUS, and Google Scholar, based on their strong relevance to PjBFL. The search combinations were “project” AND “vocational” AND “flipped” AND “English”, and other similar combinations. A comprehensive reading of these articles was conducted to extract essential elements related

to both the components and processes involved in PjBFL. Based on the results of this qualitative study, a classroom implementation design for PjBFL was developed, which provided a theoretical foundation for the subsequent quantitative research design.

Sampling

This study was conducted at a TVET college specializing in engineering located in Chongqing, a southwestern city in China. A purposive sampling method was employed to include 120 first-year Mechanical Engineering students, who were required to study English according to the curriculum. These students were evenly distributed across three classes, with each class comprising students from different admission categories: Spring Admission Categorized Exam (graduates from secondary vocational schools), Spring Admission Categorized Exam (high school graduates), and National College Entrance Examination (high school graduates).

Instrumentation and Data Collection

After the PjBFL implementation, student satisfaction was evaluated using a structured questionnaire. This survey was designed to capture elements related to the PjBFL approach within the English course. It encompassed multiple dimensions, including demographic factors such as admission pathways, and components from the ACSI model, namely Student Expectations, Perceived Quality, Perceived Value, and Overall Satisfaction. Additionally, the questionnaire addressed Prior Experience/Knowledge, Ownership and Autonomy, and Behavioral Engagement to provide a comprehensive assessment of student satisfaction. The questionnaire utilized a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The distribution of the questionnaire and the collection of data were facilitated through the WJX, an online data distribution tool.

Data Analysis

Thematic Analysis

A thematic analysis was conducted using NVivo to systematically organize and analyze data from selected studies. This analysis aims to identify key components and processes involved in achieving effective English learning and enhancing student satisfaction.

Descriptive Analysis

A descriptive analysis was performed on survey data regarding student admission types.

Normality Test

A normality test was conducted to assess the distribution of the survey data. This analysis determined whether the data met the assumption of normality, which further informed the choice of the statistical tests for subsequent analysis. Two tests of normality, the Kolmogorov-Smirnov (KS) test, and the Shapiro-Wilk (SW) test, were applied. Among the tested domains, only the mean of Prior Knowledge shows p-values greater than 0.05 for both the KS and SW tests, suggesting that it follows a normal distribution. In contrast, all other domains, including Student Expectation, Ownership and Autonomy, Behavioral Engagement, Perceived Quality, Perceived Value, and Student Satisfaction, exhibited p-values less than 0.05 in both tests, indicating non-normal distributions.

One-Way ANOVA

Given that the Prior Knowledge variable is normally distributed, a one-way ANOVA was employed to analyze the differences in Prior Knowledge based on admission types. This analysis helped identify whether the types of admission significantly affect the Prior Knowledge domain.

Kruskal-Wallis H Test

For variables that exhibited non-normal distribution, the Kruskal-Wallis H test was conducted. This non-parametric test allowed for the comparison of different satisfaction domains, such as Student Expectation and Behavioral Engagement, across different admissions.

Results and Findings

Essential Elements of PjBFL

After the exploration of 20 articles regarding PjBL and FCM in English teaching of TVET, 7 components, and 7 processes were identified as the key elements of PjBFL. It indicates an effective teaching needs to address these important components, including 21st-century skills, ownership and autonomy, and group work, etc, and to follow a certain sequence of teaching steps, involving orientation, pre-class comprehension, and activation, etc. before, in and after the class (Table 1).

Table 1
Essential Elements of PjBFL

PjBFL	Essential components	● 21st-century skills ● Ownership and autonomy ● Project design ● Coaching ● Group work ● Technology ● Evaluation
	Essential processes	① Orientation ② Pre-class comprehension ③ Activation ④ Development ⑤ Presentation ⑥ Assessment ⑦ Consolidation

PjBFL Implementation

Due to the limited teaching hours and the required contents for the final written examination, only one project could be implemented and the topic “Product Presentation” was finally determined as the theme of this project. Students were set in an exhibition conference on behalf of their companies. This selection is universally applicable to students from different disciplines, while also distinguishing itself from professional English. Moreover, the theme of “Product Presentation” reflects the needs of the real workplace and can be broken down into several small tasks, including writing invitation letters, creating product presentation posters, recording product demonstration explanations, and conducting product promotions and sales at the product presentation event. Students could purposefully apply their knowledge of English and integrated competencies in each task, ultimately achieving the project task of

"Product Presentation". Notably, knowledge derived from the textbook was considered when determining the theme, with the target to reorganize the knowledge students were about to learn as planned in the curriculum. Finally, this project spanned over three weeks, including a 20-minute orientation, 3 online pre-class sessions, 3 80-minute in-class sessions, and 1 online after-class session.

Student Satisfaction with PjBFL

Respondents' Profile

In this study, student demographic information involves admission pathways only (Table 2).

Table 2

Demographic Distribution of Students

Background	Details	Frequency(*f*)	Percentage(%)
Admission Pathway	National College Entrance Exam (High school graduates)	71	65.14
	Spring Admission Categorized Exam (High school graduates)	26	23.85
	Spring Admission Categorized Exam (secondary vocational school graduates)	11	10.09
	Others	1	0.92

Notably, 0.92% selected "others", but subsequent investigation revealed this was likely an error. Therefore, the further analyses are around the three admission pathways, without "others".

Student Satisfactory with PjBFL

Table 3

Mean Score and Deviation Value

Domain	Mean	Standard Deviation	Interpretation
Prior Knowledge	3.50	0.60	Moderate
Student Expectation	3.86	0.60	High
Ownership&Autonomy	3.96	0.50	High
Behavioral Engagement	3.84	0.52	High
Perceived Quality	4.09	0.44	Very High
Perceived Value	4.07	0.40	Very High
Overall Satisfaction	4.02	0.44	Very High

The mean cores of all the domains (Table 3), except Prior Knowledge, fall between 3.84 to 4.09, indicating a high level of student satisfaction. The highest levels of satisfaction are found in Perceived Quality, Perceived Value, and Overall Satisfaction.

The mean score for Prior Knowledge is 3.50. According to Damayanthi's interpretation (2014), it can be explained as "moderate", suggesting students view their previous knowledge dedicated to PjBFL at a moderate level, adequate but not outstanding. It is important to point out that the mean score of "Prior Knowledge" does not refer to the PjBFL itself, but rather to student recognition of their knowledge or experience before the class. When a mean score of Prior Knowledge is perceived as "moderate" while the satisfaction with other domains is rated "high", it suggests students recognize the value of PjBFL.

The larger standard deviations in these domains indicate considerable individual variability, such as Prior Knowledge with a value of 0.6. Despite an overall high level of satisfaction, there are significant differences among individuals.

The Effect of Admissions on Different Dimensions of Satisfaction in PjBFL

The Effect of Admissions on Prior Knowledge

Results from One-Way ANOVA presents the effect between admission pathways on Prior Knowledge.

Table 4
Description of One-Way ANOVA

Prior Knowledge					95% Confidence Interval for Mean			
	N	Mean	SD	Std. Error	Lower Bound	Upper Bound	Min	Max
National College Entrance Exam (High School)	71	3.55	.61	.07	3.40	3.69	1.80	5.00
Categorized Exam (High School)	26	3.45	.49	.10	3.25	3.64	2.20	4.40
Categorized Exam (Secondary TVET School)	11	3.31	.79	.24	2.78	3.88	2.00	4.20
Others	1	3.60	.	.	.	.	3.60	3.60
Total	109	3.50	.60	.06	3.39	3.61	1.80	5.00

Table 5
ANOVA Results

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.64	3	.21	.58	.63
Within Groups	38.37	105	.37		
Total	39.01	108			

Table 4 provides the basic statistical information necessary for conducting the ANOVA, while Table 5 shows the ANOVA results calculated based on this information. Table 5 compares the between-groups and within-groups variances. The key F-value is 0.58, with a significance level (Sig.) of 0.63, which is greater than the 0.05 significance threshold. This suggests there is no statistically significant difference in the mean Prior Knowledge scores across the different types of admissions. Therefore, the type of admission does not significantly affect the Prior Knowledge domain scores.

The Effect of Admissions on Other Domains

Findings from the Kruskal-Wallis H Test (Table 6) explain the effects between Admission Pathways across the domains.

Table 6
Mean Rank of Domain with Kruskal-Wallis H Test

Domain	Admission	N	Mean Rank
Student Expectation	National College Entrance Exam(high school graduates)	71	56.79
	Categorized Exam(high school graduates)	26	53.27
	Categorized Exam(vocational education school graduates)	11	48.36
Ownership and Autonomy	National College Entrance Exam(high school graduates)	71	57.05
	Categorized Exam(high school graduates)	26	41.83
	Categorized Exam(vocational education school graduates)	11	71.00
Behavioral Engagement	National College Entrance Exam(high school graduates)	71	55.98
	Categorized Exam(high school graduates)	26	42.50
	Categorized Exam(vocational education school graduates)	11	78.82
Perceived Quality	National College Entrance Exam(high school graduates)	71	55.73
	Categorized Exam(high school graduates)	26	44.44
	Categorized Exam(vocational education school graduates)	11	75.77
Perceived Value	National College Entrance Exam(high school graduates)	71	54.90
	Categorized Exam (high school graduates)	26	47.56
	Categorized Exam(vocational education school graduates)	11	73.68

Table 7
Test Statistics for Kruskal-Wallis H

Test Statistics	Kruskal-Wallis H	df	Asymp. Sig.
Student Expectation	.89	3	.83
Ownership& Autonomy	8.24	3	.04
Behavioral Engagement	10.56	3	.01
Perceived Quality	8.15	3	.04

Table 7 shows the test statistics which was used to compare the scores of Student Expectation, Ownership and Autonomy, Behavioral Engagement, and Perceived Quality across different admissions.

The p-value (0.83) for Student Expectation is greater than 0.05, indicating no significant difference in Student Expectation scores across different admissions.
The p-value (0.04) for Ownership and Autonomy is less than 0.05, suggesting a significant difference in Ownership and Autonomy scores across different admissions.
The p-value (0.01) for Behavioral Engagement is less than 0.05, indicating a significant difference in Behavioral Engagement scores across different admissions.
The p-value (0.04) for Perceived Quality is less than 0.05, meaning a significant difference in Perceived Quality scores across different admissions.

As shown in Table 6, the Categorized Exam (High School) group (41.83) has the lowest mean rank, indicating participants from this group scored the lowest on Ownership and Autonomy. The National College Entrance Exam (high school) group (57.05) has an intermediate mean rank, while the group of secondary vocational school graduates (71.00) has the highest mean rank. These results (Table 6) suggest that students from the Categorized Exam (high school) group perceive their ownership and autonomy significantly differently (lower) compared to students from other admission groups. This difference is statistically significant, while the other groups (National College Entrance Exam-High School graduates and secondary

vocational School graduates) do not significantly differ from each other in terms of ownership and autonomy.

From Table 6, it can be seen the secondary vocational school graduates group (78.82) has the highest mean rank, indicating participants from this group scored the highest on Behavioral Engagement. The Categorized Exam (high school) group (42.50) has the lowest mean rank, suggesting that participants from this group scored the lowest on Behavioral Engagement. These results indicate that there is a statistically significant difference in behavioral engagement across admission pathways, with the secondary vocational school group scoring the highest and the Categorized Exam (high school) group scoring the lowest.

As presented in Table 6, participants from secondary vocational schools have the highest mean rank of 75.77, indicating they perceive the PjBFL quality more positively compared to participants from other groups. Participants in the Categorized Exam (high school) group have the lowest mean rank of 44.44, suggesting their perception of PjBFL quality is relatively less positive. These results highlight a statistically significant difference in perceived quality between students from secondary vocational schools and those from high schools (Categorized Exam), with the former having a more positive perception.

To sum up, it is found that students exhibit a high level of satisfaction with the PjBFL in TVET English, particularly in Perceived Quality, Perceived Value, and Overall Satisfaction. However, they score the Prior Knowledge dedicating to this PjBFL at a moderate level (Table 8).

Table 8
Summary of Findings in Student Satisfaction with PjBFL

Themes	Results
Overall satisfaction	Very high
Prior Knowledge	moderate
Student Expectation	high
Ownership& Autonomy	high
Behavioral Engagement	high
Perceived Quality	Very high
Perceived Value	Very high
Effects of Admission Pathways on Student Satisfaction	Admission does not significantly affect the Prior Knowledge scores. Admission does not significantly affect Student Expectation scores. Admission significantly affects Ownership and Autonomy scores. Admission significantly affects Behavioral Engagement scores. Admission significantly affects Perceived Quality scores. Comparison between admission pathways: The Categorized Exam (high school) group presents the significantly lowest score in ownership & autonomy, behavioral engagement, and perceived quality, while the secondary vocational school group exhibits the highest in these domains.

The study also found admission types do not affect Prior Knowledge significantly. However, significant differences were observed in Ownership and autonomy, Behavioral Engagement, and Perceived Quality scores, with the Secondary Vocational School group generally having more positive outcomes. Notably, the Categorized Exam (High School) group perceived their ownership and autonomy, behavioral engagement, and PjBFL quality lower than other groups.

Discussion

The findings suggested a high level of student satisfaction with the PjBFL, except in the domain of Prior Knowledge. It also presented effects of different admission pathways on student satisfaction.

Essential Elements of PjBFL

One of the objectives of this study is to identify the key elements of PjBFL in TVET English. By analyzing 20 articles on PjBL and FCM, seven key components were identified: 21st-century skills, ownership and autonomy, project design, guidance, group collaboration, technology, and evaluation. These elements not only enhance student engagement but also create a learning environment closely connected to the real world. Each of the seven key elements holds its significance.

To cultivate the employability and lifelong learning *skills needed for the 21st century*, students must enhance their communication skills, teamwork, critical thinking, and creativity.
Initially, an appropriate *project design* serves as the foundation for this classroom learning. Selecting suitable content to integrate English learning with workplace tasks is not simple. Teachers need to adapt content to meet student needs and align it with the curriculum, setting differentiated goals and determining assessment criteria accordingly.

With well-designed project frameworks, *evaluation methods, and assessment standards*, students can actively participate under the *teacher's guidance*, learn through *group collaboration*, and acquire skills by implementing projects.
In this process, it is particularly noteworthy that *ownership and autonomy* are crucial for the successful implementation of PjBFL. This element allows students to have a sense of control over their learning process, thus stimulating their intrinsic motivation. This was well demonstrated in this “Product Presentation” project, where students assumed company roles and participated in simulated product promotion tasks, significantly enhancing their sense of engagement and responsibility.

Equally important is the use of *technology*, which facilitates personalized learning and provides opportunities for one-on-one interactions between teachers and students before, during, and after class. The integration of technology also enables teachers to track data, implement further oversight, and provide feedback, thereby promoting the continuity of teaching.

Moreover, the proposed sequence of the teaching processes, including orientation, pre-class comprehension, activation, development, presentation, assessment, and consolidation, reveals the coherence and gradual nature of learning. Effective implementation of each process is crucial for students' understanding and skill development. Through this structured approach, teachers can ensure that students have clear objectives at each stage and acquire the necessary knowledge and skills.

Student Satisfaction

A high overall satisfaction level indicates that students recognize the value of PjBFL and its effectiveness in English learning. This high level of satisfaction can be attributed to several linking factors that enhance engagement and personal development.

Prior knowledge serves as the foundation for acquiring new knowledge and skills. When students lack the necessary prior knowledge, it can lead to diminished confidence, increased frustration, and ultimately result in low satisfaction with the learning experience and poor learning outcomes. In PjBFL, prior knowledge not only encompasses the relevant foundational knowledge but also includes essential competencies for each task, such as information technology skills, experience with self-directed learning platforms, and teamwork abilities. Thus, a satisfaction level categorized as moderate indicates the need to address all facets of students' prior knowledge and experiences. Teachers also need to ensure the difficulty of project design aligns with students' proficiency levels. This is critical given the generally low English proficiency and varying abilities of higher vocational students, which can lead to their lack of self-confidence.

High student expectation plays a significant role in shaping satisfaction levels. When students enter a project with an anticipation of rich, engaging, and interactive learning experiences, a mismatch between their expectations and actual outcomes can lead to disappointment. Therefore, keeping expectations high while ensuring that the learning design meets those expectations through clear goals and responsive teaching strategies is essential. This alignment can be critical in sustaining high satisfaction levels.

High ownership and autonomy levels indicate that students feel empowered in their learning processes. This autonomy contributes positively to satisfaction, as students tend to value having control over their own educational journey. When learners engage actively in project-based tasks and can make decisions about their projects, they develop a sense of responsibility and investment in their learning. Facilitating this aspect can boost their confidence and provide a more satisfying educational experience.

High levels of behavioral engagement are closely linked to satisfaction and indicate that students are actively participating and invested in their learning activities. Engaged students are more likely to feel satisfied as they experience the joy of collaborative work and the completion of meaningful projects. Strategies that encourage active participation during the project, such as group discussion, feedback mini-lectures, or group presentation preparation, can sustain and enhance this engagement.

Both very high perceived quality and perceived value reflect students' recognition of the quality and cost-effectiveness of PjBFL, indicating students appreciate the relevance of PjBFL in preparing them for real-life challenges. This perception enhances satisfaction, suggesting that the project is thoughtfully designed and effectively meets students' educational and professional goals.

Impact of Different Admission Pathways

Since the implementation of the new Vocational Education Reform Law in China, there has been a situation in higher vocational colleges where the admission pathways are varied and the students are differentiated (Wang & Lei, 2021). In this study, students are divided into three groups: high school graduates through the National College Entrance Exam, high school graduates through the Categorized Exam, and secondary vocational school graduates through the Categorized Exam. Hence, there are differences in students' professional qualities. Meanwhile, the past learning environment has a significant effect on students' English

proficiency, motivation, and learning habits (Li et al., 2009). These differences affect student satisfaction.

Admission does not significantly affect Student Expectations. This may be due to the overall situation of unfamiliarization with PjBFL in English courses. Based on the intertwined relations in ACSI and the data from this study, high levels of expectation and overall satisfaction indicate that the learning experience and outcomes meet those expectations.

Admission significantly affects both ownership and autonomy, and behavioral engagement, with secondary vocational school graduates scoring the highest and high school graduates from the Categorized Exam the lowest. Lack of basic general education knowledge but strong hands-on skills (Huang et al., 2017) are viewed as profiles of secondary vocational school graduates. Their prior experience with hands-on training may have positively influenced their sense of ownership and behavioral engagement in a project-oriented learning environment, while the high school graduates may be more accustomed to traditional lecturing style, leading to a lower sense of ownership and behavioral engagement in a PjBFL.

As postulated by Self-determination Theory, the basic psychological needs that university education must satisfy are the involvement of competencies, autonomy, and relatedness (Ryan and Deci 2024). Given the learning environment provides opportunities for self-regulation, then the issue leading to lower ownership and autonomy in high school graduates may be unawareness of ownership. The issue also could be a lack of responsibilities or interest. Admission also significantly affects perceived quality, reflecting differentiation in student perceptions with classroom quality and experiences. According to some research on Tourism, perceived quality is in high relevant to tourists' emotional experience (Gunawan et al. 2021; Paulose & Shakeel 2022)(Ratnasari, Gunawan et al. 2021, Paulose and Shakeel 2022). In educational psychology, perceived quality is strongly related to the emotional experience of students, suggesting a more effective and emotional interaction between students and teachers. In the educator's dual role as facilitators and experts, as stated by Zarouk et al. (2020), an effective PjBL and FC implementation requires teachers to balance designing a curriculum and providing tailored feedback, the latter of which also refers to emotional support, including encouragement, patiently guidance, and communication.

The findings show secondary vocational school graduates from the Categorized Exam score the highest while the high school graduates from the Categorized Exam score the lowest. This is different from Huang et al. (2017)'s conclusion that high-school graduates from Categorized Exams demonstrate the highest perceived information processing, self-efficacy, and learning abilities in network-based learning, outperforming the other two. Although the high school students through the categorical exams demonstrated stronger self-efficacy, it might not have effectively translated into a stronger sense of ownership, or actual behavioral performance within PjBFL. They exhibited a lack of genuine interest and struggled to connect their experiences with personal development. In contrast, secondary vocational students, benefiting from a more practical and skills-oriented education, are more likely to achieve a better performance in a PjBL environment.

Teaching Implication

Customized Project Design

To maximize student satisfaction in PjBFL environments, *Project Design*, one of the key components, should be pragmatically aligned with students' capabilities while meeting curriculum standards and connecting to real-world tasks. This not only ensures relevance but also feasibility, making the learning experience more meaningful and outcome achievable. When tailoring projects to reflect workplace challenges and appropriately lowering the difficulty, students can better appreciate the applicability of their studies, thus increasing confidence, engagement, and motivation.

Adaptive Scaffolding

Scaffolding in a PjBFL context is vital for supporting diverse learners toward greater autonomy and engagement. This involves offering structured support through clear instructions, regular feedback, and interactive opportunities, particularly for students with varied prior knowledge and cultural backgrounds. Adapting activities to individual needs promotes self-regulation, while collaborative projects strengthen behavioral engagement through peer interaction. Adaptive scaffolding helps improve perceived learning quality and ensures all students achieve meaningful outcomes.

Addressing Challenges for the High School Graduates from Categorized Exams

High school graduates entering PjBFL from the Categorized Exam tend to face challenges due to lower levels of ownership and autonomy. This may stem from unawareness of their ownership, as well as a lack of responsibilities or interest. Although these students demonstrate stronger self-efficacy (Huang et al., 2017), this does not always translate to a genuine sense of ownership and active participation in PjBFL. Unlike their peers in secondary vocational education, who benefit from a more practical and skills-oriented approach, these high school graduates may struggle to connect their learning experiences to personal development. To facilitate their adaptation, it is essential to increase their awareness of ownership and enhance their responsibilities, particularly, enhancing emotional engagement, thereby improving the overall learning experience.

Conclusion

In conclusion, this study aims to optimize the PjBFL in TVET English learning, by initially exploring its key elements through a comprehensive literature review. Following this theoretical foundation, student satisfaction, by utilizing ACSI mode, was examined to address student insights that could enhance their engagement and learning experience. The analysis of the impact of admission pathways further addressed the challenges in providing tailored teaching strategies to meet differentiated needs.

7 components and 7 processes were identified. While following a certain sequence of teaching processes as explored, although in this network era, the key components as *Ownership and Autonomy, and Technology* are prominent, other components, such as an appropriate *Project Design* as well as effective *Coaching* are also crucial in constructing a student-centered PjBFL setting.

The TVET student satisfaction with PjBFL is high, encompassing areas like expectations, ownership and autonomy, behavioral engagement, perceived quality, and value, highlighting this educational model's strengths in enhancing student involvement.

However, moderate satisfaction with prior knowledge indicates a need to better align students' foundational skills with the demands of the learning. This alignment is essential to build student confidence and ensure successful achievement in using English to solve real-world problems as required by the curriculum.

The study also underscores the significant impact of admission pathways on student experiences. Those high school graduates entering through the Spring Admission Categorized Exam face the lowest scores in ownership and autonomy, behavioral engagement, and perceived quality compared to secondary vocational school students and high school graduates through the National College Entrance Exam, emphasizing the need for tailored support to bridge these gaps.

Ultimately, future efforts should focus on providing adaptive scaffolding, customized project designs, and a focused emotional engagement to unlock this model's potential, ensuring all students are actively and equitably engaged.

Limitation

A notable limitation is the use of purposive sampling, as all participants were drawn exclusively from mechanical engineering majors. The specificity constraints and the ability to generalize the findings to other disciplines within TVET. Future research endeavors could benefit from incorporating a more diverse cohort from various academic backgrounds.

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