QUBAHAN ACADEMIC JOURNAL
VOL. 6, NO. 3, July 2026
https://doi.org/10.48161/qaj.v6n3a2460

The Mediating Role of Academic Stress in the Effect of Problem- and Project-Based Learning on Student Innovation: Evidence from Art and Design Education

Li Tan [1*], Tassanee Laknapichonachat [1] and Junaidi Junaidi [2]

[1] Department of Education and Society, Institute of Science Innovation and Culture, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand;
[2] Department of Accounting, Universitas Muhammadiyah Palopo, Palopo, Sulawesi Selatan 91911, Indonesia.

* **Corresponding author:** 659240200199@mail.rmutk.ac.th.

ABSTRACT: This research investigates how problem- and project-based learning (PPBL) enhances students' learning innovation and reduces academic stress. Data were collected from 587 students who participated in PPBL activities as part of their academic curriculum. Structural equation modeling (SEM) and Hayes's mediation analysis were employed to test the proposed hypotheses. The findings reveal that the integration of PPBL into liberal arts and design courses positively influences students' learning innovation while reducing their academic stress. Furthermore, academic stress plays a significant mediating role in the relationship between PPBL and students' innovative performance. These results suggest that art and design courses can effectively foster students' creativity and innovation through the application of PPBL. The findings also indicate the importance of developing attractive and industry-relevant curricula that enhance students' innovative capabilities and equip them with skills and knowledge aligned with evolving educational and labor market demands. This research contributes to constructivist learning theory by demonstrating the role of PPBL in promoting innovation and reducing academic stress among students. The study offers practical implications for educators and policymakers in designing curricula that support creativity, innovation, and competitiveness while incorporating skills that are increasingly valued by employers, particularly in the tourism and creative industries.

Keywords: Problem- and project-based learning (PPBL), Academic stress, Learning innovation, Constructivist learning theory, Higher education, China, Structural equation modelling, Mediation analysis, Art and design education, Student creativity.

I. INTRODUCTION

Globally, there is growing evidence that students increasingly associate education, a fundamental building block for individual and societal advancement, with rising stress levels [1, 2]. This situation has emerged in both developed and developing countries, where students face rigorous testing, heavy workloads, and rapid competition for university placements or job opportunities [3]. Multiple factors contribute to student stress, including academic demands, parental expectations, peer pressure, and uncertainty about the learning process, including learning digitalization. The expansion of digital learning and remote education has also introduced new challenges, such as social isolation, lack of motivation, and difficulties in maintaining a healthy work-life balance. The adoption of innovative pedagogical models such

as problem- and project-based learning (PPBL) is gaining attention to enhance students' practical skills and foster strong engagement, as well as to solve the learning problems [4]. These accumulating factors led to an alarming rise in mental health concerns among students, including anxiety, depression, and burnout. Understanding how educational approaches like PPBL impact student stress is therefore essential for creating supportive and effective learning environments. In this context, PPBL is increasingly considered a learner-centered approach grounded in active knowledge construction.

Traditional instructional approaches often struggle to simulate authentic work environments accurately, particularly when these involve students' skills in art and design courses, which are essential for preparing them for real-world challenges in the industry. This gap in traditional methods highlights the need for innovative teaching strategies that can better integrate practical experiences and industry standards into the curriculum. The use of problem- and project-based learning in vocational schools has become crucial because the job market is changing quickly and there is a greater focus on teaching practical skills that promote teamwork between universities and businesses [5]. This necessity is particularly critical in schools, where the primary mission is to cultivate job-ready graduates with strong technical capabilities [6]. While PPBL can also enrich university learning experiences that prioritize practical application, this is especially true for vocational schools focused on developing job-ready graduates with strong technical capabilities [7]. The adoption of PPBL helps bridge these gaps by making instruction more interactive, relevant, and engaging, ultimately enhancing both teacher and student performance and employability. PPBL helps fill in the gaps in education by making lessons more interactive, relevant, and interesting. This approach enhances both teacher and student performance, as well as employability [8, 9]. These obstacles often impede the effective implementation of pedagogies like PPBL. However, higher education in art and design continues to face significant challenges, including rigid curricula, limited resources, and misaligned evaluation systems [10]. It prevents university training from meeting market needs and the students' skill development and innovation from being in line with market needs. This gap means that university-taught knowledge often lags behind market demands, restricting students' skill development and innovation.

Although preliminary studies have explored PPBL implementation in select regions, significant gaps remain in the literature. First, most of the studies investigate the role of project- and problem-based learning separately; there is a lack of comprehensive studies examining how integrating PPBL into art and design courses affects the reduction of students' academic stress. Second, few studies have explored whether and how students' academic stress mediates the relationship between PPBL approaches and student learning innovation. Third, limited attention has been given to the combined pedagogical and psychological mechanisms through which PPBL influences innovation outcomes in higher education. Finally, actionable strategies for curriculum design, teacher development, and industry partnership can be proposed to support both the effectiveness of PPBL and the mental well-being of students. It becomes essential to investigate the potential of emerging issues in supporting both teaching and students' skills. How does the implementation of PPBL-supported practical training environments affect the students' stress? Furthermore, what is the relationship between PPBL and students' innovation? How do students' stress levels mediate the PPBL and students' learning innovation?

This study aims to enhance the effectiveness of the learning process by examining how PPBL influences student innovation in art and design education, particularly in relation to academic stress levels. This study offers a strategic roadmap for bridging the gap between theoretical knowledge and practical skills, specifically by detailing how constructivist learning theory can be effectively implemented within learning settings. Although previous studies have examined project-based learning, problem-based learning, and student innovation separately, limited research has investigated the integrated effect of PPBL on student innovation through the mechanism of academic stress, particularly within art and design education in the Chinese higher education context. This study addresses this gap by empirically testing academic stress as a mediating variable in the relationship between PPBL and student innovation.

From a theoretical perspective, there is a logical foundation for how teachers' skills aligned with the dimensions of constructivist learning theory (CLT) can boost students' performance and reduce academic

stress based on PPBL. The study contributes to constructivist learning theory by providing empirical evidence that the effectiveness of constructivist-oriented PPBL is not limited to direct learning outcomes but also operates through psychological mechanisms, specifically the reduction of academic stress. In this way, the research extends the application of constructivist learning theory by demonstrating how learning environments grounded in active knowledge construction can simultaneously support student well-being and innovation outcomes. Furthermore, the study expands the empirical scope of constructivist learning theory by validating these relationships within art and design education, a context that has received comparatively limited attention in prior research.

On a practical level, this research provides actionable recommendations for educators, policymakers, and institutions. It suggests ways to create supportive learning environments that reduce academic stress, improve vocational and creative skills, and strengthen university-industry partnerships. The findings also provide evidence-based guidance for higher education institutions seeking to integrate constructivist pedagogical approaches into creative disciplines while maintaining student well-being and fostering innovative capabilities.

II. LITERATURE REVIEW

1. CONSTRUCTIVIST LEARNING THEORY

Constructivist learning theory plays a significant role in modern education by emphasizing that knowledge is constructed through active engagement among students and teachers [11]. This theoretical framework provides insights to understanding the relationship between students' personal experiences in arts and design courses. These experiences can reduce students' academic stress and enhance their motivation to learn. This theory also asserts that learners actively construct meaning through experiences, critical reflection, and engagement with diverse perspectives [12]. PPBL is a key pedagogical approach as it is student-centered on real-world projects where students identify, analyze, and solve the current problems [13, 14]. Within this framework, PPBL emerges as a prominent pedagogical approach. PPBL is student-cantered and revolves around practical, real-life projects where students identify, analyse, and solve problems, thereby acquiring new knowledge and skills [15, 16]. In arts and design education, PPBL encourages exploration of varied cultural narratives, promoting deeper understanding and appreciation of multiculturalism. Students develop stronger multicultural attitudes and are better equipped to navigate the complexities of a globalized industry through experiential learning [17]. Furthermore, constructivist learning theory helps explain students to reduce academic stress and learning performance. The active, hands-on nature of PPBL can initially reduce academic stress as students are learning as a team and adapt to a familiar approach to solving real-world problems. However, this stress can be constructive, fostering flexibility, and critical thinking. As students gain confidence in their abilities to solve complex problems and collaborate with peers from diverse backgrounds, their motivation and entrepreneurial self-efficacy are reinforced [18]. Furthermore, this approach encourages a fundamental appreciation and understanding of multiculturalism aspects during the learning process. Figure 1 provides a theoretical framework that provides a significant basis for comprehending how experiences in arts and design courses can influence multicultural attitudes while simultaneously alleviating students' academic stress.

2. PROJECT AND PROBLEM-BASED LEARNING (PPBL)

PPBL are effective pedagogical approaches that play an important role in enhancing students' innovation [19]. This method encourages students to explore their creativity, develop critical thinking skills, and also foster intrinsic motivation towards personal experience to exist amid the authentic challenges [20]. It provides a practical platform and guidance for students to participate in practical projects and complete specific fields. Furthermore, PPBL is an innovative form of educational teaching that prioritizes students. Furthermore, the iterative nature of PPBL allows for experimentation and reflection, further promoting a growth mindset. Ultimately, these learning strategies empower art and design students to innovate in preparation for professional challenges. However, PPBL also nurtures resilience and adaptability due to

students' academic stress, which can arise from the demands of project-based learning and tight deadlines. It demonstrates that problem-based learning promotes knowledge transfer and learning by solving problems encountered by students in the learning process.

The rise of educational psychology and constructivist theory provided the theoretical basis for the adoption of project-based learning [20]. PPBL is a way of teaching that helps students and teachers learn community knowledge and skills by solving difficult problems in the real world. It provides a practical platform and guidance for students to participate in practical projects and complete specific fields [21]. Furthermore, PPBL is an innovative form of educational teaching that prioritizes students. Project-based learning mainly relies on practical projects and finds and solves problems while completing practical projects to cultivate students' practical ability [22]. It demonstrates that problem-based learning promotes knowledge transfer and learning by solving problems encountered by students in the learning process. PPBL is not only a teaching method but also a cognitive framework, which enables students to exercise practical ability while learning knowledge and also improve innovative thinking and the ability to propose and solve problems.

3. STUDENTS' ART AND DESIGN COURCE EXPERIENCE

PPBL enhances creative thinking and problem-solving skills, which can alleviate stress by fostering a more engaging and supportive learning environment [23]. PPBL also helps students connect what they learn in class with what they do in real life, which makes them feel less alone and anxious [24]. Engaging in creative processes through art-making enhances emotional well-being, offering a therapeutic outlet to combat academic stress [25]. Moreover, the flexibility inherent in PPBL encourages students to explore their interests and develop a unique artistic view, which can lead to increased motivation and learning innovation. This autonomy can further mitigate stress and promote learning innovation. The integration project and problem-based learning in art and design education enhance academic outcomes and play a crucial role in reducing stress and promoting psychological well-being [26]. Students who actively participate during the learning process, which can lead to increased motivation and innovation towards PPBL. This engagement helps alleviate their stress. Students often work in groups, sharing ideas and resources, which can create a sense of community [27]. This support network can significantly reduce academic stress, as students feel less isolated and more connected to their peers. It also utilizes creative expression and encourages students to express creativity, which promotes mental well-being. In addition, PPBL on art and design courses also enhances students' critical thinking and problem-solving skills, equipping students with tools to tackle challenges effectively. PPBL also offers students the flexibility to explore interests within the course projects.

- H1. PPBL has a positive effect on reduce students' academic stress.
- H2. PPBL has a positive effect on student' innovation.

4. STUDENTS' ACADEMIC STRESS

Constructivist learning theory explains that academic stress significantly enhances students' learning innovation in constructing knowledge and personal experiences [28]. The manageability of academic stress can stimulate creative problem-solving to promote innovative learning. This theory also posits that the contextualized process emerged when students obtain valuable information during the learning process [29]. It has an essential element in constructivism, motivates students to reconcile discrepancies between what they know and what they need to learn and also to promote critical thinking. Moreover, academic stress can heighten students' intrinsic motivation to explore and experiment, which are core to constructivist learning environments. This process often requires creativity and a pivotal approach such as PPBL to adapt to information and technology development, reframe problems, and obtain ideas to meet academic and company expectations [30]. Constructivism also stresses the importance of social interaction and collaboration in learning. The academic stress can lead students' innovation with regard to building a dynamic learning community.

- H3. Academic stress has a positive effect on students' innovation.

The combination of PPBL with art and design education has shown its transformative impact on students' creativity, critical thinking, and collaboration skills [31]. It empowers students to participation in practical projects that exercise students' practical skills to prepare them for professional careers. Some studies have

proven the effectiveness of PPBL in art and design education, and these studies emphasize that PPBL has a significant impact on improving students' creativity, critical thinking, and teamwork skills in art and design education. By participating in real projects in collaboration with schools and enterprises, students can improve their professional knowledge [32]. Despite the excellent effect of PPBL, it does face some problems when applied in the field of art and design education. For example, the accuracy of students' works is a big problem [31]. Traditional evaluation methods may not fully capture the creativity, originality, and process contained in project-oriented tasks. This leads to subjective and inconsistent evaluations, which can discourage students and restrict teachers' ability to accurately assess student progress. PPBL also requires students to demonstrate a strong sense of autonomy and teamwork. In addition, art and design projects require specific materials and technical resources, which may hinder the promotion of PPBL. Moreover, the school's inadequate infrastructure and resource allocation may limit the scale of the project, thus affecting students' creative display.

- H3. Academic stress has a positive effect on student' innovation.
- H4. Academic stress has a positive effect in mediating PPBL and students' innovation.

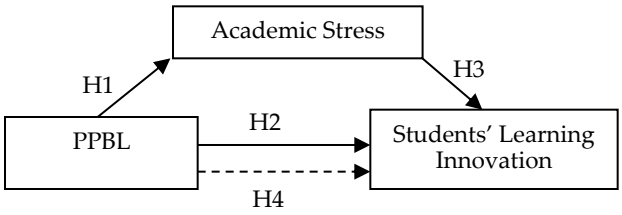

FIGURE 1. Proposed research model.

III.RESEARCH METHODOLOGY

This study adopts a quantitative research approach using a cross-sectional survey design to examine the relationships between problem- and project-based learning (PPBL), academic stress, and student learning innovation. Structural Equation Modelling (SEM) was employed to test the proposed hypotheses.

1. RESEARCH DESIGN

A pretest was carried out based on the following method, and anonymous respondents were given the measurement items (see Figure 2). Furthermore, a pilot test was applied to discover if the participants understood the questions and revised dictions to avoid single-source bias [33, 34]. The study adopted a cross-sectional, quantitative survey research design using a structured questionnaire to examine the relationships among PPBL, academic stress, and student learning innovation.

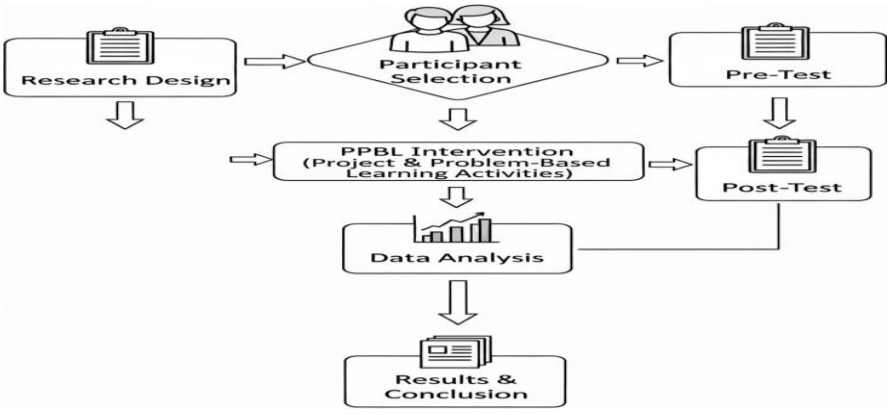

FIGURE 2. Structural model.

2. POPULATION AND SAMPLE

Teacher style, experience, and assessment methods can profoundly influence both student stress and innovation outcomes with regard to PPBL approach. Furthermore, teacher's approach to classroom management, communication, and support shapes the learning environment, with supportive and encouraging styles generally reducing student anxiety and fostering a sense of safety that allows students to take intellectual risks and innovate. In contrast, rigid or authoritarian teaching styles may heighten stress and discourage creativity, as students may fear making mistakes or deviating from expected norms. Experience also plays a pivotal role; seasoned educators typically possess a deeper repertoire of strategies for managing diverse classrooms, identifying student needs, and adapting instruction to promote both well-being and creative thinking. Inexperienced teachers, while often enthusiastic, may rely more heavily on traditional practices or struggle to recognize subtle signs of stress, inadvertently increasing pressure and limiting opportunities for innovation. This study focused on art and design higher education settings in Yunnan Province, China.

The survey sample was recruited by contacting the personnel administrators of universities through social media platforms and email invitations. Participants were selected for the questionnaire survey by obtaining a list of university teachers and students through the university's human resources department and conducting a random sampling of those who have experience with PPBL. Participants were provided with detailed recruitment information, including the purpose of the study, expected time commitment, participants' rights, and privacy safeguards, with emphasis on the voluntary and anonymous nature of participation. Finally, a letter of thanks via email or message was sent after the participants had completed the questionnaire to re-emphasize the importance of the study and thank them for their contribution.

The study covers three art and design majors: visual communication design, digital media art, and environmental art and design in Yunan province, China. During the PPBL model development and curriculum experimentation, three university faculty members were selected for this study. They had at least 5 years of teaching experience in art and design courses, at least a doctoral degree or equivalent, and a title of at least lecturer. A total of 677 vocational students who enrolled in three classes of students at the same time were invited to participate in this study. However, 587 valid survey questionnaires were collected, with an effective rate of 86.70% (Table 1). Furthermore, a cross-sectional survey design with Structural Equation Modelling (SEM) was applied to test the proposed hypotheses.

The experience of PPBL students includes five dimensions: the helpfulness of understanding the subject, the helpfulness of cultivating interest in the subject, enjoyment in participating in activities, increased participation, and improvement in problem-solving abilities [18]. The students' academic stress includes factors such as academic achievement, homework, and college entrance exams, while learning stress is defined in reference to [35]. The outcomes of the PPBL learning process fall into four categories, namely cognitive, affective, and behavioural outcomes and students' art and design innovation [32, 36].

Table 1. Respondent demographics

	Demographic Items	Frequency	Percentage (%)
Age	18-20 years	177	30.1
	21-23 years	195	33.2
	24 and over	215	36.7
Gender	Male	272	46.3
	Female	315	53.4
Grade	First-year university student	112	19.0
	Second-year university student	129	22.0
	Third-year university student	215	36.6
	Fourth-year university student	131	22.4

The research was approved by the ethics committee of Mahachulalongkornrajavidyalaya University, Thailand (letter number R 522/2024). Participation in this study was voluntary, following the ethical

standards outlined in the 1964 Declaration of Helsinki and the ethical principles and code of conduct. All participants in this study gave their informed consent, agreeing to participate in the research and publish their data in publications. This consent was provided through online survey forms. Data collection for this study occurred online between October 1 and November 20, 2024.

IV. RESULT

1. DATA ANALYSIS

The study adopted a purposive sampling strategy targeting Chinese university students enrolled in liberal arts and design-related courses who had experience with PPBL. A pretest and a pilot test were applied before the formal test. This study also utilized Common Method Variance (CMV) to reduce bias issues towards anonymous questionnaire distribution and randomly arranged the measurement items. The SEM was additionally used to examine the correlation of research constructs using analysis of moment (AMOS) and statistical package for social science (SPSS) software. This study also suggested post-detection methods for the Common Latent Factor (CLF) using Harman's single-factor test. Table 2 reveals that almost all the correlations between the variables in this study are significant, allowing for further analysis. A two-step methodology was applied, including Confirmatory Factor Analysis (CFA) followed by Structural Equation Modelling (SEM) to assess causal relationships between variables and research hypotheses.

Table 2. Correlation matrix for measurement scales.

Constructs	Mean	SD	SE	AS	SI
SE	5.33	1.52	**0.836**		
AS	5.64	1.35	0.563**	**0.833**	
SI	5.72	1.52	0.576**	0.457**	**0.796**

Note: SE: Students' of PBL learning experience, AS: Academic stress, SP: Students' innovation
SD: standard Deviation
Diagonal elements are the square roots of the AVE for each construct
Pearson correlations are shown below the diagonal
Significant at *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

2. MEASURMENT MODEL

The CFA results $\chi 2/df$ 3.471, TLI = 0.943, RMSEA = 0.043, CFI = 0.946, and IFI = 0.948) showed that the data fit well with the model. The results given in Table 3 showed that all the items of all the variables loaded significantly, and therefore, no item was deleted. The values of Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE) are significantly above the threshold value, indicating that inter-item reliability exists among the items of each variable in this study.

Table 3. Measurement results.

Constructs	MLE estimates factor loading	Composite reliability (CR)	Average of variance extracted (AVE)	Cronbach's α
PPBL learning experience		0.877	0.723	0.854
PPBL Help me to				
PE1: Encourage to integrate concep and skill	0.737			
PE2: depper understand of the cource	0.780			
PE3: enhance problem-solving ability	0.798			
PE4: Improve communication skill	0.730			
PE5: contribution to society	0.840			
PE6: satisfy with the assignment of the cource	0.757			
Students' academic stress from PBL experience		0.788	0.535	0.811
AS1: I am afraid of getting a bad grade	0.754			

AS2: I feel stress from lots of PBL homework	0.784			
AS3: I am stressed out with the burden of PBL	0.837			
AS4: I am bored of learning by PBL method	0.725			
Students' innovation behavior		0.841	0.527	0.763
ET1: PBL address to understand of the subject	0.812			
ET2: I can apply the concepts learned in this	0.725			
ET3: I can describe the project and information	0.718			
ET4: I can to complete similar project	0.741			
ET5: I can collaborate during the learning process	0.827			
ET6: PBL make us learning effectively	0.713			
ET7: PBL makes us understand the project	0.714			

Note. Model fit: $\chi^2/df = 3.475$, GFI = 0.941, NFI = 0.942, CFI = 0.943, IFI = 0.943, and RMSEA= 0.049.

3. STRUCTURAL MODEL

Figure 2 shown that the art and design liberal arts courses towards PPBL approach have a significant and positive effect to reduce students' academic stress ($\gamma 11 = 0.485$, $p < 0.001$), hence supporting H1. Furthermore, PPBL approach also has a crucial role to improve students' learning innovation including innovation behavior ($\gamma 21 = 0.564$, $p < 0.001$), which supports H2. Furthermore, students' academic stress has a positive and significant effect on students' innovation ($\beta 21 = 0.552$, $p < 0.010$), which means that H3 is supported.

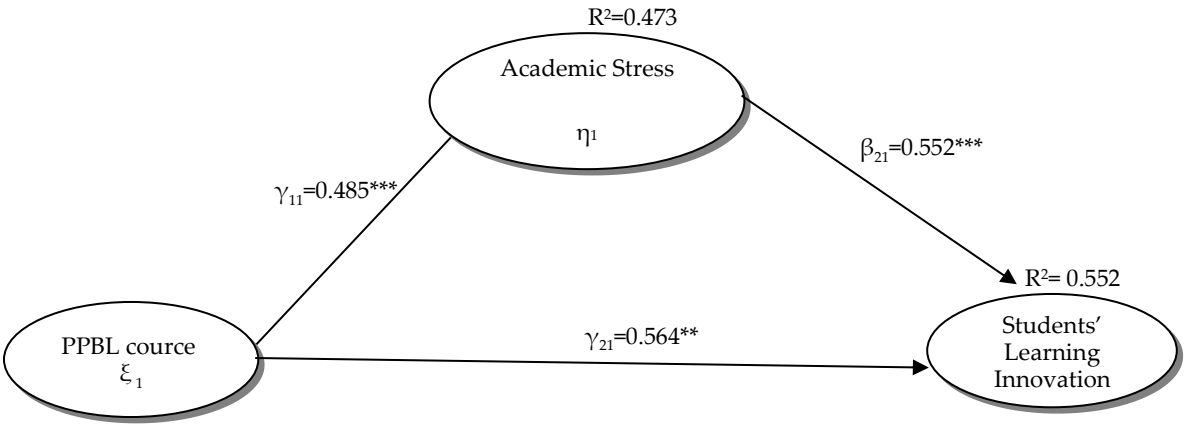

FIGURE 2. Structural model.

4. MEDIATION EFFECT

To test the effects of students' academic stress in mediating the relationship between PPBL and students' learning innovation, this study adopted a confidence interval bootstrapping method with 5000 simulations [37]. Table 4 shows that all the confidence intervals for the percentile method and bias-corrected excluded zero, indicating that all mediation effects are significant. The results show the entire are partial mediators. The PPBL course positively influenced students' performance, which was mediated by academic stress ($\beta = 0.454 \times 0.552 = 0.252$) to support H4. It indicates that PPBL significantly influences students' learning performance, particularly when students effectively manage their academic stress or when their level of academic stress is low.

Table 4. Mediation result.

Direct effect			***b***	***t***	**95% CI**
PPBL cource	→ Academic stress		0.458	13.674***	(0.524, 0.642)
Academic stress	→ Learning performance	0.552	15.885***	(0.635, 0.761)	
Indirect effect				*b* SE	95% CI

PPBL cource	→	Academic stress	→	Learning performance	0.252	0.023	(0.131, 0.232)

Note: Significant at *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

V. DISCUSSION

PPBL shifts the focus from individual achievement, standardized testing, and rigid curricula to collaborative projects and active engagement. This method is different from traditional teaching methods. It aligns with prior studies that found that the shift of the PPBL approach from traditional methods can alleviate students' anxiety and academic stress [2, 7]. However, beyond this general alignment, the present study empirically demonstrates that PPBL not only reduces academic stress but also enhances student innovation through a statistically significant mediating mechanism, which extends prior descriptive findings. On the other hand, PPBL creates a more dynamic and supportive learning environment that encourages critical thinking, problem-solving, and teamwork, which subsequently build essential skills and help students establish meaningful psychological well-being. These relationships serve as sources of emotional support and can reduce the sense of isolation that is associated with academic stress. In addition, teachers play a crucial role as guides, facilitators, coaches, feedback providers, evaluators, coordinators, and motivators in the education field [24].

The present findings are consistent with these results, where the R^2 value is 47.3 percent of participants in this study recognized that the PPBL approach significantly influences students' stress levels. More specifically, this indicates that PPBL explains a substantial proportion of variance in academic stress, confirming its psychological relevance rather than merely instructional effectiveness. In addition, the role of the teacher has evolved under the PPBL method. Whereas traditional methods position teachers as primary authorities and transmitters of knowledge, PPBL transforms them into guides, facilitators, coaches, evaluators, coordinators, and motivators. This aligns with earlier research highlighting the benefits of teacher guidance and personalized feedback in project-based settings [15, 19]. The combination of PPBL with the modern apprenticeship approach stimulates learning innovation, encouraging students to independently explore and solve problems in fostering student growth and innovation, but it may also exacerbate academic stress due to the open-ended nature of the tasks involved. This dual effect is important, as it supports the present finding that academic stress functions not only as an outcome but also as a mediating mechanism between PPBL and innovation.

PPBL has a significant impact on students' academic innovation. Unlike traditional learning methods that frequently focus on theory, PPBL addresses students in real-world problems, which promotes critical thinking and the practical application of concepts [19, 22]. It enables students to bridge theoretical knowledge with hands-on experiences, which is particularly beneficial for grasping complex subjects. These findings are consistent with prior studies, which have demonstrated that PPBL cultivates essential 21st-century skills, including collaboration, communication, and creativity [15, 16, 19]. However, the present study extends this understanding by empirically confirming that innovation outcomes are not only directly influenced by PPBL but are also indirectly shaped through students' academic stress levels. Students practice articulating their ideas, listening to diverse viewpoints, and collectively developing innovative solutions as a team. Furthermore, collaborative learning strengthens students' interpersonal skills and prepares them for the dynamics of future workplaces. This approach is in line with previous studies, which prove that students' engagement increases when they recognize the relevance of academic work to real-life situations and are motivated to achieve academic success [10, 21, 26]. Consequently, effective teachers must adapt instructional strategies and align with the PPBL model and modern apprenticeship approaches. This approach is supported by earlier studies, which highlight the importance of contextual and experiential learning in promoting both academic achievement and readiness for professional environments [13, 20]. Consequently, effective teachers must adapt instructional strategies and align with the PPBL model and modern apprenticeship approaches to enhance student engagement and ensure that learning is relevant to real-world applications, such as by incorporating project-based learning that connects classroom activities with industry practices.

High levels of academic stress can lead to anxiety, reduced motivation, and impaired cognitive functioning, all of which negatively impact students' ability to concentrate and perform academically. Within the context of PPBL, academic stress serves as a mediating factor between the PPBL learning approach and students' capacity for innovation. The empirical results of this study confirm this mediating pathway, indicating that academic stress partially transmits the effect of PPBL on innovation outcomes. PPBL is intentionally designed to engage students actively in the learning process and in students' innovations. However, the management of academic stress closely influences the effectiveness of PPBL, despite its potential to enhance academic innovation. This finding aligns with preliminary studies [25, 27], which reported a strong correlation between students' academic stress and academic innovation. In addition, factors such as the quality of the anxiety about GPA achievement, abundant homework, and students' burnout play essential roles in influencing students' learning innovation [24, 26]. The current results support this idea, as indicated by an R^2 value showing that 55.2 percent of participants recognized that academic stress significantly impacts their learning outcomes. Thus, academic stress should be interpreted not only as a negative outcome but also as a structural mechanism shaping learning innovation outcomes in PPBL environments.

VI. CONLUSSION

Collaborative projects within PPBL offer significant advantages in modern educational settings. Students can understand of the subject matter by moving beyond surface-level knowledge to develop comprehensive solutions that uncover complex concepts and promote learning through teamwork. This confirms the first research question regarding how PPBL enhances student learning processes through collaboration and active engagement. Develop a comprehensive solution that uncovers complex concepts and promotes learning through teamwork. The collaborative structure of PPBL helps students feel less anxious and stressed, which is common in traditional, high-stakes academic settings. It also generates a strong sense of community within the classroom. Students are encouraged to share their ideas, support each other's learning, and engage in meaningful dialogue. Therefore, it bridges academic theory and real-world practice, preparing students to thrive in increasingly interconnected and dynamic environments. In addition, teachers serve as pivotal figures with regard to the transformative learning process. It also extends beyond traditional instruction to facilitating and guiding students throughout their PPBL experiences. Moreover, teachers help students navigate complex projects and maintain motivation by establishing clear guidelines, providing regular feedback, and collaborative activities. These findings directly address the second research question by demonstrating the dual role of PPBL in enhancing innovation while simultaneously influencing academic stress levels.

1. ACADEMIC IMPLICATIONS

The PPBL extend across various educational settings and also provides frameworks to enrich the understanding of effective teaching and learning. This study emphasizing real-world problems and collaborative projects encourages students to construct understanding of the course through exploration, discussion, and reflection on their cognitive engagement. It addresses students learning to communicate effectively, negotiate ideas, and appreciate diverse perspectives to enhance interpersonal skills and foster a sense of belonging, which is crucial for reducing academic stress.

Importantly, this study extends constructivist learning theory by empirically validating a stress-mediated learning mechanism, showing that student outcomes are shaped not only by active knowledge construction but also by psychological factors such as academic stress. This study also extends the constructivist learning theory concept with regard to describing three orientations students may develop: impersonal, controlled, and performance-oriented. PPBL has a greater influence on students who manage their stress well. Teachers can significantly increase students' performance in education contexts by addressing these psychological needs and utilizing technology to create supportive learning environments, such as through the use of interactive tools and resources that foster engagement and collaboration among students, which is particularly important for those with impersonal, controlled, and performance-driven needs.

2. PRACTICAL IMPLICATIONS

The practical implications of PPBL are significant for teachers, students, and educational institutions. Hence, the university should develop professional programs to establish teachers' skills and also create engaging and supportive learning environments. It can also improve teachers' ability to understand and guide students in conducting independent learning based on their individual situations, which is essential for fostering personalized education and addressing diverse learning needs. Hence, universities and governments should design projects that encourage teamwork, allowing students to work together to solve real-world problems. This collaboration enhances students' innovation and promotes a sense of community and belonging, which can mitigate academic stress. The Chinese university also should provide students with explicit objectives, timelines, and assessment criteria to help them navigate the complexities of projects. Furthermore, schools should establish partnerships with local businesses to provide students with authentic learning experiences, such as internships or project-based collaborations that connect classroom learning to real-world applications. The education institutions should also prioritize the integration of PPBL into the curriculum across various subjects, ensuring that students have opportunities to engage in meaningful, interdisciplinary projects that can cultivate critical thinkers, problem solvers, and collaborative learners.

3. LIMITATIONS AND FUTURE STUDY DIRECTIONS

This study has three limitations. First, the territorial universities sampled in this research do not represent all of China, so the study's results may not be generalizable. Future research needs to confirm the role of PPBL courses across diverse cultures and regions, as well as incorporate additional variables such as socioeconomic status, educational background, and institutional support to obtain more comprehensive results. Secondly, the political sensitivity in China may have influenced my informants' willingness to answer the questionnaires' questions openly. This limitation could lead to biased responses and a lack of depth in the data collected. Furthermore, engaging with a broader range of participants, including those from different educational backgrounds and regions, will enrich the findings and offer valuable information regarding the effectiveness of PPBL in various contexts. Lastly, longitudinal studies could be beneficial to assess the long-term impacts of PPBL on students' academic stress and learning innovation.

Funding Statement

The authors received no financial support for the research, authorship, and/or publication of this article.

Author Contributions

Conceptualization, L.T. and T.L.; methodology, J.J., and T.L.; software, J.J.; validation, T.L. and J.J.; formal analysis, T.L.; investigation, T.L. and J.J.; resources, L.T.; data curation, J.J.; writing—original draft preparation, L.T and T.L.; writing—review and editing, T.L.; project administration, L.T. All authors have read and agreed to the published version of the manuscript. All authors have read and agreed to the published version of this manuscript.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

This research was conducted by the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of Mahachulalongkornrajavidyalaya University on September 16, 2024 and number R 522 / 2024.

REFERENCES

1. Aalto, S., Kankaanpää, R., Peltonen, K., Derluyn, I., Verelst, A., De Haene, L., De Smet, S., Spaas, C., Jervelund, S. S., Skovdal, M., Andersen, A. J., Hilden, P. K., Opaas, M., Durbeej, N., Osman, F., Sarkadi, A., Soye, E., & Vänskä, M. (**2024**). The effect of teacher multicultural attitudes on self-efficacy and wellbeing at work. *Social Psychology of Education, 27*, 2527–2557.
2. Shakirova, N., Abdimanapov, B., Bazilova, A., Muzdybayeva, K., Kalkashev, S., & Kenjekey, T. (**2025**). Evaluating the Effectiveness of Sustainable Development Goals Integration into the Future Geography Teachers' Education. *Qubahan Academic Journal, 5*(4), 421–436.
3. Rožman, M., Vrečko, I., & Tominc, P. (**2025**). Psychological factors impacting academic performance among business studies' students. *Education Sciences, 15*(2), 121.
4. Zhang, J., Peng, C., & Chen, C. (**2024**). Mental health and academic performance of college students: Knowledge in the field of mental health, self-control, and learning in college. *Acta Psychologica, 248*, 104351.
5. Yang, P., Liu, Y., Xiong, R., Run, P., & Junaidi, J. (**2025**). The emotional impact of cultural tourism: Tourist cultural attributes and delight. *Tourism Recreation Research*, 1–15.
6. Ying, L., Ziyi, Q., Shizhuan, H., Yan, L., & Tongqian, Z. (**2024**). The development of digital tourism in China. *Cogent Social Sciences, 10*(1).
7. Chen, A. S. (**2024**). Study on teaching practices of multicultural competences: Fostering a cultural connection between new immigrant females and undergraduate students. *International Journal of Intercultural Relations, 100*, 101968.
8. Liu, B., Anyanmu, C. C., Siripala, W., Songsiengchai, S., Junaidi, J., & Hamka, H. (**2025**). Examining on-and-off-campus students' public participation experiences in management consciousness towards a sense of responsibility. *Ianna Journal of Interdisciplinary Studies, 7*(1), 225–237.
9. Ali, M. A., Kabil, M., Alayan, R., Magda, R., & Dávid, L. D. (**2021**). Entrepreneurship ecosystem performance in Egypt: An empirical study based on the Global Entrepreneurship Index (GEI). *Sustainability, 13*(13), 7171.
10. Junaidi, J., Anwar, S. M., Sahrir, S., Ath-Thaariq, M., Rosdiana, S., & Imran, M. P. (**2025**). The role of religious social capital on students' entrepreneurial motivation: A self-determination theory perspective. *Journal of Entrepreneurship and Public Policy*.
11. Do, H. N., Do, B. N., & Nguyen, M. H. (**2023**). How do constructivism learning environments generate better motivation and learning strategies? The design science approach. *Heliyon, 9*(12), e22862.
12. Viken, A., Höckert, E., & Grimwood, B. S. R. (**2021**). Cultural sensitivity: Engaging difference in tourism. *Annals of Tourism Research, 89*, 103223.
13. Kwan, Y. W., & Wong, A. F. L. (**2015**). Effects of the constructivist learning environment on students' critical thinking ability: Cognitive and motivational variables as mediators. *International Journal of Educational Research, 70*, 68–79.
14. Luong, T. T., & Kim, E. (**2022**). A constructivism-based training course for hospitality and tourism instructors in Vietnam to improve their self-confidence in synchronous online teaching. *Interactive Technology and Smart Education, 19*(3), 360–389.
15. Alemneh, S., & Gebrie, G. (**2024**). The role of project-based learning in improving the writing ability and sub-writing abilities of 10th-grade Amharic-speaking students. *Social Sciences & Humanities Open, 9*, 100843.
16. Ghosheh Wahbeh, D., Najjar, E. A., Sartawi, A. F., Abuzant, M., & Daher, W. (**2021**). The role of project-based language learning in developing students' life skills. *Sustainability, 13*(12), 6518.
17. Hossain, K. I. (**2024**). Reviewing the role of culture in English language learning: Challenges and opportunities for educators. *Social Sciences & Humanities Open, 9*, 100781.
18. Alwi, A., & Hussin, R. (**2018**). Becoming socially responsible: The implementation of project-oriented problem-based learning. *International Journal of Contemporary Educational Research, 5*(2), 103–112.
19. Almulla, M. A. (**2020**). The effectiveness of the project-based learning (PBL) approach as a way to engage students in learning. *SAGE Open, 10*(3).
20. Ngereja, B., Hussein, B., & Andersen, B. (**2020**). Does project-based learning (PBL) promote student learning? A performance evaluation. *Education Sciences, 10*(11), 330.
21. O'Connor, S., Power, J., Blom, N., & Tanner, D. (**2024**). Engineering students' perceptions of problem- and project-based learning (PBL) in an online learning environment. *Australasian Journal of Engineering Education, 29*(2), 88–101.
22. Sun, X., & Zhu, P. (**2023**). Implementing project-based language teaching to develop EFL high school students' key competences. *Sustainability, 15*(2), 1658.
23. Skrbinjek, V., Vičič Krabonja, M., Aberšek, B., & Flogie, A. (**2024**). Enhancing teachers' creativity with an innovative training model and knowledge management. *Education Sciences, 14*(12), 1381.
24. Almarzouki, A. F. (**2024**). Stress, working memory, and academic performance: A neuroscience perspective. *Stress, 27*(1).
25. Basri, S., Hawaldar, I. T., Nayak, R., & Rahiman, H. U. (**2022**). Do academic stress, burnout, and problematic internet use affect perceived learning? Evidence from India during the COVID-19 pandemic. *Sustainability, 14*, 1409.
26. Chyu, E. P. Y., & Chen, J. K. (**2022**). The correlates of academic stress in Hong Kong. *International Journal of Environmental Research and Public Health, 19*, 4009.

27. Liu, M., Shi, B., & Gao, X. (**2024**). The way to relieve college students' academic stress: The influence mechanism of sports interest and sports atmosphere. *BMC Psychology, 12*, 327.
28. Rehman, N., Huang, X., Mahmood, A., AlGerafi, M. A. M., & Javed, S. (**2024**). Project-based learning as a catalyst for 21st-century skills and student engagement in the math classroom. *Heliyon, 10*(23), e39988.
29. Rasoolimanesh, S. M., Seyfi, S., Hall, C. M., & Hatamifar, P. (**2021**). Understanding memorable tourism experiences and behavioral intentions of heritage tourists. *Journal of Destination Marketing & Management, 21*, 100621.
30. Taylor, J. C., Allen, L. M., Van J., & Moohr, M. (**2024**). The effects of project-based learning on student behavior and teacher burnout in an emotional/behavioral support classroom. *Journal of Emotional and Behavioral Disorders, 32*(2), 81–94.
31. Guo, P., Saab, N., Post, L. S., & Admiraal, W. (**2020**). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research, 102*, 101586.
32. Post, L. S., Guo, P., Saab, N., & Admiraal, W. (**2019**). Effects of remote labs on cognitive, behavioral, and affective learning outcomes in higher education. *Computers & Education, 140*, 103596.
33. Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (**2003**). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903.
34. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (**2019**). *Multivariate data analysis* (8th ed.). Cengage Learning EMEA.
35. Park, H. (**1998**). Effect of parent-adolescents' relationships and pressure of study on psychosocial problem traits among adolescents. *Korean Journal of Child Welfare, 6*, 93–118.
36. Brinson, J. R. (**2015**). Learning outcome achievement in non-traditional (virtual and remote) versus traditional (hands-on) laboratories: A review of the empirical research. *Computers & Education, 87*, 218–237.
37. Hayes, A. F. (**2018**). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). Guilford Press.