



## The Impact of Project-Based Learning on Student Achievement and Engagement in Secondary Education: A Mixed-Methods Study

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### ABSTRACT

Project-Based Learning (PBL) has emerged as a transformative pedagogical approach that situates student learning within authentic, real-world problems. Despite its growing adoption across secondary educational contexts globally, empirical evidence examining its simultaneous effects on academic achievement, student engagement, and teacher pedagogical perceptions remains sparse. This mixed-methods study investigates the impact of a structured eight-week PBL intervention implemented across 12 secondary school classrooms in three countries: Australia, Kenya, and Qatar. Quantitative data were collected from 312 students through pre- and post-tests and a validated engagement survey, while qualitative data were gathered through semi-structured interviews with 30 teachers. Results demonstrated statistically significant improvements in student academic outcomes across all assessed competencies, with a mean effect size of  $d = 1.19$ . Student engagement levels also increased substantially, particularly in motivation, peer collaboration, and technology integration. Teachers reported overwhelmingly positive

perceptions of PBL's alignment with curriculum goals and its impact on student motivation. These findings offer strong empirical support for scaling PBL adoption in secondary education.

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## INTRODUCTION

The evolving demands of the 21st-century knowledge economy have compelled educators and policymakers to reconsider traditional teacher-centered instructional models. Passive reception of information is increasingly regarded as insufficient preparation for students who will enter a world requiring complex problem-solving, collaboration, critical thinking, and digital literacy (World Economic Forum, 2020) (Muhsyanur, 2025). Consequently, constructivist pedagogies – those that position learners as active constructors of knowledge – have attracted considerable scholarly and policy attention.

Project-Based Learning (PBL) is among the most widely researched constructivist approaches in secondary education. Rooted in Dewey's philosophy of experiential learning and Vygotsky's socio-cultural theory, PBL engages students in sustained inquiry around complex, meaningful questions or challenges (Krajcik & Shin, 2014). Rather than receiving discrete, decontextualized content, students collaborate to design, investigate, and produce artifacts that reflect deep disciplinary understanding while addressing authentic problems (Muhsyanur, 2023).

Empirical literature consistently identifies positive associations between PBL and student outcomes. Meta-analyses by Hattie (2009) and Strobel and van Barneveld (2009) report moderate to large effect sizes favoring PBL over traditional instruction, particularly for long-term retention, transfer of knowledge, and higher-order thinking skills. However, methodologically robust studies – particularly those employing mixed-methods designs and comparing cross-national contexts – remain relatively scarce (Han et al., 2015).

Furthermore, while the benefits of PBL for students are frequently documented, less attention has been paid to how teachers experience and perceive the implementation of PBL, especially in resource-varied contexts across the Global North and South. Teacher perceptions are critical since they mediate implementation fidelity and ultimately determine whether PBL is sustained beyond isolated interventions (Ertmer et al., 2015).

This study addresses these gaps by reporting findings from a structured eight-week PBL intervention implemented across 12 secondary school classrooms in Australia, Kenya, and Qatar. The study employs a concurrent mixed-methods design to: (1) measure the effect of PBL on student academic achievement and engagement, and (2) explore teacher perceptions of PBL's pedagogical value and practical implementation.

The findings contribute to the growing body of literature advocating for evidence-based instructional reform while also offering practical insights for educators and curriculum developers in diverse educational contexts.

## **METHOD**

### **Research Design**

This study employed a concurrent triangulation mixed-methods design (Creswell & Plano Clark, 2018), integrating quantitative and qualitative data streams collected simultaneously and analyzed separately before synthesis. The quantitative strand utilized a quasi-experimental pre-test-post-test design without a control group, while the qualitative strand employed a phenomenological approach to capture teacher experiences.

### **Participants**

A total of 312 secondary school students (Grades 9–11) from 12 classrooms across three countries participated in the study: Australia (n = 108), Kenya (n = 102), and Qatar (n = 102). Purposive sampling ensured diversity in gender, socioeconomic background, and academic performance levels. Additionally, 30 classroom teachers (10 per country) who implemented the PBL intervention participated in semi-structured interviews. All participants provided informed consent in accordance with ethical guidelines approved by the respective institutional review boards.

### **Intervention**

The eight-week PBL intervention was collaboratively designed by the research team with input from local curriculum advisors to ensure contextual relevance. Each project was structured around a driving question aligned with national curriculum standards. Students worked in heterogeneous groups of four to six, guided by scaffolded milestones, formative feedback cycles, and a culminating public exhibition of their projects. Teachers received a three-day professional development workshop prior to implementation, including simulation activities, coaching, and access to a shared digital resource platform.

### **Instruments**

Quantitative data were collected through: (1) curriculum-aligned pre- and post-tests assessing critical thinking, collaborative skills, subject mastery, and problem-solving; and (2) a 25-item Student Engagement Survey adapted from the validated Engagement Instrument developed by Fredericks et al. (2011), rated on a four-point Likert scale. Cronbach's alpha for the engagement survey was  $\alpha = .87$ , indicating high internal consistency (Muhsyanur and Semmang, 2025). Qualitative data were gathered through semi-structured interview protocols consisting of 12 open-ended questions probing teachers' perceptions of curriculum alignment, implementation challenges, and student motivation.

### Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics 27. Paired-sample t-tests assessed differences between pre- and post-test scores, and Cohen's d was computed to determine effect sizes. Survey responses were analyzed using descriptive statistics. Qualitative interview transcripts were analyzed using thematic analysis following Braun and Clarke's (2006) six-phase framework. Two independent coders conducted the coding process, achieving an inter-rater reliability coefficient of  $\kappa = .83$ .

## RESULT AND DISCUSSION

### Student Academic Achievement

The quantitative analysis revealed statistically significant improvements across all four competency domains assessed. As presented in Table 1, the overall mean pre-test score across all students was 56.9 (SD = 8.4), which increased to 81.9 (SD = 7.2) at post-test, yielding an average gain score of 25.0 points. Cohen's d for the overall sample was 1.19, indicating a large effect size consistent with findings from prior meta-analyses (Strobel & van Barneveld, 2009). Problem-solving demonstrated the greatest improvement, with  $d = 1.31$ , reflecting the particular suitability of PBL for developing higher-order cognitive skills.

**Table 1**  
*Student Academic Achievement: Pre-Test vs. Post-Test Scores and Effect Sizes*

Assessment Category	Pre-Test Mean	Post-Test Mean	Gain Score	Effect Size (d)
Critical Thinking	58.3	82.7	24.4	1.12
Collaborative Skills	61.0	85.4	24.4	1.08
Subject Mastery	55.6	80.1	24.5	1.24
Problem-Solving	52.8	79.3	26.5	1.31
<b>Overall Average</b>	56.9	81.9	25.0	1.19

*Note. Effect size (d) interpreted as: small = 0.2, medium = 0.5, large = 0.8 (Cohen, 1988).*

These findings align with the theoretical predictions of Vygotsky's (1978) Zone of Proximal Development, wherein collaborative scaffolded tasks push learners beyond their current independent capabilities. Cross-national analysis further indicated that while all three country cohorts demonstrated significant gains, the Kenyan cohort exhibited the largest mean gain score ( $M = 27.3$ ), potentially reflecting higher baseline receptivity to collaborative learning formats in collectivist cultural contexts (Hofstede, 2011).

### Student Engagement Levels

The Student Engagement Survey results revealed high levels of engagement across all five dimensions measured (Table 2). Technology integration recorded the

highest rate of strong agreement (53.2%), underscoring students' receptivity to digitally enhanced PBL environments. Peer collaboration followed closely (50.3%), reflecting the social constructivist dynamics embedded in project-based tasks. Motivation to learn also showed notably high positive ratings (47.8% strongly agree; 38.6% agree), suggesting that the authentic, problem-oriented nature of PBL enhanced students' intrinsic motivation.

**Table 2**  
*Student Engagement Survey Results by Dimension (N = 312)*

<b>Engagement Dimension</b>	<b>Strongly Agree (%)</b>	<b>Agree (%)</b>	<b>Neutral (%)</b>	<b>Disagree (%)</b>
Motivation to Learn	47.8	38.6	10.2	3.4
Active Participation	42.1	41.3	12.5	4.1
Peer Collaboration	50.3	35.7	11.2	2.8
Teacher Interaction	44.6	39.8	10.9	4.7
Technology Integration	53.2	32.4	10.5	3.9

*Note. Values represent percentage of respondents selecting each response category.*

These results corroborate Fredericks et al.'s (2011) multidimensional model of engagement, which posits that behavioral, emotional, and cognitive engagement are interrelated and mutually reinforcing. The high levels of peer collaboration and active participation observed in this study suggest that PBL's group-oriented structure naturally activates multiple engagement dimensions simultaneously.

### **Teacher Perceptions of PBL Implementation**

Teacher interviews and the corresponding perception survey (Table 3) revealed predominantly positive views toward PBL implementation. All 30 teachers reported that PBL aligned well with their national curriculum standards, with 60.0% rating curriculum alignment as 'very positive.' Student motivation was similarly perceived favorably, with 56.7% of teachers strongly affirming its positive impact. Notably, ease of implementation received a broader distribution of responses, with 43.3% rating it 'very positive' and an equal proportion rating it merely 'positive,' suggesting that while PBL is valued, logistical and resource challenges remain a practical concern (Muhsyanur and Mustapha, 2023).

**Table 3**  
*Teacher Perceptions of PBL Implementation (N = 30 teachers)*

<b>Perception Aspect</b>	<b>Very Positive</b>	<b>Positive</b>	<b>Neutral</b>	<b>Negative</b>
Curriculum Alignment	60.0	30.0	6.7	3.3

Student Motivation	56.7	36.7	6.6	0.0
Ease of Implementation	43.3	43.4	10.0	3.3
Assessment Effectiveness	50.0	40.0	6.7	3.3

*Note. Values represent percentage of teachers selecting each perception category.*

Qualitative thematic analysis of interview transcripts produced three overarching themes: (1) Pedagogical Empowerment, wherein teachers felt greater agency in co-designing learning experiences; (2) Structural Challenges, encompassing time constraints, material resources, and large class sizes; and (3) Student Transformation, where teachers observed visible shifts in student ownership of learning. These findings resonate with Ertmer et al.'s (2015) assertion that teacher beliefs and first-order (resource) as well as second-order (belief) barriers significantly mediate PBL implementation quality.

### **Comparative Qualitative Shifts: Pre- and Post-Implementation Classroom Dynamics**

Table 4 presents a synthesized comparison of observed classroom dynamics before and after PBL implementation, derived from teacher interviews and classroom observation notes (Muhsyanur et.al, 2025). The data highlight a fundamental paradigm shift from teacher-centered to student-centered learning environments. Prior to PBL, classrooms were characterized by passive learning roles, transmission-oriented instruction, and assessment regimes focused on memorization.

**Table 4**  
*Comparative Classroom Dynamics Before and After PBL Implementation*

<b>Theme</b>	<b>Before PBL Implementation</b>	<b>After PBL Implementation</b>
Classroom Atmosphere	Passive; teacher-centered; minimal interaction	Active; student-centered; high peer interaction
Student Roles	Recipients of information	Active problem solvers and co-creators
Teacher Roles	Knowledge transmitters	Facilitators and learning guides
Assessment Focus	Memorization and recall	Application, analysis, and synthesis
Learning Motivation	Extrinsic (grades)	Intrinsic (curiosity and relevance)

*Note. Themes derived from thematic analysis of 30 teacher semi-structured interviews.*

Post-implementation, teachers described a transformed classroom culture in which students assumed autonomous roles as inquiry-driven problem solvers. One teacher from Kenya articulated this shift: 'Students started asking questions I had

never heard before. They were no longer waiting to be told – they were discovering.' This emergent autonomy aligns with Self-Determination Theory (Ryan & Deci, 2000), which posits that intrinsic motivation flourishes when students experience competence, autonomy, and relatedness – all of which are structurally embedded within well-designed PBL experiences.

### **Cross-National Considerations and Contextual Factors**

While results were consistently positive across all three national contexts, notable contextual variations emerged. Teachers in Kenya identified infrastructure limitations – particularly inconsistent internet access – as the primary barrier to technology-integrated PBL. In Qatar, cultural dynamics around group work required deliberate facilitation strategies to promote equitable participation across gender lines. Australian teachers, by contrast, highlighted time pressures arising from standardized testing schedules as the principal implementation constraint.

Despite these variations, all three cohorts demonstrated significant gains, suggesting that PBL's core pedagogical architecture is robust across diverse socioeconomic and cultural contexts when adequately scaffolded. This finding is consistent with UNESCO's (2021) framework for inclusive quality education, which emphasizes the need for contextually responsive pedagogical adaptation.

### **CONCLUSION**

This study provides robust empirical support for the efficacy of Project-Based Learning in improving student academic achievement and engagement in secondary education across culturally and geographically diverse contexts. The large effect sizes observed (overall  $d = 1.19$ ) alongside high engagement levels and predominantly positive teacher perceptions affirm PBL as a pedagogically sound and practically viable instructional approach.

The cross-national nature of this study strengthens the generalizability of its findings while simultaneously highlighting the importance of contextual adaptation in PBL design and implementation. Policymakers and curriculum developers are encouraged to invest in structured teacher professional development, adequate resource provisioning, and flexible curriculum frameworks that create the enabling conditions for PBL to thrive.

Future research should employ randomized controlled trial designs with matched control groups to more rigorously isolate the causal effects of PBL on student outcomes. Longitudinal studies tracking knowledge retention and skill transfer six to twelve months post-intervention would also substantially enrich the evidence base. Additionally, further investigation into gender-differentiated and socioeconomically stratified outcomes would advance equity-focused understandings of PBL's impact.

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