

Project-Based Learning in Alternative Secondary Education: Effects on Academic Achievement and Student Engagement

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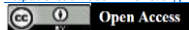
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ABSTRACT

Alternative secondary schools serve learners for whom mainstream education has failed, yet instruction in such settings frequently reproduces the transmissive pedagogy associated with students' original disengagement. This study evaluated project-based learning (PBL) as a systematic alternative. A quasi-experimental design was implemented across two alternative upper-secondary schools serving second-chance learners aged 16–19 ($N = 214$): six classes ($n = 108$) completed a 16-week integrated science curriculum organised around four extended projects, while six matched classes ($n = 106$) covered identical content through conventional instruction. Outcomes comprised a curriculum-aligned achievement test ($KR-20 = 0.87$), a three-dimensional engagement scale administered at five time points, attendance records, and a retention test eight weeks after the intervention. Controlling for pre-test scores, the PBL group significantly outperformed the comparison group on post-test achievement (adjusted means 74.6 vs 68.2; $F(1,211) = 24.7$, $p < 0.001$, $d = 0.58$) and retained the advantage at follow-up ($d = 0.49$). Engagement in the PBL group rose steadily across the intervention while remaining flat in comparison classes, with the largest gains in cognitive engagement ($d = 0.62$); attendance improved by 4.2 percentage points against a stable comparison baseline. Project artefact quality correlated moderately with achievement gains ($r = 0.39$). The findings indicate that PBL is not merely compatible with alternative education settings but particularly well suited to re-engaging learners whom conventional formats have alienated, and implementation conditions—block scheduling, teacher coaching, and authentic community audiences—are discussed.

Introduction

Alternative education exists because mainstream schooling does not work for everyone. Across systems, a persistent minority of adolescents—early school leavers, chronically absent students, young people returning to education after exclusion—are served by alternative schools whose founding purpose is to offer a different relationship with learning [1, 2]. Research on these settings, however, has repeatedly observed a paradox: while alternative schools typically transform relational climate through small classes and strong teacher–student bonds, their instructional core often remains the worksheet-driven, credit-recovery pedagogy that many of their students already experienced as meaningless [2, 3]. Structural change without pedagogical change risks re-engaging students with school while leaving them disengaged from learning itself.

Project-based learning offers a candidate pedagogical core with a long lineage in progressive education [4, 5] and a contemporary evidence base in mainstream settings. In PBL, students learn through extended, collaborative investigation of authentic problems, producing public artefacts that require and consolidate curricular knowledge [6, 7]. Meta-analytic evidence associates PBL with moderate achievement advantages over conventional instruction [8, 9], and its theorised mechanisms—autonomy, relevance, collaboration, and visible competence—map directly onto the motivational deficits documented among alternative-school populations [10, 11]. Yet the PBL evidence base is strikingly thin precisely where its mechanisms promise most: controlled evaluations in alternative secondary settings are rare, small, and seldom measure engagement longitudinally [3, 9].

This study addresses that gap with a quasi-experimental evaluation of a 16-week PBL science curriculum in two alternative upper-secondary schools. Three research questions are posed. RQ1: Does PBL produce greater achievement in curricular science content than conventional instruction with equivalent content coverage? RQ2: How does student engagement—behavioural, emotional, and cognitive—develop over the course of the intervention in each condition? RQ3: Are achievement effects retained after the intervention ends? The paper proceeds through a review of relevant literature (Section 2), the design and methods (Section 3), results (Section 4), and discussion and conclusions (Sections 5–6).

2. Literature Review

2.1. Alternative education and its pedagogical problem

Typologies of alternative education distinguish innovative schools of choice from remedial and disciplinary placements [1]. The population served across types shares educational biographies marked by accumulated failure, low institutional trust, and fragile academic self-concept [2, 12]. Qualitative studies consistently identify the relational climate of alternative schools as their active ingredient, while noting that curriculum and instruction receive far less deliberate design [2, 3]. Aron [12] and subsequent reviews call explicitly for evidence on *what pedagogy* alternative settings should adopt, beyond what climate they should cultivate.

2.2. Project-based learning: evidence and mechanisms

PBL descends from Dewey's experiential philosophy [4] and Kilpatrick's project method [5], formalised in contemporary design frameworks specifying driving questions, sustained inquiry, authenticity, student voice, reflection, and public products [6, 7]. Reviews and meta-analyses report achievement effects typically between $d = 0.3$ and 0.7 in school science and cross-curricular applications [8, 9, 13], with implementation quality—teacher scaffolding expertise chief among factors—moderating outcomes [7, 14]. Motivationally, PBL operationalises the conditions self-determination theory associates with internalised engagement: autonomy support, competence experience, and relatedness [10]. Engagement itself is best treated as multidimensional—behavioural participation, emotional identification, and cognitive investment [11, 15]—dimensions that respond differently to interventions and predict different outcomes.

2.3. Research gap

Existing PBL trials overwhelmingly sample mainstream schools and measure engagement, when at all, with single post-hoc administrations. Alternative-education research, conversely, is rich in ethnography and poor in controlled outcome designs [3]. The intersection—controlled PBL evaluation with longitudinal engagement measurement in alternative secondary settings—is nearly empty, and it is the location of this study.

3. Materials and Methods

3.1. Design and setting

A non-equivalent-groups quasi-experimental design with pre-, post-, and delayed testing was implemented in two urban alternative upper-secondary schools that serve students aged 16–19 who left or were referred out of mainstream education. Within each school, half of the intact science classes were assigned to the PBL condition and half to the comparison condition, balancing assignment across morning/afternoon schedules and teacher experience. Random assignment of individual students was infeasible institutionally; the analytic strategy therefore adjusts for baseline differences and the design's threats are examined in Section 5.

3.2. Participants

The sample comprised 214 students (PBL $n = 108$; comparison $n = 106$) across twelve classes taught by eight teachers. Table 1 reports baseline characteristics; groups were statistically equivalent on

age, gender composition, prior attainment, and the school-meals indicator used as a socioeconomic proxy (all $p > 0.30$). Participation followed institutional ethics approval, informed consent (parental consent for minors), and assurance that non-participation carried no academic consequence; twelve students declined data use and are excluded from all analyses.

Table 1. Baseline characteristics by condition.

Characteristic	PBL (n = 108)	Comparison (n = 106)	p
Mean age (years)	17.3 (0.9)	17.4 (0.9)	0.41
Female (%)	46.3	44.3	0.77
Prior attainment index (0–100)	48.7 (11.2)	49.5 (10.8)	0.59
Free-meals eligibility (%)	57.4	60.4	0.66
Pre-test score (0–100)	52.4 (12.6)	53.1 (12.1)	0.68

3.3. Intervention and comparison condition

Both conditions covered the same 16-week integrated science syllabus (energy, environment, human biology, and materials strands) with equal instructional hours. The PBL condition organised content into four four-week projects—a neighbourhood energy audit, a water-quality investigation, a public-health campaign, and a materials-testing challenge for a local maker space—each defined by a driving question, team-based inquiry, milestone scaffolds, and a public presentation to an authentic audience of community stakeholders. Teachers received three days of initial training and fortnightly coaching. The comparison condition followed the schools’ established practice: teacher-led instruction, individual worksheets, and unit tests, taught by teachers matched on experience. Implementation fidelity was monitored through biweekly observations against a structured checklist; PBL classes met a mean of 8.3 of 10 design criteria, and no comparison class exhibited more than 2.

3.4. Instruments

Achievement was measured with a 40-item curriculum-aligned test (score range 0–100) assembled from released standardised items and blueprint-matched to the syllabus; internal consistency was $KR-20 = 0.87$, and parallel forms were rotated across the three administrations (pre, post, +8-week retention). *Engagement* was measured at weeks 0, 4, 8, 12, and 16 with a 15-item adaptation of the multidimensional school-engagement scale [11], yielding behavioural, emotional, and cognitive subscales ($\alpha = 0.79–0.86$) on a five-point metric. *Attendance* was extracted from school records for the term preceding and the term containing the intervention. *Artefact quality* in the PBL condition was rated with a five-dimension rubric by two raters ($ICC = 0.84$).

3.5. Analysis

Achievement outcomes were analysed by ANCOVA with pre-test as covariate and condition as between-subjects factor, with standardised mean differences (Cohen’s d) computed from adjusted means; class-level clustering was accommodated with cluster-robust standard errors. Engagement trajectories were analysed with linear mixed models (time $\times$ condition, random intercepts for student and class). Alpha was set at 0.05, and complete-case rates exceeded 94% for all instruments with no differential attrition by condition ($p = 0.62$).

4. Results

4.1. Achievement (RQ1)

Figure 1 displays unadjusted means. Adjusting for pre-test, post-test achievement differed significantly by condition: PBL adjusted mean 74.6 versus comparison 68.2, $F(1,211) = 24.7$, $p < 0.001$, partial $\eta^2 = 0.105$, $d = 0.58$. The advantage was consistent across both schools (interaction $p = 0.71$) and across achievement tertiles: students in the lowest baseline tertile gained 24.1 points under PBL versus 17.3 under comparison instruction, indicating that the format did not privilege already-stronger students—a concern sometimes raised for inquiry formats with struggling learners.

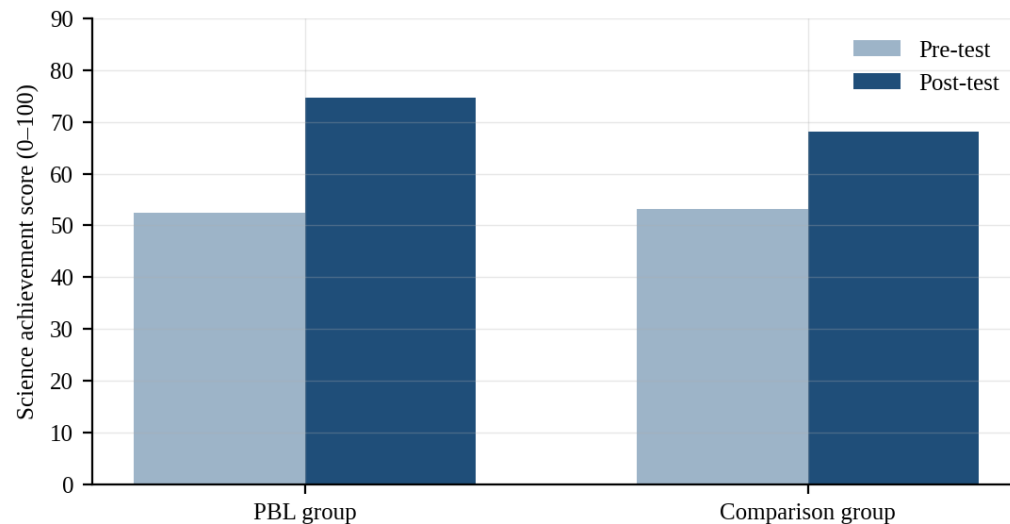


Figure 1. Science achievement before and after the 16-week intervention, by condition.

4.2. Engagement trajectories (RQ2)

Mixed-model analysis of overall engagement yielded a significant time $\times$ condition interaction ($p < 0.001$): PBL classes rose from 3.12 to 3.58 across the sixteen weeks while comparison classes were statistically flat (3.15 to 3.21), as shown in Figure 2. Table 2 decomposes the change by subscale. Cognitive engagement showed the largest standardised gain under PBL ($d = 0.62$), followed by emotional ($d = 0.51$) and behavioural ($d = 0.44$); comparison-group changes were negligible on all three ($d \leq 0.08$). Attendance corroborated the self-report pattern: PBL students' attendance rose from 81.3% in the preceding term to 85.5% during the intervention (+4.2 percentage points), against +0.6 points in the comparison group (difference-in-differences $p = 0.008$).

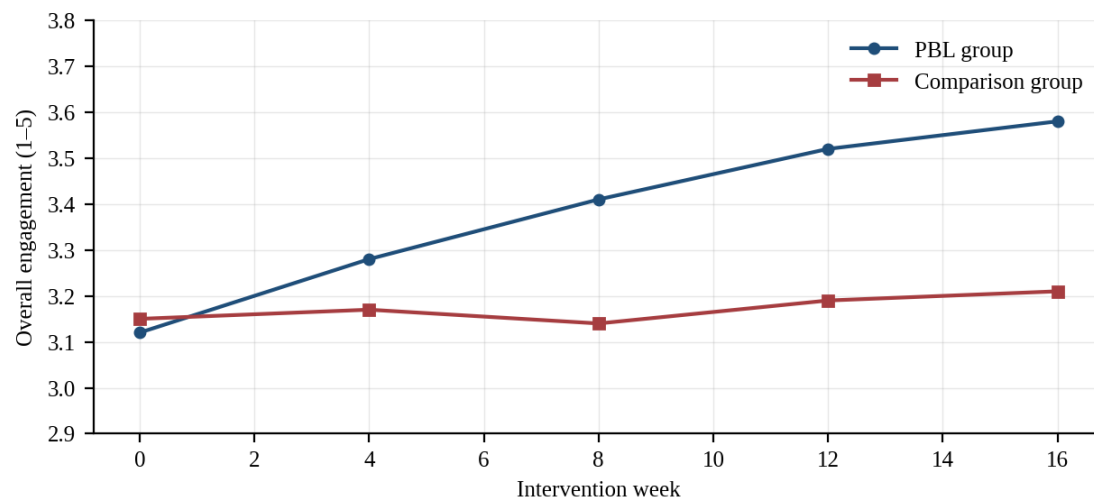


Figure 2. Overall engagement across the intervention at five measurement points.

Table 2. Engagement subscale change from week 0 to week 16, by condition.

Subscale	PBL Δ (SD units)	Comparison Δ	Effect size d
Behavioural	+0.38	+0.05	0.44
Emotional	+0.45	+0.07	0.51
Cognitive	+0.54	+0.04	0.62

4.3. Retention and artefact quality (RQ3)

Eight weeks after the intervention, the PBL group retained a significant advantage on the parallel-form retention test (adjusted means 71.2 vs 64.8; $d = 0.49$), with both groups declining modestly from post-test levels (−3.4 and −3.4 points respectively): the PBL advantage neither grew nor eroded,

consistent with deeper initial encoding rather than transient test-preparation effects. Within the PBL condition, artefact rubric scores ($M = 3.4/5$, $SD = 0.7$) correlated moderately with residualised achievement gain ($r = 0.39$, $p < 0.001$), and team-level rubric variance was substantial ($ICC = 0.31$), pointing to project execution quality as a proximal driver of learning. Table 3 summarises all achievement outcomes.

Table 3. Achievement outcomes (covariate-adjusted means, 0–100 scale).

Outcome	PBL	Comparison	d	p
Post-test (week 16)	74.6	68.2	0.58	< 0.001
Retention (+8 weeks)	71.2	64.8	0.49	< 0.001

4.4. Implementation observations and differential effects

Fidelity observations contextualise the outcome pattern. PBL classes met a mean of 6.9 of 10 design criteria during the first project, rising to 9.1 by the fourth, with the largest early deficits in milestone scaffolding and student voice—the two elements teachers reported finding hardest to reconcile with their protective instincts toward academically fragile students. Teacher-level variance in achievement gains was modest ($ICC = 0.06$) and fidelity growth was shared across all four PBL teachers, suggesting the coaching model rather than individual teaching talent carried implementation. Exploratory subgroup analysis found the attendance effect concentrated among students flagged at baseline as chronic absentees ($< 80\%$ prior attendance): this subgroup’s attendance rose 7.1 points under PBL versus 1.2 under comparison instruction, while already-regular attenders changed little in either condition—a pattern consistent with the interpretation that authentic projects re-attach precisely the students loosest from school. No gender interaction was detected on any outcome (all $p > 0.4$).

5. Discussion

The results answer all three research questions in favour of the project-based condition and, more importantly, illuminate *why* the format suits the alternative-education population. The engagement trajectories are the study’s most distinctive evidence: disengagement among second-chance learners is not a fixed trait that schools must work around but a state that responded, within four weeks, to instruction organised around authentic purpose—and the strongest movement occurred on the cognitive subscale, the dimension most closely tied to the self-regulated learning these students are typically assumed incapable of [11, 15]. The parallel movement of attendance, an administratively recorded behaviour immune to self-report inflation, strengthens the causal reading.

The achievement effect ($d = 0.58$) sits at the upper end of mainstream PBL meta-analytic ranges [8, 9], which merits interpretation rather than celebration. A plausible account is floor-release: learners whose baseline engagement is unusually low have unusual headroom, so a pedagogy that converts engagement into study behaviour yields larger returns than in mainstream samples already near their engagement ceiling. The tertile analysis supports this reading, as does the artefact-quality correlation: where teams executed projects well, learning followed. Conversely, the retention parallelism suggests PBL’s advantage here operated through more learning rather than more durable learning—a useful precision for theory, since claims that PBL produces categorically deeper encoding receive only partial support (the advantage persisted proportionally, but forgetting slopes were equal).

Implementation conditions deserve emphasis because alternative settings both helped and constrained delivery. Small classes and flexible timetables—structural features of the sector—made sustained project work and community presentations easier to organise than in mainstream schools; teacher coaching, by contrast, proved indispensable, with observed fidelity climbing across the first two projects as teachers calibrated scaffolding to students with fragile academic self-concepts. The public-audience element generated the strongest anecdotal responses and, in teachers’ judgement, drove the

emotional-engagement gains; alternative schools' community embeddedness makes this element unusually accessible to them.

The subscale ordering—cognitive engagement moving most, behavioural least—also speaks to theory. Models of engagement commonly treat behavioural participation as the gateway dimension, with emotional identification and cognitive investment following once attendance and compliance are secured [11, 15, 19]. The present trajectories are more consistent with the reverse ordering for this population: cognitive engagement responded first and hardest to the change in task structure, and behavioural indicators (including recorded attendance) moved later and less. A plausible interpretation is that second-chance students' behavioural disengagement is downstream of accumulated experiences of meaningless work, so interventions targeting task meaning act on the causal source, whereas compliance-focused interventions—the sector's traditional levers of contracts and incentives—act on symptoms. Longitudinal cross-lagged designs could test this ordering formally, and the five-wave data structure piloted here is suited to exactly that analysis at larger scale.

Two practical considerations bear on adoption decisions. First, cost: the intervention's marginal expenses—teacher training days, coaching time, and modest project materials—were absorbed within the schools' ordinary professional-development budgets, and no element required technology or facilities beyond what the sites already possessed; PBL's resource demands are organisational (block scheduling, planning time) rather than financial, which matters in a sector that is chronically underfunded. Second, assessment alignment: teachers initially worried that project time would cost performance on the externally set examinations their students must eventually pass. The achievement results, obtained on a blueprint-matched conventional test rather than project-embedded assessment, speak directly to that worry: content learning was measured on the comparison condition's home ground and still favoured PBL. This detail deserves emphasis because assessment-format anxiety is among the most commonly reported barriers to inquiry pedagogy adoption in credential-oriented alternative programmes [9, 20].

Limitations bound the claims. Intact-class assignment leaves selection threats that covariate adjustment mitigates but cannot eliminate; teacher effects are imperfectly separable from condition despite matching; the engagement instrument, though multidimensional, is self-report; and the two-school, one-curriculum, sixteen-week frame limits generalisation across subjects, sites, and durations. Replication with cluster randomisation and cross-subject extension is the natural next step.

6. Conclusions

A sixteen-week project-based science curriculum in two alternative upper-secondary schools produced significantly higher achievement than matched conventional instruction ($d = 0.58$), a retained advantage at eight-week follow-up ($d = 0.49$), steadily rising multidimensional engagement against flat comparison trajectories, and a 4.2-point attendance gain. The evidence positions PBL not as a generic enhancement imported into alternative education but as a pedagogy whose mechanisms align specifically with the sector's population and structural affordances. Practical implications include organising alternative-school curricula around a small number of extended, publicly presented projects; investing in sustained teacher coaching rather than one-off training; and exploiting community ties for authentic audiences. Future research should employ cluster-randomised designs, test transfer to literacy and mathematics, and investigate which project design elements—authenticity, collaboration, or public product—carry the engagement effects that this study measured but could not yet decompose.

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