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Project-Based Learning and Student Engagement in Seaweed Nursery Vocational Education: A Three-Cycle Classroom Action Study

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ABSTRACT

This classroom action research examined the implementation of project-based learning (PjBL) in seaweed nursery techniques among 35 Grade XI students in the Seaweed Agribusiness program at SMK Negeri 1 Tual, Maluku, Indonesia. Three iterative cycles were conducted on July 25, August 1, and August 8, 2022, following planning, action, observation, and reflection. Evidence included formative tests, classroom observations, interviews, and documentation. Reported mastery increased from 24 of 35 students (68.57%) in Cycle I to 29 (82.86%) in Cycle II and 33 (94.29%) in Cycle III; corresponding reported class means were 71, 75, and 79. Classroom observations also described increased student participation in preparing nursery materials and planting seaweed seedlings. The findings support the feasibility of progressively refined project work for this vocational context. However, the reported mastery counts are not consistently aligned with the stated score threshold, and interest was not measured with a separately reported validated scale. Thus, the achievement trend is descriptive and cannot establish a causal improvement in learning interest.

Keywords: classroom action research; project-based learning; seaweed nursery; student engagement; vocational education

INTRODUCTION

Vocational education must integrate knowledge with authentic production processes. For seaweed agribusiness, students need to connect nursery preparation, seedling selection, rope installation, and cultivation practices with environmental conditions and workplace expectations. Project-based learning (PjBL) offers a potentially suitable instructional architecture because it organizes inquiry, collaboration, planning, product development, and reflection around a meaningful task (Blumenfeld et al., 1991; Barron et al., 1998; Kokotsaki et al., 2016; Guo et al., 2020).

The Merdeka Curriculum context in Indonesia emphasizes differentiated and contextual learning. In the source study, Grade XI Seaweed Agribusiness students at SMK Negeri 1 Tual learned Seaweed Nursery Techniques through teacher-facilitated projects. Rather than treating seaweed nursery work as a sequence of isolated facts, the intervention asked learners to prepare cultivation materials and carry out nursery-

related tasks. Interest and motivation were the stated educational aims, while cycle-based formative mastery was the principal quantified outcome (Hartini, original classroom-action dataset, 2022).

Research syntheses suggest that project-oriented methods can improve motivation and achievement, but outcomes vary with task design, scaffolding, assessment and learner preparation (Chen & Yang, 2019; Wijnia et al., 2024; Suparmi et al., 2024). Evidence from vocational students also indicates that authentic projects may increase perceived relevance and willingness to participate (Sari et al., 2023).

The study therefore addresses two questions: (1) how was PjBL implemented and refined across three classroom-action cycles in seaweed nursery instruction, and (2) how did reported formative mastery and observed engagement change across those cycles? Distinguishing these two outcomes is essential: formative test mastery is not itself a direct measurement of learning interest.

LITERATURE REVIEW

Project-Based Learning in Vocational Contexts

PjBL positions learners as active participants in a sustained task requiring decisions, feedback and tangible outcomes. The literature identifies authenticity, inquiry, learner agency and structured support as central design principles (Blumenfeld et al., 1991; Marx et al., 1997; Krajcik et al., 1998; Bell, 2010; Kokotsaki et al., 2016). Its effectiveness depends not only on the presence of a project but also on the coherence between driving questions, curricular content and assessment (Holm, 2011; Guo et al., 2020; Chen & Yang, 2019).

Studies of active and inquiry-based learning emphasize guided participation and formative feedback rather than unguided discovery (Hmelo-Silver, 2004; Hmelo-Silver et al., 2007; Lazonder & Harmsen, 2016; Furtak et al., 2012; Minner et al., 2010). The vocational setting adds practical constraints: equipment, safe procedures, materials, group coordination and authentic task completion (Suparmi et al., 2024).

Learning Interest, Motivation, and Engagement

Interest, motivation, engagement and achievement are related but non-equivalent constructs. Interest refers to a developing relation between the learner and a domain or activity (Schiefele, 1991; Hidi & Renninger, 2006; Renninger & Hidi, 2011; Harackiewicz et al., 2016). Self-determination theory highlights autonomy, competence and relatedness, whereas expectancy-value theory emphasizes perceived success and task value (Deci et al., 1999; Ryan & Deci, 2020; Wigfield & Eccles, 2000; Eccles & Wigfield, 2020).

Engagement can be behavioral, emotional and cognitive; it is best evaluated with appropriate observations or validated measures, rather than inferred solely from examination scores (Fredricks et al., 2004; Skinner et al., 2009; Chi & Wylie, 2014). Learners may display more participation without

necessarily developing a durable interest in the subject. Accordingly, the present article describes qualitative engagement observations separately from the numerical mastery trend.

Collaboration, Feedback, and Reflection

Collaborative projects can support peer explanation and shared accountability (Johnson & Johnson, 2009; Slavin, 2014; Gillies, 2016). Teachers remain responsible for guiding learners, monitoring misconceptions and supplying actionable feedback (Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006; Black & Wiliam, 1998). Reflection across cycles can also foster self-regulation as learners plan, monitor and revise their actions (Zimmerman, 2002; Panadero, 2017).

METHOD

Design and Participants

This study used three-cycle classroom action research with planning, action, observation and reflection. The participants were 35 Grade XI students enrolled in the Seaweed Agribusiness concentration at SMK Negeri 1 Tual, Maluku. The study was implemented on July 25, August 1 and August 8, 2022. A collaborating colleague assisted with classroom observation. No control group or random assignment was reported.

Instructional Actions

In Cycle I, the teacher prepared the teaching module, learning materials, a learning video, practical tools and nursery materials, formative questions, observation sheets and student-response instruments. During subsequent cycles, the teacher revised instruction on the basis of observed difficulties. Students undertook hands-on project activities, including preparation of cultivation ropes and seaweed seedlings, and subsequently planting seedlings in the cultivation area. The source does not specify a standardized project rubric or provide full item-level questionnaire results.

Data and Analysis

The source reports observation, interviews, formative testing and documentation. Descriptive analysis focused on mean formative scores and the proportion of students meeting the school mastery standard. The methods section states a passing criterion above 75, whereas a later results narrative refers to at least 65; several student-level completion marks also include scores of 70 and 75. For transparency, the results below reproduce the original reported counts while showing mathematically recalculated

percentages. This inconsistency should be resolved against original assessment records before journal submission.

RESULTS

Formative Achievement Across Cycles

Table 1. Reported formative outcomes across three classroom-action cycles

Indicator	Cycle I	Cycle II	Cycle III
Date	25 Jul 2022	1 Aug 2022	8 Aug 2022
Students	35	35	35
Reported class mean	71	75	79
Reported mastered (n)	24	29	33
Reported not mastered (n)	11	6	2
Mastery, recalculated (%)	68.57	82.86	94.29
Mastery, rounded in source (%)	68	82	94

The source reports 24 of 35 students achieving mastery in Cycle I, 29 in Cycle II and 33 in Cycle III. Recalculated from these counts, the respective mastery rates are 68.57%, 82.86% and 94.29%, an increase of 25.72 percentage points from Cycle I to Cycle III. The reported class mean increased by eight points (71 to 79). These are descriptive changes within one cohort, not controlled treatment effects.

Changes in Classroom Activities

Cycle I observations described unfamiliarity with the project format and limited understanding of seaweed nursery procedures. In Cycle II, students reportedly became more involved in preparing cultivation ropes and seedling materials, while the teacher facilitated and monitored project completion. By Cycle III, the narrative reports that students were more accustomed to preparing seedlings and planting them in the cultivation site. The source characterizes classroom participation as increasingly active but does not report item-level observation totals or quantitative interest scores.

Data-Reporting Checks

Table 2. Source-reporting issues requiring author confirmation

Issue	Observation	Editorial treatment
Mastery criterion		
	Methods: >75; results: ≥65	
		Not silently reconciled
Cycle I counts		
	24/35 = 68.57%	
		Count-based rate shown
Cycle II counts		
	29/35 = 82.86%	
		Count-based rate shown
Cycle III counts		
	33/35 = 94.29%	
		Count-based rate shown
Interest measure		
	No complete scale statistics	
		No numerical interest effect claimed
Score totals		
	Cycle tables contain inconsistent totals	
		Reported class means retained

DISCUSSION

The progressively higher reported formative scores are consistent with the general proposition that guided, authentic project work can help learners connect concepts to practical tasks (Barron et al., 1998; Freeman et al., 2014; Prince, 2004). The seaweed nursery context gives a concrete purpose to material preparation and seedling planting. Project-based learning is particularly relevant when learners must coordinate tools, materials, sequences and group responsibilities rather than merely recall terminology (Kokotsaki et al., 2016; Guo et al., 2020; Suparmi et al., 2024).

The reported increase in participation also fits theoretical accounts of interest development and motivational relevance. Practical work can make task value visible, and collaborative success can support competence beliefs (Hidi & Renninger, 2006; Harackiewicz et al., 2016; Ryan & Deci, 2020; Wijnia et al., 2024). However, such a mechanism remains an interpretation rather than a directly tested mediator because the original report does not supply validated interest scores or a formal motivational analysis.

Repeated planning, observation and reflection were central to the three-cycle improvement process. Teacher guidance and feedback may have helped learners move from unfamiliarity to more fluent practical engagement (Hmelo-Silver et al., 2007; Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006). Group work may likewise have encouraged peer exchange and participation (Johnson & Johnson, 2009; Slavin, 2014; Gillies, 2016).

The evidence is nevertheless weaker than a causal claim that PjBL increased learning interest. Students completed successive tests and repeated similar practical work, so gains may partly reflect practice, task familiarity or changes in assessment difficulty. Further, inconsistencies in the reported mastery threshold and student-level classifications reduce the precision of the achievement estimate. The contribution of this classroom study is therefore practical and descriptive: it documents an implementable project sequence and a favorable within-class trend, while identifying the need for better measurement and reporting.

LIMITATIONS AND IMPLICATIONS

The study involved a single class (n = 35), lacked a comparison group and did not report psychometric evidence for its interest questionnaire. Formative assessments may not have been equivalent across cycles. The reported pass threshold, marked mastery statuses and score totals also require reconciliation. Future research should report anonymized score-level data, define one mastery criterion, use a validated interest scale before and after instruction, include practical-performance rubrics and assess retention. A comparison class would strengthen causal inference.

CONCLUSION

Across three classroom-action cycles of project-based seaweed nursery instruction, reported mastery increased from 24/35 (68.57%) to 33/35 (94.29%), while the reported mean formative score rose from 71 to 79. Observations described greater participation in preparation and planting activities. These findings suggest that progressively refined, authentic project work is a promising instructional option for vocational seaweed agribusiness. The source data do not, however, independently establish a quantified increase in learning interest or a causal effect of PjBL.

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