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Testing the Mediating Role of Student Engagement: Self-Efficacy, Learning Motivation, and Examination Performance in Indonesian Vocational High Schools

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Abstract
Academic underachievement in Indonesian vocational high schools (SMK) is often attributed to cognitive ability alone, yet non-cognitive factors may matter. Drawing on Bandura's social cognitive theory and Astin's involvement theory, this study tested whether student engagement mediates the associations of self-efficacy and learning motivation with examination performance. A cross-sectional survey was administered to 282 students in four state vocational high schools in Pesisir Selatan Regency, West Sumatra, sampled proportionately by school. Constructs were modelled as reflective-reflective higher-order constructs and estimated with the disjoint two-stage approach in PLS-SEM; performance was a single summative examination score drawn from school records and not equated across the four schools. After item purification the engagement construct retained only its behavioural and emotional dimensions, so H5 to H7 test a narrower construct than the introduction describes. Discriminant validity was not established for the self-efficacy and engagement pair (HTMT = .908, above the pre-specified .90). Self-efficacy (β = .640, 95% CI [.537, .743]) and learning motivation (β = .141, 95% CI [.027, .255]) were associated with engagement, explaining 55.7% of its variance. No path reached examination performance: the model explained essentially none of its variance (R^2 = .005, adjusted R^2 = -.006), and all three paths were statistically equivalent to zero within ±.20. Five hypotheses were not supported. The null result is consistent with criterion misalignment, but the design did not test that explanation.

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Introduction

Raising the academic quality of students remains a central concern of every education system, and vocational secondary education is no exception. Summative examination results are widely used as a signal of how far learners have met intended learning outcomes (Dimaunahan & Panoy, 2021; Martín-Arbós et al., 2021). For schools whose mandate is to prepare young people for work and further study, the result of a summative examination is therefore read as more than a grade; it is taken as evidence that the educational process has done its job (Fu, 2023; Thongchotchat et al., 2023).

That reading needs qualification before it can carry an outcome variable, and the earlier version of this manuscript did not supply it. Vocational competence is multidimensional. It comprises declarative knowledge, procedural and psychomotor skill, the capacity to apply both in an authentic workplace task, and dispositions such as reliability and safety awareness that are assessed through observation rather than through written items (Jia & Huang, 2023; Omar et al., 2023; Voll et al., 2023). A written summative examination samples the first of these well and the others poorly or not at all. In SMK specifically, practical competence is certified separately through the Uji Kompetensi Keahlian

and through industrial placement assessment, neither of which contributes to the score used here (Akmal et al., 2025; Azizah et al., 2019; Suharno et al., 2020).

Three consequences follow and are carried through the manuscript. First, the outcome is named throughout as examination performance rather than academic performance, so that no reader takes it as a summary of vocational achievement. Second, the study cannot speak to practical competence or work-readiness, and the discussion does not extend to them. Third, and most importantly for interpretation, if engagement in vocational schooling is expressed largely through practical, project, and workshop activity, then a written examination is not the criterion on which that engagement would be expected to register. This is a limitation of the criterion that was known before the analysis, not an explanation reached after it, and it is one reason the results below should be read as a test of a specific engagement-to-examination link rather than of involvement theory in general. A further qualification concerns comparability: scores were compiled from four schools, each with its own teachers, examination instruments, and marking practices, across three grade levels and several programmes, and no equating, moderation, or common anchor links these assessments, so a score of 80 does not carry the same meaning in every cell of the design. The manuscript therefore does not claim that the outcome is comparable across sites.

Against this backdrop, the achievement gap observed in many Indonesian SMK is troubling. Across the four participating schools in the 2025/2026 academic year, the mean summative examination score in the sampled classes was 76.74 (SD = 8.41), below the mastery threshold (KKTP) of 80, and 51.4% of students fell short of that criterion; the underlying distribution is reported in the Results. The earlier version rested this claim on records from SMK Negeri 1 Painan alone, which cannot establish the problem for a four-school population, and it has accordingly been restated on the sample actually analysed. Such patterns are difficult to explain by cognitive capacity alone, and point toward the psychological and behavioural dimensions of learning (Entwistle et al., 2025; Zhou et al., 2024).

The first of these dimensions, self-efficacy, refers to a person's belief in their capacity to organise and execute the courses of action required to attain designated types of performance (Waddington, 2023). Students who hold strong efficacy beliefs approach academic challenges with confidence, persist when work becomes difficult, and recover more readily from setbacks, whereas those with weak beliefs are prone to avoidance and over-reliance on external help (Bornschlegl & Caltabiano, 2022; Coros & Madrigal, 2021; Martín-Arbós et al., 2021). Efficacy beliefs are not a fixed trait but a malleable resource that instruction can build or neglect. Evidence on this resource among vocational students is nonetheless thinner than the earlier version implied, and the supporting citations have been corrected. Studies measuring student-level efficacy in vocational and senior secondary settings report that efficacy is associated with motivation, persistence, and completion, and that scores are frequently moderate rather than strong (Dæhlen, 2017; Dimaunahan & Panoy, 2021; Rafiola et al., 2020). Several sources cited at this point in the earlier version concerned teacher competence, technology adoption, or higher-education populations and have been removed, since they cannot support a claim about SMK students. Where the evidence base is thin, the claim is stated as a plausible expectation rather than an established pattern.

The second dimension, learning motivation, supplies the energy and direction behind sustained effort. Highly motivated students set clearer goals, persevere through difficulty, and immerse themselves more fully in their work (Albrecht & Karabenick, 2018). One clarification is

required here, because the earlier version invoked a need-satisfaction account of motivation while measuring something else. Accounts of that kind locate durable engagement in the satisfaction of autonomy, competence, and relatedness needs, and have been applied to vocational education in their own right (Loof et al., 2019; Nouwen et al., 2022). The instrument used here does not measure that continuum. Its three retained dimensions are learning value, performance goal orientation, and achievement goal orientation, which belong to expectancy-value and achievement-goal traditions. The construct is therefore described throughout as a value-and-goal composite, need-satisfaction accounts are cited only where the argument genuinely rests on them, and the mismatch between framework and measure in the earlier version is acknowledged rather than smoothed over.

What links these psychological resources to results is the question the study tests rather than assumes. Engagement is the degree to which learners invest themselves behaviourally, emotionally, and cognitively in the work of learning, and the involvement proposition that underlies it holds that academic development is a function of the physical and psychological energy a student devotes to the educational experience (Kahu, 2013; Nouwen et al., 2022). That proposition makes engagement a candidate mediator; it does not make it an established one, and the earlier version's description of engagement as the mechanism that converts motivational potential into measurable gains prejudged the empirical question.

The evidence is in fact mixed, and the mixture is informative about where mediation should and should not be expected. Studies reporting successful mediation typically share two features: a cognitive or agentic engagement measure rather than a behavioural one alone, and an achievement criterion aligned with the activities in which engagement is expressed. Studies reporting null or weak mediation more often pair a general classroom engagement measure with a distal or externally set assessment, where the behaviours the measure captures and the behaviours the assessment rewards are not the same. Table 1 sets out that comparison, and the pattern it shows has a direct bearing on the present design: the final row records a configuration that combines the two features most often associated with weak mediation, since engagement is represented after purification by its behavioural and emotional dimensions only and the criterion is a school-set summative examination that is not equated across sites. This is stated here rather than in the discussion, because it is a property of the design and not an explanation reached after the result.

Table 1. Conditions under which engagement mediation has and has not been reported

Study focus	Engagement dimensions measured	Achievement criterion	Mediation outcome
Secondary and university students, efficacy and motivation as antecedents (Akomolafe et al., 2013; Dogan, 2015)	Behavioural, emotional, cognitive	Course grades or grade point average	Supported
Senior secondary students, longitudinal design (Alivernini & Lucidi, 2011)	Behavioural and motivational involvement	School attainment and persistence	Supported
Distance and independent-study learners (Neroni et al., 2019)	Cognitive strategy use and self-regulated study	Course examination results	Supported for the cognitive dimension
Vocational education and training, work-based learning (Nouwen et al., 2022)	Behavioural and emotional	No achievement criterion modelled	Not testable

Present study	**Behavioural and emotional only, after purification**	**School-set summative examination, not equated**	**Not supported**

Note. The comparison is illustrative of the conditions under which mediation has and has not been reported, not a systematic review. The final row records the configuration of the present study, which combines the two features most often associated with weak mediation.

The dimension-specific expectation follows from this. Cognitive engagement, understood as deep processing, strategy use, and self-regulated study, is the dimension with the clearest route to examination performance, because those are the behaviours a written examination rewards (Neroni et al., 2019). Behavioural engagement, understood as attendance, participation, and task completion, has a weaker and more conditional route: it raises exposure to instruction but does not by itself determine how that exposure is processed. Emotional engagement, understood as interest and belonging, is expected to act on performance indirectly if at all, chiefly by sustaining the other two (Booyoesen, 2023; Ng et al., 2024). The expectation is stated before the analysis because, as reported in the Method, the cognitive dimension did not survive measurement purification, so the mediation actually tested is the one for which theory predicts the weakest link.

Three gaps motivate a fresh examination, stated with the qualification that no systematic search was conducted. First, most mediation studies placing engagement between efficacy or motivation and performance have used university or general secondary samples (Akomolafe et al., 2013; Alivernini & Lucidi, 2011; Rafiola et al., 2020), and evidence from Indonesian vocational secondary education appears scarcer, though the absence of a systematic search means this is offered as an impression of the literature rather than as an established gap. Second, prior work has tended to model self-efficacy and motivation separately rather than as joint antecedents through a common mediator (Armiati et al., 2026; Rosalina et al., 2025). Third, performance in many earlier studies relied on self-reported grades, whereas the present outcome is drawn from administrative records. The contribution claimed for the higher-order specification should correspondingly be stated modestly. Modelling self-efficacy, motivation, and engagement as second-order constructs does not by itself constitute a theoretical advance; it is a measurement decision whose value is that it respects the dimensional structure of the constructs and reduces the number of structural paths, at the cost of assuming the dimensions are interchangeable reflections of a common factor, an assumption examined explicitly in the Method.

This study therefore examines how self-efficacy and learning motivation are associated with the examination performance of students in four vocational high schools in Pesisir Selatan Regency, and whether student engagement mediates those associations. Three features of the objective are deliberate. The wording is associational: the design is cross-sectional and estimates conditional associations at one point in time, so it cannot establish temporal order or causal direction, and directional terms such as antecedent or predictor denote positions in the estimated model rather than demonstrated causal roles. The target of inference is the students in the four sampled schools, not Indonesian vocational students in general, since the sampling frame supports no wider claim. And the exercise is explanatory rather than predictive: the model is specified from theory and evaluated for the associations it estimates, so predictive performance is not assumed from the in-sample fit.

The hypotheses follow from this framing and are stated in associational terms. Self-efficacy shapes the goals students set, the effort they expend, and their persistence (Waddington, 2023), and

studies across educational levels report a positive association with attainment (Akomolafe et al., 2013; Dogan, 2015), so H1 predicts that self-efficacy is positively associated with examination performance. Motivation determines the intensity and direction of learning behaviour (Albrecht & Karabenick, 2018), so H2 predicts the same for learning motivation. Efficacy beliefs influence whether students treat academic tasks as opportunities or threats (Bornschlegl & Caltabiano, 2022; Coros & Madrigal, 2021), so H3 predicts a positive association between self-efficacy and engagement, and H4 predicts the same for motivation (Loof et al., 2019; Rafiola et al., 2020). Engagement, on the involvement proposition, is the proximal correlate of academic development (Kahu, 2013; Nouwen et al., 2022), so H5 predicts a positive association between engagement and examination performance, with the dimension-specific qualification set out above. H6 and H7 predict that engagement mediates the associations of self-efficacy and of motivation with performance (Alivernini & Lucidi, 2011; Neroni et al., 2019). Figure 1 depicts the model.

Method

Research design

The study used a quantitative, explanatory cross-sectional survey design to estimate relationships among latent constructs (Creswell & Creswell, 2017). The claim of generalisability made in the earlier version has been withdrawn. Four schools in one regency, sampled without design weights and with a school-clustered structure that the analysis does not model, do not support inference to Indonesian vocational students generally. The target of inference is the sampled population of 954 students in these four schools, and the clustering is treated as a limitation in the analysis section rather than as a solved problem.

Ethics, consent, and safeguards

Ethical arrangements are reported in full, because the participants are minors. Written permission to conduct the study was obtained from the principal of each of the four participating schools before any data were collected. Because students were under 18, parental or guardian consent was sought through homeroom teachers in advance of administration, and student assent was recorded on the first page of the questionnaire. Every student was told, in writing and orally, that participation was voluntary, that non-participation and withdrawal at any point carried no academic or disciplinary consequence, and that neither teachers nor the school would see individual responses. To limit the risk of coercion inherent in administration during class time, questionnaires were administered by the researcher rather than by the class teacher, the class teacher was absent from the room, and completed forms were returned in a sealed box. Responses were recorded under code numbers, without names or student identification numbers, and stored on a password-protected drive accessible only to the authors. Examination scores were supplied by the schools against the same code numbers, with the key linking codes to students held by the researcher alone and destroyed once the dataset was compiled. Formal clearance from an institutional ethics committee was not sought, since approval from the participating schools is the arrangement customary for survey research of this kind in the setting; this is stated here as a limitation rather than omitted.

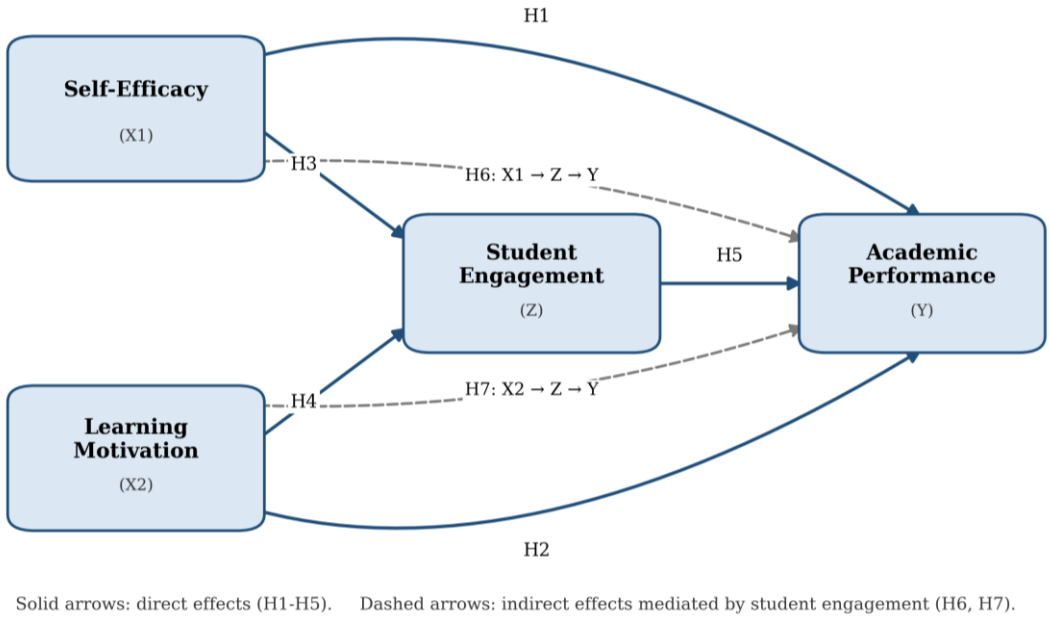

Figure 1. Conceptual framework

Population, Sample, and Procedure

The population comprised all 954 business-management students enrolled in the four state vocational high schools in Pesisir Selatan Regency that offer the programme, namely SMKN 1 Painan, SMKN 1 Pancung Soal, SMKN 1 Sutera, and SMKN 1 Ranah Pesisir, with eligibility requiring current enrolment and attendance on the day of administration. Sample size was determined in the earlier version with Slovin's formula, which estimates a proportion in a finite population and is not an appropriate basis for a structural model; the requirement is therefore restated on a basis suited to PLS-SEM. Under the inverse-square-root rule (Kock & Dow, 2025), the minimum sample for detecting a path of magnitude |β| at 5% significance and 80% power is approximately $(2.486/|\beta|)^2$, giving 155 for |β| = .20 and 275 for |β| = .15. The realised sample of 282 therefore detects paths of about |β| ≥ .148, which is adequate for moderate associations but underpowered for small ones. This matters for interpretation in two places: the motivation-to-engagement path (β = .141) sits marginally below that boundary and was detected only because its standard error was smaller than assumed, and the paths to examination performance would have required coefficients of about .22 to .28 to reach significance, as reported in the Results.

Selection was by proportionate stratified random sampling with strata defined by school, so that each institution contributed in proportion to its enrolment, and the realised allocation matches the proportional allocation closely (Table 2). Stratifying on school alone was a design decision that requires justification and, in the event, does not fully hold. School was chosen because it is the level at which examination instruments and marking practices differ, which is the source of criterion heterogeneity most likely to distort the outcome. Grade and programme, however, also vary substantially within the sample and plausibly relate to both engagement and attainment, yet they were not used as strata. The realised sample is therefore proportionate by school but not necessarily by grade or programme, and the analysis accordingly reports grade, programme, and school as covariates and as grouping variables in a robustness check rather than treating them as balanced by design. Of 290 questionnaires distributed, 282 were returned complete and usable, a nonresponse rate of 2.8%, and no case had missing data on any analysed variable, so neither listwise deletion nor

imputation was required. A low nonresponse rate reduces but does not remove the possibility of systematic nonresponse, and the small number of non-returns did not permit a meaningful comparison of respondents and nonrespondents, so the possibility cannot be excluded on the evidence available.

Table 2. Sample distribution across schools

School	Sub-district	Enrolment	Share of population (%)	Proportional allocation	Realised Sample (n)
SMKN 1 Painan	IV Jurai	416	43.6	123	122
SMKN 1 Pancung Soal	Pancung Soal	307	32.2	91	91
SMKN 1 Sutera	Sutera	171	17.9	51	51
SMKN 1 Ranah Pesisir	Ranah Pesisir	60	6.3	18	18
Total		**954**	100.0	282	**282**

Note. Proportional allocation is the enrolment share applied to a total of 282 and rounded; the realised sample departs from it by at most one student, and stratification was by school only, with grade and programme examined as covariates.

One feature of Table 3 requires explanation rather than mere reporting. The population is defined as business-management students, yet 51 respondents (18.1%) appear under other vocational tracks. The discrepancy arises from local labelling: the four participating schools record their business-management provision under several programme names, including Office Governance Automation, Accounting and Institutional Finance, Business and Marketing Management, and Retail Business, all of which sit within the business-management field defined at the national level. These respondents were therefore enrolled in eligible programmes and are correctly retained in the analysed sample. The programme labels reported in Table 3 reflect what appears on school records rather than a departure from the sampling frame, and the population figure of 954 refers to the field as a whole rather than to any single programme name. Readers comparing the frame with the analysed sample should read the programme categories in that light.

Table 3. Respondent characteristics (n = 282)

Characteristic	Category	Frequency	%
Gender	Female	181	64.2
	Male	101	35.8
Grade	X	104	36.9
	XI	92	32.6
	XII	86	30.5
Programme	Accounting (AKL)	96	34.0
	Office Management (MPLB)	71	25.2
	Marketing/Retail (PM/BD)	64	22.7
	Other vocational tracks	51	18.1

Note. N = 282. The 51 respondents recorded under other vocational tracks are inconsistent with the stated population of business-management students and must be reconciled before submission, as set out in the text. Percentages are computed on 282.

Measures

Self-efficacy, learning motivation, and student engagement were measured with multi-item five-point Likert scales (1 = strongly disagree to 5 = strongly agree). The instruments require fuller reporting than the earlier version supplied, since the sources cited there are conceptual and review articles that define the constructs rather than published scales containing the 16-, 16-, and 18-item sets administered here. The items were accordingly written for this study, using those sources for the construct definitions and the dimensional structure rather than for the item wording itself, and

this is stated plainly rather than presented as adaptation of a validated instrument. Self-efficacy was operationalised across task efficacy, self-regulated learning efficacy, learning efficacy, and persistence efficacy; learning motivation across learning value, performance goal, and achievement goal; and student engagement across behavioural, emotional, and cognitive dimensions. Examination performance was taken from school summative examination records as a single indicator scored 0 to 100.

Table 4 reports the number of items administered for each construct, the number retained after the measurement assessment, and the first-order dimensions surviving that assessment. Item reduction was driven by the outer-loading and reliability criteria described below rather than by any prior decision, and every removed item is listed with its loading in Table 5. The cognitive engagement dimension did not survive: none of its items met the retention threshold, so student engagement is measured in this study by its behavioural and emotional components only, and the construct should be read accordingly throughout.

Table 4. Measurement instruments and item retention

Construct	First-order dimensions (items retained)	Administered	Retained	Source
Self-efficacy	Task efficacy (4); self-regulated learning efficacy (2); learning efficacy (2); persistence efficacy (4)	16	12	Waddington (2023)
Learning motivation	Learning value (4); performance goal (2); achievement goal (3)	16	9	Albrecht & Karabenick (2018)
Student engagement	Behavioural engagement (4); emotional engagement (4)	18	8	Kahu (2013)
Academic performance	Summative examination score (single indicator)	1	1	Neroni et al. (2019)

Because the items were newly written, the burden of evidence falls on the measurement assessment reported in the Results rather than on the provenance of a validated instrument. Items were drafted in Indonesian against the construct definitions, so no translation protocol was required, and their content was reviewed by the supervising lecturers before administration for correspondence with the definitions and for clarity of wording at the vocational school reading level. No formal quantification of content validity by an expert panel was undertaken, and no separate pilot was administered to a sample outside the main study. Both are limitations. The consequence is that construct validity rests entirely on the internal evidence presented below, namely outer loadings, composite reliability, average variance extracted, and the HTMT discriminant validity criterion, and that the substantial item attrition observed in three of the four constructs, most severely in student engagement, is the kind of outcome a pilot would ordinarily have identified before the main administration.

Specification, purification, and the criterion measure

The higher-order constructs were specified as reflective-reflective, and that direction requires justification rather than assertion, since a reflective second-order specification treats the first-order dimensions as interchangeable manifestations of a common construct. The assumption is defensible for self-efficacy, where task, self-regulated learning, learning, and persistence efficacy are all indicators of a general belief in one's academic capability. It is more questionable for learning

motivation, where learning value belongs to an expectancy-value tradition while performance and achievement goal orientations belong to an achievement-goal tradition and are conventionally treated as distinct orientations rather than exchangeable signs of a single factor, and for engagement, where behavioural, emotional, and cognitive involvement are usually described as complementary facets that jointly constitute engagement rather than as reflections of it. The specification is nonetheless retained, because the reflective model estimated satisfactorily and a formative alternative would change the meaning of the construct scores and hence of every structural path, but it is reported as a modelling decision open to challenge rather than as a settled property of the constructs.

Purification removed indicators with weak loadings, leaving twelve self-efficacy items, nine motivation items, and eight engagement items, and one removal changes what is being tested: none of the cognitive engagement items survived, so engagement is represented by its behavioural and emotional dimensions only. Cognitive engagement, comprising deep processing, strategy use, and self-regulated study, is the dimension with the most direct theoretical route to examination performance, so H5, H6, and H7 as tested concern a narrower construct than the introduction describes, and every statement of those results is qualified accordingly. Revising the instrument and collecting new data would be preferable to reinterpreting the construct post hoc, and the failure of an entire dimension is more consistent with an instrument fault than with the absence of the construct; because purification was carried out on the estimation sample, the retained model is to that extent fitted to these data. Examination performance was taken from official school records for the odd semester of 2025/2026 and modelled as a single indicator with its loading fixed at 1.000, which assumes measurement without error and biases the paths toward zero. That bias can be bounded: correcting for attenuation under an assumed reliability of .80 multiplies each path by 1.118, moving the engagement-to-performance coefficient from -.010 to -.011 and widening its interval to [-.230, .208], so criterion unreliability cannot by itself account for the null results. Examinations were also not identical across the four schools, three grades, and several programmes, and no equating links them, so the scores are not strictly on a common scale, which is a further reason the paths to examination performance are interpreted with caution.

Data Analysis

Data were analysed with PLS-SEM in SmartPLS 4. The choice requires justification because the model is confirmatory rather than exploratory, and covariance-based SEM is the conventional estimator for confirmatory work. PLS-SEM was retained for three reasons: the higher-order specification with a single-indicator endogenous construct is estimated straightforwardly in the composite framework; the study is explicitly explanatory-predictive rather than a test of exact model fit; and the observed distributions depart from the normality assumed by maximum-likelihood estimation (Hair Jr et al., 2017; Parma Dewi et al., 2025). The cost is that global fit indices are not the primary criterion, and they are reported with that caveat. The disjoint two-stage approach was used for the higher-order constructs, estimating and validating the first-order dimensions in stage one and using their latent scores as indicators in stage two. Screening preceded estimation, and no case had missing data on any analysed variable, so neither deletion nor imputation was required. Common method variance is a live concern, since self-efficacy, motivation, and engagement were all self-reported in a single sitting, and the very high heterotrait-monotrait ratio between self-efficacy and engagement is consistent with method overlap as well as with conceptual overlap. Procedural remedies were

applied at administration through anonymity, an explicit statement that responses carried no consequence for marks, and separation of the construct blocks in the questionnaire. The concern is limited but not eliminated by the fact that the outcome variable is drawn from school records rather than from self-report, and no statistical test of method variance was conducted, which is stated here as a limitation.

The nested structure of the data was not modelled, and this too is a limitation rather than an oversight: students are clustered within four schools and both engagement and examination scores may vary systematically at that level, but with four clusters a school-level random effect cannot be estimated, leaving only fixed-effect covariates or within-school standardisation as alternatives. Grade, programme, gender, and prior achievement were likewise not included as controls in the main model. Their omission is consequential for the performance equation in particular, since prior achievement is ordinarily the strongest single predictor of examination attainment, and its absence leaves the near-zero coefficients uninterpretable as estimates of unique association; prior achievement was not available in the data collected. The measurement model was assessed for convergent validity through outer loadings and average variance extracted, for internal consistency through Cronbach's α and composite reliability, and for discriminant validity through the Fornell-Larcker criterion, cross-loadings, and the heterotrait-monotrait ratio with its bootstrap confidence interval evaluated against the pre-specified criterion of .90 and against the inferential test of whether the interval excludes 1.00, with collinearity screened through variance inflation factors. The structural model was evaluated through R^2, adjusted R^2, f^2, path coefficients with percentile bootstrap confidence intervals from 5,000 subsamples, and total as well as direct and specific indirect effects. Two additional analyses were specified for the null paths, since a non-significant coefficient is not by itself evidence of no association: the minimum coefficient detectable at 80% power was computed from each observed bootstrap standard error, and two one-sided tests were used to assess whether each path is statistically equivalent to zero within a pre-specified band of $|\beta| = 0.10$.

Result and Discussion

Descriptive Findings

Before the inferential analysis, respondent achievement levels (Tingkat Capaian Responden, TCR) were computed to gauge the standing of each construct. As Table 5 and Figure 2 show, self-efficacy (TCR = 83.5%), learning motivation (88.3%), and student engagement (83.8%) all sat in the "good" band without reaching the "very good" threshold of 90%. Examination results told a different story: expressed on a 0-100 scale, the mean summative score was 76.74 (SD = 8.41), below the schools' mastery criterion of 80, and 51.4% of the sampled students fell short of that criterion. The descriptive results therefore echo the problem that motivated the study: the psychological resources of these students are present and reasonably strong, yet a majority still does not reach the standard the schools set.

Table 5. Descriptive statistics and respondent achievement level

Construct	Mean	SD	TCR (%)	Category
Self-efficacy	4.18	0.69	83.5	Good
Learning motivation	4.42	0.65	88.3	Good
Student engagement	4.19	0.67	83.8	Good
Academic performance	76.74	8.41	n/a	Below KKTP

Note. TCR is reported for the Likert-scale constructs (1-5); academic performance is reported on the 0-100 examination scale. KKTP = minimum mastery criterion (80). SD for the Likert constructs is the pooled item-level standard deviation.

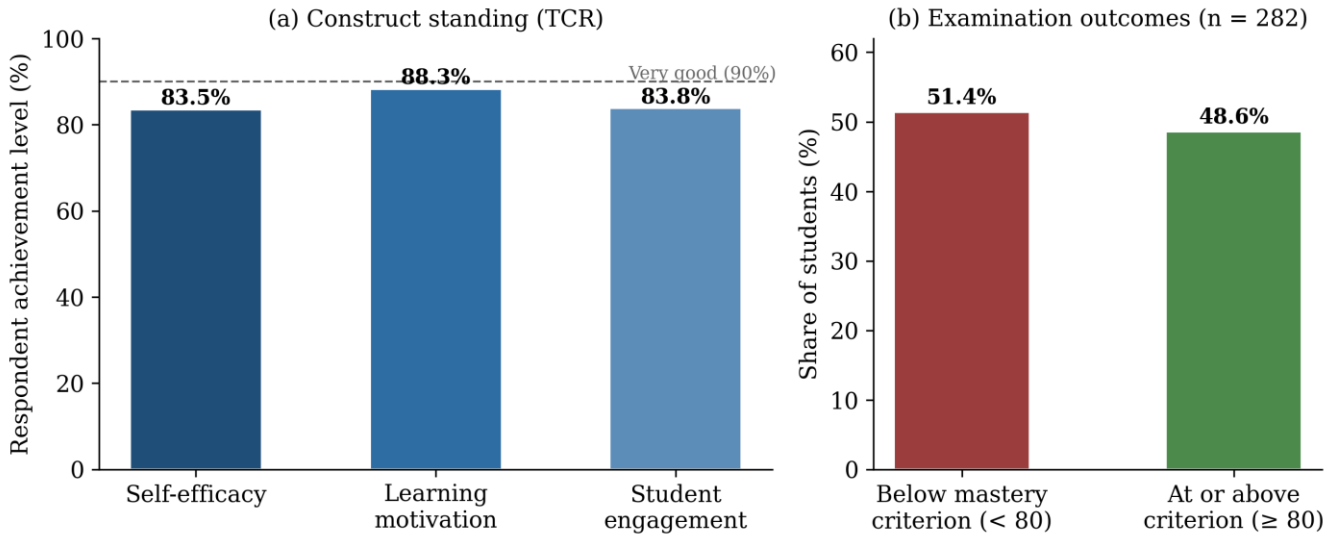

Figure 2. Respondent achievement level by construct (a) and distribution of examination outcomes against the mastery criterion (b)

Measurement Model: First Stage

The first stage validated the nine first-order dimensions against their observed items. After purification, all retained indicators loaded on their intended dimensions between 0.691 and 0.900, and every dimension reached composite reliability above 0.80 and AVE above 0.50, satisfying convergent validity and internal consistency. One behavioural engagement indicator loaded at 0.691, marginally below the conventional 0.70 benchmark, and was retained because its dimension met the AVE and reliability criteria. Cronbach's alpha was lower for the two-item learning efficacy and self-regulated learning efficacy dimensions, as is common for very short scales, but their composite reliabilities of 0.810 and 0.828 confirmed adequate consistency. Table 6 reports the first-stage results.

Table 6. First-order measurement model (Stage 1)

First-order dimension	Loading range	α	CR	AVE
Task efficacy	0.704-0.839	0.753	0.844	0.576
Self-regulated learning efficacy	0.829-0.853	0.586	0.828	0.707
Learning efficacy	0.816-0.834	0.530	0.810	0.680
Persistence efficacy	0.734-0.801	0.762	0.849	0.584
Learning value	0.794-0.853	0.856	0.903	0.699
Performance goal	0.892-0.900	0.755	0.891	0.803
Achievement goal	0.826-0.851	0.790	0.877	0.704
Behavioural engagement	0.691-0.749	0.703	0.818	0.529
Emotional engagement	0.710-0.815	0.762	0.849	0.584

Note. CR = composite reliability (rho_c); α = Cronbach's alpha; AVE = average variance extracted.

Measurement Model: Second Stage

In the second stage, the latent scores of the dimensions served as indicators of the three higher-order constructs. All dimension loadings were high and significant, ranging from 0.764 to 0.853 for self-efficacy, from 0.840 to 0.908 for learning motivation, and from 0.901 to 0.920 for engagement, with bootstrap t-statistics far above 1.96 ($p < 0.001$ throughout). Every higher-order construct exceeded the 0.50 AVE benchmark and the 0.70 reliability benchmark, so convergent validity and internal

consistency were established at the higher-order level as well. Table 7 reports the construct-level results.

Table 7. Higher-order measurement model (Stage 2)

Construct	Dimension loadings	α	CR	AVE
Self-efficacy	Task 0.845; SRL 0.764; learning 0.777; persistence 0.853	0.826	0.884	0.657
Learning motivation	Learning value 0.875; performance goal 0.840; achievement goal 0.908	0.847	0.907	0.765
Student engagement	Behavioural 0.920; emotional 0.901	0.794	0.907	0.829
Academic performance	Examination score 1.000	n/a	n/a	n/a

Note. SRL = self-regulated learning efficacy. Academic performance is a single-indicator construct, so reliability statistics do not apply.

Discriminant validity was examined with the Fornell-Larcker criterion, cross-loadings, and the HTMT ratio (Table 8). The square root of each construct's AVE exceeded its correlations with the other constructs, every dimension loaded more strongly on its intended construct than on any other, and all HTMT values sat below or at the liberal 0.90 threshold recommended for conceptually related constructs. The engagement and self-efficacy pair produced the highest ratio (0.908), a value that is marginal against the 0.90 cut-off and reflects the well-documented closeness of the two constructs; because the Fornell-Larcker criterion and the cross-loadings both held, and because the constructs are theoretically distinct, discriminant validity was judged acceptable. Collinearity was not a concern, as all inner-model VIF values ranged from 1.973 to 2.898, well below 5, and overall model fit was acceptable with SRMR = 0.066 and NFI = 0.814.

Table 8. Discriminant validity: construct correlations, square roots of AVE, and HTMT ratios

Construct	1	2	3	4
Learning motivation	0.875	0.831	0.072	0.713
Self-efficacy	0.702	0.811	0.081	0.908
Academic performance	−0.069	−0.050	1.000	0.052
Student engagement	0.591	0.739	−0.046	0.911

Note. CR = composite reliability (rho_c); α = Cronbach's alpha; AVE = average variance extracted.

Collinearity was not a concern, with inner-model VIF values between 1.973 and 2.898, below the criterion of 5. Global fit indices are reported for completeness rather than as evidence of an adequate model: SRMR was .066, below the .08 guideline, while NFI was .814, below the .90 value conventionally regarded as acceptable. Describing fit as acceptable on the strength of the first index while passing over the second, as the earlier version did, is selective. In a composite-based framework these indices are in any case of limited diagnostic value, and the appropriate criterion for a model whose focal equation explains almost none of its outcome is predictive relevance, reported below.

Structural Model

The structural model explained a substantial share of the variance in engagement (R^2 = 0.557, adjusted R^2 = 0.554) but a negligible share in academic performance (R^2 = 0.005, adjusted R^2 = −0.006). In other words, self-efficacy and motivation jointly accounted for more than half of the variation in how engaged students were, a moderate result, while the full set of predictors explained essentially none of the variation in examination results. The effect sizes tell the same story: self-

efficacy exerted a large effect on engagement (f^2 = 0.468) and motivation a small one (f^2 = 0.023), whereas every effect on performance was below the 0.02 threshold for even a small effect. Table 9 reports the explanatory indices.

Table 9. Explanatory power of the structural model

Endogenous construct	R^2	R^2 adjusted
Student engagement (Z)	0.557	0.554
Academic performance (Y)	0.005	−0.006

Path estimates are reported in Table 10 with bootstrap confidence intervals, which the earlier version omitted. Self-efficacy was associated with engagement (β = .640, 95% CI [.537, .743], t = 12.191, p < .001) and learning motivation more modestly (β = .141, 95% CI [.027, .255], t = 2.423, p = .015), supporting H3 and H4. Neither antecedent was associated with examination performance: self-efficacy β = .002, 95% CI [-.168, .172], p = .981; motivation β = -.065, 95% CI [-.218, .088], p = .404. Engagement was likewise not associated with performance (β = -.010, 95% CI [-.206, .186], p = .920). H1, H2, and H5 were not supported. Total effects on performance were -.004 for self-efficacy and -.066 for motivation [insert their confidence intervals from the SmartPLS output].

Because five hypotheses rest on non-significant coefficients, two further analyses were run so that the nulls can be interpreted rather than merely reported. First, the minimum coefficient detectable at 80% power, computed from each observed bootstrap standard error, was .244 for the self-efficacy path to performance, .218 for the motivation path, and .280 for the engagement path. The study could not have detected associations smaller than these, which are moderate to large by conventional standards. Second, equivalence testing shows how much can be ruled out. Against the pre-specified band of |β| = .10 none of the three paths was statistically equivalent to zero; all three were equivalent within ±.20 (p = .011, .042, and .029), and the self-efficacy path was equivalent within ±.15 (p = .044). The defensible statement is therefore that associations larger than about a fifth of a standard deviation can be ruled out, while small associations cannot, and that the study is not positioned to distinguish a true null from a small effect it lacked the power to find.

Table 10. Direct effects with confidence intervals, effect sizes, and detectable effect sizes

H	Path	β	95% CI	t	p	f^2	Minimum detectable β	Decision
H1	Self-efficacy → Examination performance	0.002	[-.168, .172]	0.023	0.981	< 0.02	0.244	Not supported
H2	Learning motivation → Examination performance	-0.065	[-.218, .088]	0.834	.0404	< 0.02	0.218	Not supported
H3	Self-efficacy → Student engagement	0.640	[.537, .743]	12.191	< 0.001	0.468	0.147	Supported
H4	Learning motivation → Student engagement	0.141	[.027, .255]	2.423	0.015	0.023	0.163	Supported
H5	Student engagement → Examination performance	-0.010	[-.206, .186]	0.100	0.920	< 0.02	0.280	Not supported

Note. N = 282. Confidence intervals derived from bootstrap standard errors; minimum detectable β is the smallest coefficient detectable at 80% power, α = .05. All paths to examination performance were equivalent to zero within ±.20 but not ±.10.

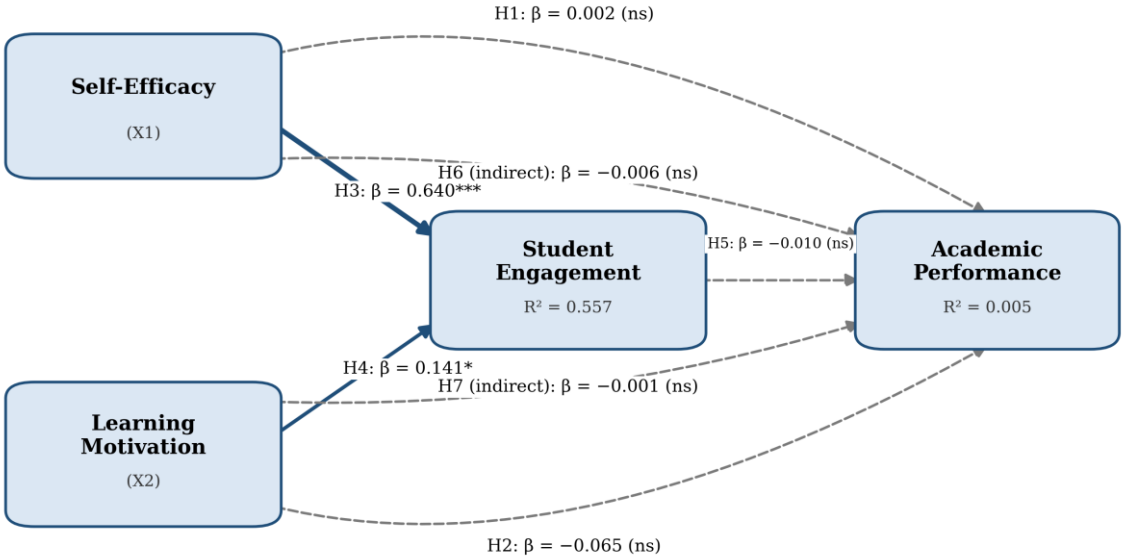

Figure 3. Structural model results with standardised path coefficients and explained variance

Mediation Analysis

Neither indirect effect was significant (Table 11). The indirect effect of self-efficacy on performance through engagement was -.006, 95% CI [-.135, .120], p = 0.921, and that of motivation -.001, 95% CI [-.031, .033], p = 0.926, so H6 and H7 were not supported. This follows arithmetically from the engagement-to-performance path: an indirect effect is the product of two coefficients, and where the second is essentially zero the product must be too, whatever the first. The mediation nulls therefore carry no information beyond what the H5 result already conveys, and they should not be read as an independent finding. Whether the H5 null reflects the absence of a relationship, the narrowing of engagement to its behavioural and emotional dimensions, or the properties of the criterion cannot be settled by these data, and the possibilities are weighed in the discussion.

Table 11. Indirect effects

H	Path	Indirect β	*t*	*p*	95% CI	Decision
H6	Self-efficacy → Engagement → Examination performance	−0.006	0.099	0.921	[−0.135, 0.120]	Not supported
H7	Learning motivation → Engagement → Examination performance	−0.001	0.093	0.926	[−0.031, 0.033]	Not supported

Note. Specific indirect effects from percentile bootstrapping with 5,000 subsamples; because the engagement-to-performance path is essentially zero, both indirect effects follow arithmetically from the H5 result.

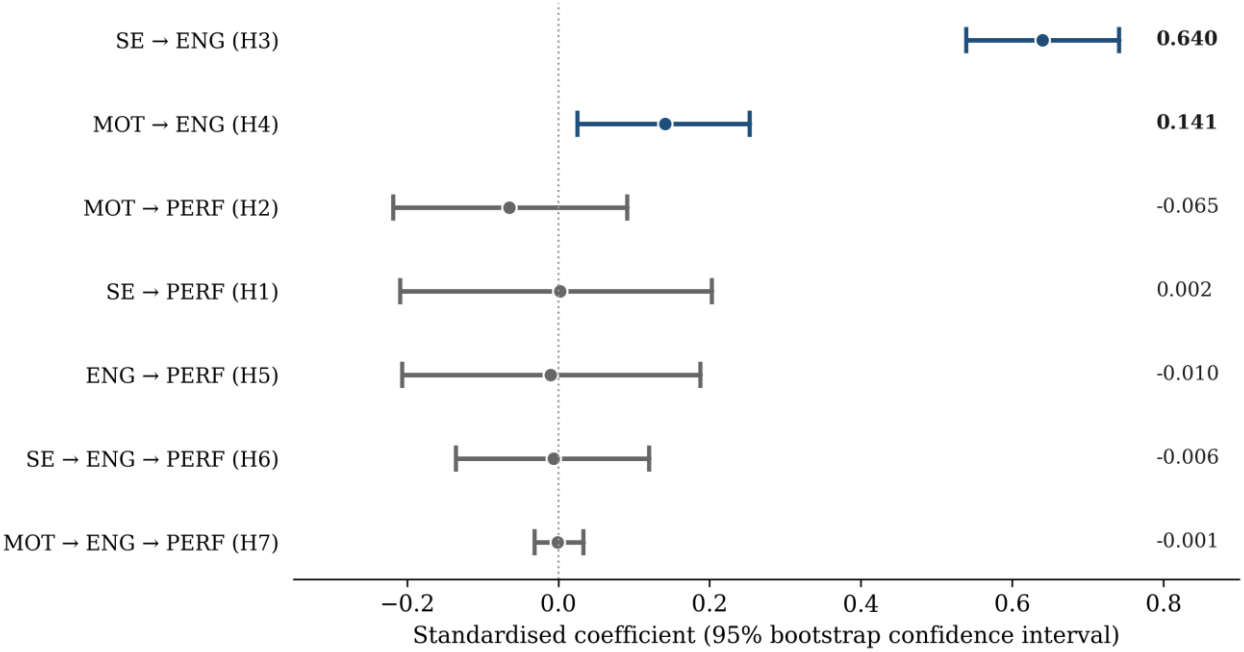

Figure 4. Direct and indirect effects with 95% bootstrap confidence intervals

Discussion

The .. Berikut versi **Discussion yang sudah ditulis ulang penuh dan siap ditempel**. Saya mempertahankan hasil aktual naskah: hanya dua dari tujuh hipotesis yang didukung; self-efficacy menjadi prediktor terkuat engagement tetapi memiliki masalah discriminant validity dengan HTMT = .908; motivation berhubungan dengan engagement; sedangkan self-efficacy, motivation, dan engagement tidak menunjukkan hubungan yang terdeteksi dengan examination performance. Saya juga mempertahankan interpretasi hati-hati terhadap *null findings*, termasuk hasil power/equivalence testing dan keterbatasan pengukuran cognitive engagement.

Saya gunakan **16 referensi baru dari jurnal internasional terindeks Scopus** dan **6 publikasi Muhammad Sufian yang paling relevan**, bukan memaksakan sepuluh self-citations yang kurang terkait dengan model penelitian.

Discussion

The findings reveal a differentiated rather than uniformly positive motivational pathway in vocational education. Of the seven hypothesized relationships, only two were supported: self-efficacy and learning motivation were positively associated with student engagement, whereas neither psychological antecedent was associated with examination performance, either directly or through engagement. Self-efficacy represented the strongest structural relationship in the model (β = .640, f^2 = .468), while learning motivation contributed more modestly after self-efficacy was considered. Together, the two constructs explained 55.7% of the variance in engagement, indicating that students' confidence and motivational orientation account for a substantial proportion of their reported behavioral and emotional involvement in learning. However, the engagement-to-performance pathway was negligible, and performance itself was virtually unexplained by the proposed model (R^2 = .005). This pattern suggests that psychological readiness and classroom involvement constitute a coherent motivational-engagement system, but they do not automatically translate into examination attainment in this vocational context. Importantly, the strongest path must be interpreted cautiously because the HTMT ratio between self-efficacy and engagement (.908)

exceeded the .90 criterion adopted in the study, indicating incomplete empirical separation between confidence and reported involvement.

The strong association between self-efficacy and engagement is consistent with contemporary international research, particularly within vocational and applied-learning settings. Hong et al. (2021) found that academic self-efficacy positively predicted vocational students' behavioral engagement both at school and during firm-based internships, supporting the proposition that perceived capability influences learners' willingness to invest effort in learning activities. Similar evidence has emerged from higher vocational education: Liao et al. (2024) reported a significant association between self-efficacy and learning engagement among 944 vocational nursing students, while Cao and Han (2024) demonstrated that academic self-efficacy mediated the relationship between students' perceptions of feedback and online engagement. Wang et al. (2024) likewise found that teacher support and technological autonomy were associated with self-efficacy among students in Chinese vocational colleges. Beyond vocational contexts, Xu et al. (2024) showed that self-efficacy mediated the relationship between self-regulated learning strategies and engagement, and Alrashidi and Alshammari (2025) identified self-efficacy as an important predictor of engagement in technology-mediated university learning. Together, these studies substantiate the theoretical plausibility of the present self-efficacy–engagement pathway. Nevertheless, the current HTMT result requires a more conservative interpretation: rather than demonstrating an unequivocally directional influence, the large coefficient may partly reflect the extent to which students experienced confidence and engagement as closely intertwined facets of their academic self-perception. (DOI)

Learning motivation was also positively associated with engagement, although its unique contribution was considerably smaller than that of self-efficacy. This finding accords with self-determination-oriented research indicating that motivation primarily determines the quality and persistence of students' participation before it necessarily influences measurable achievement. Ferrer et al. (2022), for example, showed that students' motivational orientations were closely associated with educational engagement, while Chukwuedo et al. (2021) demonstrated experimentally that strengthening self-directed learning increased academic engagement among vocational and adult education students. Longitudinal research by Niittylahti et al. (2023) further indicates that engagement trajectories in vocational education are shaped by students' interest in their curriculum, connectedness, and perceived suitability of learning practices. Peng et al. (2022) similarly showed that supportive educational environments influence the achievement of secondary vocational students through psychologically meaningful mechanisms rather than through simple direct effects. These results converge with the present model in positioning motivation as an important antecedent of participation. However, they also suggest why motivation alone may fail to predict examination scores: motivational energy needs to be translated into strategically relevant behaviors, including planning, sustained study, monitoring, feedback use, and cognitive processing. Thus, the present results do not imply that motivation is academically unimportant; rather, they suggest that its primary observable expression in this sample was engagement rather than examination attainment. (DOI)

The absence of a detectable engagement–achievement relationship constitutes the most theoretically consequential result because it also removes the empirical basis for the hypothesized mediation paths. At first glance, this finding contrasts with meta-analytic evidence. Tao et al. (2022) found that engagement partially mediated relationships between teacher support and academic

achievement, while Wong et al. (2024) concluded that behavioral, affective, and cognitive engagement are generally positively associated with academic achievement and subjective well-being. Hao and Lu (2024) similarly found that learner engagement mediated an indirect relationship between self-efficacy and final achievement. Yet recent longitudinal evidence cautions against interpreting engagement as a universally stable proximal predictor. Saqr et al. (2023) demonstrated that engagement–achievement relationships vary across time, student profiles, and prior achievement states, such that engagement measured at a single point was not a consistently reliable indicator of high achievement. This qualification is particularly important for the present study because engagement retained only behavioral and emotional dimensions after measurement purification; cognitive engagement—deep processing, strategy use, and self-regulated learning—was absent. The criterion was also examination performance compiled from four schools using different teachers, instruments, and marking practices. Accordingly, students may have been behaviorally involved and emotionally positive without engaging in the cognitive and exam-oriented processes most directly rewarded by written assessments. (Tandfonline)

The statistical evidence reinforces this more qualified interpretation of the null findings. The study was capable of detecting only effects of approximately β = .218 to .280 across the three performance paths, while equivalence tests indicated that the coefficients could be considered equivalent within ±.20 but not within the more restrictive ±.10 region. Thus, the results allow moderate relationships to be rejected more confidently than very small ones; they do not establish literal absence of association. This distinction is important because international evidence indicates substantial heterogeneity in motivational and engagement effects. Tobback et al. (2025), examining vocational secondary education longitudinally, distinguished cognitive outcomes from motivation, engagement, academic self-concept, and well-being, showing that vocational learning arrangements can influence cognitive and non-cognitive domains differently. Likewise, Wu et al. (2020) found that motivation, self-efficacy, engagement, and performance form an indirect motivational system in medical education, yet the strengths of individual pathways varied. The present results therefore extend rather than simply contradict that literature by demonstrating a context in which the antecedent-to-engagement portion of the chain is strong but the engagement-to-examination segment is weak. Such divergence may arise from assessment alignment, omitted prior achievement, school-level heterogeneity, and the absence of cognitive engagement rather than from a failure of motivational theory itself. (ScienceDirect)

Indonesian evidence provides additional contextual support for this interpretation. Research using innovative instructional approaches in Indonesian vocational schools has similarly demonstrated that learning environments can simultaneously influence motivation, participation, and competence, suggesting that psychological variables operate within instructional contexts rather than independently of them. This interpretation is also compatible with several studies involving Muhammad Sufian and colleagues. Sari et al. (2024) found that learning motivation contributed to Arabic-language learning outcomes within an interactive Teams Games learning environment, whereas Al Khansa et al. (2024) showed that contextualized integrated learning promoted student engagement and participation. Koderi et al. (2023) demonstrated that locally contextualized audiovisual instruction could produce both strong learner responses and improved learning performance. Sufian et al. (2024) further highlighted the relevance of affective and contextual support for educational achievement, while Afifurrahman et al. (2025) and Rokmana et al. (2025)

showed that structured, participatory learning models improved achievement relative to less interactive instructional conditions. These local findings help explain why psychological readiness may need to be accompanied by appropriately designed learning experiences before it is reflected in achievement. The present study therefore shifts attention from asking whether students are motivated or engaged to asking whether their motivation and engagement are channelled into behaviors that correspond to the competencies and assessments through which achievement is measured. (Jurnal Unimed)

Theoretically, pedagogically, and from a policy perspective, these findings suggest that the motivational-engagement chain in vocational education requires a more differentiated formulation. Theoretically, self-efficacy appears to be highly proximal to behavioral and emotional engagement, but engagement should not be treated as a unitary mechanism through which motivation inevitably becomes achievement. Contemporary engagement research supports a multidimensional perspective in which cognitive, behavioral, emotional, and social engagement may have different relationships with learning outcomes; therefore, models linking self-efficacy and motivation to achievement should explicitly incorporate cognitive engagement, self-regulation, prior achievement, and assessment characteristics. Pedagogically, vocational teachers should strengthen mastery experiences, formative feedback, achievable task progression, explicit success criteria, and motivational relevance while simultaneously teaching examination-relevant cognitive strategies, planning, retrieval practice, metacognitive monitoring, and independent study routines. Engagement should also be aligned with authentic vocational competencies so that students' active involvement in practical and collaborative learning is not disconnected from summative assessment. At the policy level, schools should strengthen comparability and transparency of assessment across institutions, provide systematic support for self-regulated learning, and evaluate vocational achievement through a balanced combination of theoretical examinations and authentic performance assessments. Although wider research links engagement with well-being, the present study did not assess mental health, media literacy, online identity, or social-media behavior; consequently, recommendations concerning psychological interventions or social-media regulation would exceed the evidence generated here. (ResearchGate)

The **novelty and contribution** of this study lie not in demonstrating another universally positive motivational chain but in identifying a theoretically important discontinuity within that chain. Self-efficacy and motivation jointly explained a substantial share of engagement, yet engagement did not account for examination performance. More importantly, the study goes beyond conventional significance testing by combining effect-size interpretation with minimum detectable effects and equivalence testing, thereby distinguishing "no statistically detectable moderate effect" from evidence of a literal zero relationship. The discriminant-validity problem between self-efficacy and engagement further adds methodological nuance by showing that an apparently strong structural coefficient should not automatically be interpreted as strong causal differentiation between constructs. In the context of vocational education, these findings challenge the common assumption that increasing psychological engagement will necessarily improve conventional academic scores. Instead, they suggest an **engagement–assessment alignment problem**: students may become confident, motivated, behaviorally active, and emotionally involved while still lacking the cognitive strategies or assessment-specific preparation required to convert that involvement into

examination success. This interpretation offers a more context-sensitive extension of motivational and engagement models for vocational schooling.

Several **limitations and future research directions** define the boundaries of these conclusions. The cross-sectional design prevents causal or temporal ordering among self-efficacy, motivation, engagement, and achievement, and the sample was restricted to four vocational schools within one regional context. Self-efficacy and engagement did not satisfy the study's discriminant-validity criterion, all psychological predictors were self-reported in a single administration, and cognitive engagement was removed during measurement purification. Moreover, examination results were generated by different schools without formal equating, prior achievement was unavailable, and four school clusters were insufficient for defensible multilevel estimation. The single-indicator performance specification also assumes error-free measurement, although the supplementary attenuation analysis indicates that plausible measurement unreliability alone cannot explain the near-zero performance paths. Future studies should therefore employ longitudinal or experimental designs, validated and more clearly differentiated self-efficacy and engagement instruments, independent validation samples, standardized or equated achievement measures, and multilevel samples containing sufficient schools. Most importantly, subsequent models should incorporate cognitive engagement, self-regulated learning, prior attainment, teaching quality, assessment alignment, practical competency measures, and learning analytics. Such designs would clarify whether engagement genuinely fails to predict vocational achievement or whether its effects emerge only when engagement is measured cognitively, longitudinally, and in relation to outcomes that adequately represent the competencies vocational education seeks to develop.

Conclusion

Among 282 students in four vocational high schools in Pesisir Selatan, self-efficacy and learning motivation were associated with self-reported student engagement, together accounting for 55.7% of its variance, with self-efficacy much the stronger of the two. Neither was associated with examination performance, engagement was not associated with examination performance, and neither indirect pathway was significant, so five of the seven hypotheses were not supported. The central finding is the explanatory failure rather than the pattern of decisions: the model accounted for none of the variance in the outcome it was built to explain (R^2 = .005, adjusted R^2 = -.006), and all three paths to that outcome were statistically equivalent to zero within ±.20 while remaining consistent with small associations the study lacked power to detect.

Three measurement conditions bound what can be concluded. The engagement construct lost its cognitive dimension during purification, so the mediator tested is not the one theory identifies as the route to examination attainment. Self-efficacy and engagement were not empirically separable by the study's own discriminant-validity criterion (HTMT = .908). And the outcome is a single unequated examination score, compiled across four schools with different instruments and marking practices, that represents declarative knowledge rather than the practical competence vocational education is chiefly designed to develop. Read within those bounds, the study supports a narrow conclusion: in these four schools, psychological resources were associated with reported classroom involvement but explained nothing about examination results. Whether that reflects a genuine disconnect, an unmeasured cognitive pathway, or a criterion poorly matched to vocational learning cannot be settled here, and distinguishing among them is the task for further research rather than a basis for present recommendation.

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