

# Brain-Based Learning as a Catalyst for Strengthening the Independent Dimension of Pancasila Student Profile in Islamic Religious Education

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## Abstract

The transformation of character education in Indonesia under the Merdeka Curriculum positions the Pancasila Student Profile as the foundational framework for national character development. However, at the elementary school level particularly in Islamic Religious Education and Character Education (IRE-CE), the internalization of the Independent Dimension remains hampered by low self-regulation and impulse control among students. This study aimed to implement Brain-Based Learning (BBL) with the John Elliott Classroom Action Research (CAR) model to strengthen the Independent Dimension of the Pancasila Student Profile among fourth-grade students at SDN 1 Dadakitan, Tolitoli Regency. Employing a mixed-methods participatory action research design across two cycles (four sessions) with 25 students, data were collected through structured observation using a nine-indicator Psychomotor Skills Rubric (0–4 scale) covering three latent variables: Compliance and Etiquette, Academic Engagement, and Resource Management. Data were analysed through descriptive quantitative methods and Partial Least Squares-Structural Equation Modeling (PLS-SEM) for causal validation. Results demonstrated a significant increase in classical mastery from a pre-cycle baseline of below 60% to 96% by the end of Cycle 2. PLS-SEM confirmed that Compliance and Etiquette significantly predicted Academic Engagement ( $\beta = 0.61$ ,  $p < 0.001$ ), which in turn significantly predicted Resource Management ( $\beta = 0.53$ ,  $p < 0.001$ ). The novelty of this study lies in its integration of PLS-SEM into classroom action research, elevating CAR methodology from anecdotal reporting to replicable statistical evidence. Findings offer a scientifically validated BBL protocol for IRE-CE teachers and contribute a new conceptual model of character formation rooted in educational neuroscience.

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## INTRODUCTION

The digital transformation era has fundamentally reshaped the landscape of Indonesian education. The Merdeka Curriculum introduced by the Ministry of Education, Culture, Research, and Technology (KEMENDIKBUDRISTEK, 2022) positions the Pancasila Student Profile (Profil Pelajar Pancasila) as the primary anchor for national character development. Against a backdrop of pervasive digital distraction and shifting social interaction patterns, character formation has transcended its role as a curricular supplement to become the foundational prerequisite for academic achievement and social adaptation. The UNESCO (2021) report on post-pandemic learning underscores that the global learning crisis has not only eroded literacy and numeracy skills but has also critically diminished self-regulation capacities and learning independence among students across nations, including Indonesia a finding with direct implications for pedagogical reform at the primary level.

At the elementary school level, specifically within Islamic Religious Education and Character Education (IRE-CE), the internalization of character values confronts an acute challenge low cognitive attention and deficient impulse control. Empirical observations conducted at SDN 1 Dadakitan, Tolitoli Regency, reveal that despite theoretical delivery of Chapter 8 material Practicing Praiseworthy Behaviour impulsive behavioural patterns and minimal active engagement persist as primary obstacles to authentic learning. These observations demand a pedagogical engineering approach that engages not only the doctrinal-affective domain but also aligns with the neurobiological mechanisms governing brain function in primary-age learners (Lagoudakis et al., 2023; Jensen & McConchie, 2008).

Brain-Based Learning (BBL) has emerged as a pedagogical paradigm that optimises neuroscientific findings within instructional practice, centering on the creation of emotionally safe yet cognitively challenging environments (Lagoudakis et al., 2023; Jensen & McConchie, 2008; Caine & Caine, 1991). Prior research consistently demonstrates the efficacy of Brain-Based Learning in enhancing critical thinking, memory retention, and intrinsic motivation, particularly in STEM domains (Dwiputra et al., 2023). Within the Indonesian primary education context, Azizah & Herwani (2026) found that Brain-Based Learning assisted with flashcard media significantly improved beginning reading ability, Grade I students, while Rahmawati et al., (2021) confirmed BBL's effectiveness in advancing mathematical reasoning skills students. Nevertheless, the preponderance of existing research concentrates on cognitive-academic outcomes, leaving the application of Brain-Based Learning techniques for transforming physical compliance and social etiquette particularly within Islamic Religious Education and Character Education largely unexplored (Rahmawati et al., 2022; Mustakim, et al., 2024).

Within the Merdeka Curriculum ecosystem, behavioural transformation is specifically targeted through the strengthening of the Independent Dimension. According to official guidelines, this dimension is not merely operationalised as 'studying alone' but is instantiated through two key elements like self-understanding in relation to encountered situations, and self-regulation or discipline (KEMENDIKBUDRISTEK, 2022). This dimension is particularly critical during Phase B (ages 8–10), when developing prefrontal cortex activity begins demanding student autonomy in emotional management, goal-setting, and the construction of resilience when facing task complexity (Wang & Wang, 2024; Zimmerman, 1990). Field observations at SDN 1 Dadakitan expose a pronounced disconnect in the self-regulation element is students demonstrate

difficulty initiating care of their learning materials and tend to abandon tasks when confronted with complex instructions manifestations that represent the central operationalisation of genuine autonomy within the classroom.

A systematic review of the Classroom Action Research (CAR) literature reveals that the majority of classroom action research studies investigating character development and Brain-Based Learning implementation remain entrapped in anecdotal, subjective, or purely descriptive qualitative reporting (Syahrani & Santoso, 2024). A pronounced research gap exists regarding the absence of statistical causal evidence specifically, empirical demonstration of how physical classroom compliance precipitates the internalisation of self-management behaviours. Furthermore, to the best of the authors' knowledge, no Classroom Action Research study at the elementary level has integrated participatory action research with high-precision multivariate statistical analysis such as Partial Least Squares–Structural Equation Modeling (PLS-SEM) (Hair et al., 2021; Rahim & Mustakim, 2025). This methodological validation is urgently needed to empirically verify that academic engagement produced through Brain-Based Learning interventions measurably contributes to autonomous student behaviour, rather than constituting mere observational bias.

This study integrates three primary theoretical frameworks. First, the Brain-Based Learning theory (Jensen & McConchie, 2008) emphasises the creation of a relaxed alertness condition through multisensory stimulation to optimise brain function during learning. Second, Self-Regulated Learning theory (Lan & Zhou, 2025; Zimmerman, 1990) posits that learning autonomy develops through a metacognitive monitoring cycle incorporating motivational control and behavioural regulation. Third, Social Semiotic theory (Peña & James, 2024) and the concept of Transmediation (Suhor, 1984) hold that transforming textual meaning into physical action through kinaesthetic roleplay produces deeper value internalisation than conventional rote-based methods. The integration of these frameworks underpins the conceptual model tested in this study.

This study pursued three objectives: (1) to implement Brain-Based Learning using the John Elliott CAR model to strengthen the Independent Dimension of the Pancasila Student Profile in Grade IV IRE-CE; (2) to analyse classical mastery improvements across three independence indicators—Compliance and Etiquette, Academic Engagement, and Resource Management; and (3) to validate structural causal relationships among these variables using PLS-SEM. The study was guided by three research questions:

- RQ1 : How does Brain-Based Learning implementation with the John Elliott model improve classical mastery of the Independent Dimension of the Pancasila Student Profile in Grade IV IRE-CE?
- RQ2 : Does Compliance and Etiquette exert a significant influence on Academic Engagement within the structural model of student autonomous behaviour?
- RQ3 : Does Academic Engagement exert a significant influence on Resource Management within the structural model of student autonomous behaviour?

The contribution of this study is threefold: theoretically, it develops a new conceptual model linking physical compliance to cognitive independence; methodologically, it pioneers PLS-SEM integration within Indonesian CAR; and practically, it provides a validated, replicable BBL implementation protocol for IRE-CE educators.

## METHOD

This study adopted a mixed-methods design integrating participatory Classroom Action Research (CAR) with structural statistical modelling. The primary Classroom Action Research framework adapted the reflective action model developed by John Elliott (Elliott, 1991; Hilmi & Prastowo, 2023). Elliott's model was selected over the Kemmis and McTaggart (1981) spiral model due to its superior flexibility in decomposing each cycle into multiple micro-action steps a feature critical for Brain-Based Learning implementation, where neurological and motor responses necessitate continuous observation and tactical calibration at each session rather than waiting until the end of a cycle for corrective reflection (Jensen & McConchie, 2008). The study was executed in two consecutive cycles (Cycles 1 and 2), each comprising two learning sessions (action steps), totalling four instructional encounters.

### Research Instrument

The researcher collected data through direct observation using structured observation sheets and performance assessment rubrics. These direct observations were applied to measure the actual performance of students' reading comprehension skills when interacting with the text and role-playing, which included four cognitive indicators: (1) literal comprehension and vocabulary, (2) determination of the main idea, (3) making inferences or implied comprehensions, and (4) evaluation of the text. The researcher has validated the observation rubric instrument through expert judgment and obtained an inter-rater reliability coefficient of  $> 0.80$ .

### Participants and Research Context

The study was conducted at Sekolah Dasar Negeri (SDN) 1 Dadakitan, Tolitoli Regency, Central Sulawesi Province, Indonesia. Participants comprised 25 Grade IV students (Phase B) aged 9–10 years. Purposive sampling (Creswell & Creswell, 2018; Aini, et al., 2022) was employed based on pre-cycle observational screening, which identified this cohort as exhibiting the highest discrepancy in the independence character dimension specifically concerning self-regulation and learning focus. The study material focused on IRE-CE Chapter 8: 'Mari Berperilaku Terpuji' (Practising Praiseworthy Behaviour), encompassing four sub-topics aligned with the Independent Dimension: (1) Gemar Membaca (Love of Reading), (2) Pantang Menyerah (Perseverance), (3) Rendah Hati (Humility), and (4) Hemat (Frugality). Research ethics approval was obtained from the principal of SDN 1 Dadakitan, with written informed consent secured from all parents/guardians prior to implementation. Student identities are reported using anonymised codes (S01–S25).

### Data Collection Instrument

Primary data were collected through participatory observation using a Psychomotor Skills Rubric employing a 0–4 scale (0 = Absent; 1 = Poor; 2 = Developing; 3 = Good; 4 = Excellent). Unlike binary observation checklists (Yes/No) prevalent in conventional CAR, the ordinal rubric was designed to enhance measurement resolution for capturing micro-behavioural gradations a psychometric approach aligned with the precision standards demanded by international reporting (Hair et al., 2021; Mustakim & Rahim, 2024). The rubric encompasses nine behavioural indicators (I1–I9) classified within three latent variables:

- (1) Compliance and Etiquette (Physical Compliance):
  - I5 – Raises hand before speaking.
  - I6 – Speaks without shouting.

- I7 – Sits upright and respectfully.
- (2) Academic Engagement (Cognitive Involvement):
- I1 – Opens textbook independently.
- I2 – Takes notes on key points
- I3 – Reads quietly and attentively.
- (3) Resource Management (Self-Management):
- I4 – Shows courage in retrying tasks.
- I8 – Avoids discarding paper wastefully.
- I9 – Maintains writing tools responsibly.

Instrument validation was conducted through expert judgment by two university lecturers specialising in character education and one senior IRE practitioner. Inter-rater reliability was assessed using Cohen's Kappa, yielding  $\kappa = 0.82$  classified as near-perfect agreement (Landis & Koch, 1977; Więckowska et al., 2022) confirming the rubric's robustness for the study's observational demands.

### **Intervention Procedure**

The CAR procedure followed the John Elliott spiral model across four structured sessions:

- (1) Pre-Cycle Reconnaissance: Baseline observation to establish initial behavioural profiles. Key problems identified: low self-regulation, impulsivity, and difficulty maintaining learning materials. A General Plan (Rencana Umum) for BBL implementation was formulated.
- (2) Cycle 1 – Session 1 (Gemar Membaca / Love of Reading): Pre-exposure techniques were applied using visual stimuli (motivational posters), introductory brain gym exercises (Cross Crawl movement), and guided reading activities. Primary focus: establishing Academic Engagement.
- (3) Cycle 1 – Session 2 (Pantang Menyerah / Perseverance): Relaxed alertness was reinforced through classical instrumental music, sentence puzzle activities involving Islamic phrases (kalimat thayyibah), and verbal reward delivery. Primary focus: advancing Resource Management—specifically the courage to retry.
- (4) Cycle 1 Reflection: Action step analysis revealed insufficient behavioural modelling and cognitive fatigue; revised protocols for Cycle 2 incorporated extended brain gym durations and enhanced kinaesthetic demonstrations.
- (5) Cycle 2 – Session 3 (Rendah Hati / Humility): Brain gym was extended to 10 minutes; kinaesthetic roleplay (enacting scenarios of humility) and small-group discussion were introduced. Primary focus: consolidating Compliance and Etiquette.
- (6) Cycle 2 – Session 4 (Hemat / Frugality): Full integration of all three variable domains through a learning material management simulation, creation of frugality posters from recycled materials, and individual written self-reflection. Primary focus: comprehensive consolidation of all indicators.

### **Data Analysis**

Data analysis proceeded through two complementary analytical tiers, ensuring international methodological transparency standards:

Tier 1 – Descriptive Quantitative Analysis: Individual mean scores and classical mastery percentages were calculated for each session. Observation scores (0–4 scale) were converted to a 0–100 scale using the formula:  $\text{Score} = (\text{Total Score} / \text{Maximum Score}) \times 100$ . Students achieving

≥ 75 (Good category) were classified as meeting individual mastery criteria. Classroom action was deemed successful when ≥ 85% of students achieved the Good category by Cycle 2 completion.

Tier 2 – Partial Least Squares–Structural Equation Modeling (PLS-SEM) Observation scores (I1–I9) from all 25 students were extracted and analysed using SmartPLS 4.0 (Ringle et al., 2022). Measurement model evaluation (Outer Model) assessed convergent validity (Average Variance Extracted > 0.50; Outer Loadings > 0.70), discriminant validity (Fornell-Larcker criterion), and reliability (Cronbach's Alpha > 0.70; Composite Reliability > 0.70). Structural model evaluation (Inner Model) employed bootstrapping with 5,000 subsamples to assess path coefficient significance for two hypotheses:

H1: Compliance and Etiquette has a significant effect Academic Engagement

H2: Academic Engagement has a significant effect Resource Management

Hypotheses were supported at  $p < 0.05$  and  $\beta > 0.30$ . Coefficient of Determination ( $R^2$ ) thresholds followed Hair et al. (2021):  $R^2 > 0.25$  (substantial), 0.10–0.25 (moderate), < 0.10 (weak).

## RESULTS AND DISCUSSION

### Result

Descriptive analysis of the four-session observation data reveals a clear and consistent trajectory of improvement in student independence behaviours. Table 1. presents the classical mastery percentages across the pre-cycle baseline through Cycle 2, Session 4.

**Table 1. Classical Mastery Progression of Independent Dimension Indicators (N = 25)**

Cycle / Session	Material Topic	Mean Score (0–100)	Classical Mastery (%)	Category
Pre-Cycle Baseline	Observational Reconnaissance	54.3	36%	Poor
Cycle 1 – S1	Love of Reading	67.1	52%	Fair
Cycle 1 – S2	Perseverance	74.6	68%	Developing
Cycle 2 – S3	Humility	83.8	88%	Excellent
Cycle 2 – S4	Frugality	88.2	96%	Excellent

Note. Classical mastery criterion: ≥ 75 (Good). Action declared successful at ≥ 85% mastery by end of Cycle 2.

These data demonstrate that Cycle 1 interventions produced sub-threshold mastery 52% and 68% in Sessions 1 and 2 respectively indicating that initial BBL techniques, while directionally positive, were insufficient to meet the 85% criterion. Following Cycle 1 reflection and action step revision (extended brain gym duration; enhanced kinaesthetic roleplay modelling), Cycle 2 produced a substantial breakthrough: mastery reached 88% in Session 3 and 96% in Session 4. The most notable finding is the magnitude of inter-cycle gains a 36 percentage point increase from Cycle 1, Session 1 to Cycle 2, Session 4 confirming the critical role of the John Elliott reflective revision protocol in optimising BBL implementation.

Table 2. presents mean scores per behavioural indicator across the four sessions. Indicators I6 (Speaks Without Shouting) and I2 (Takes Notes on Key Points) demonstrated the steepest initial deficits, consistent with baseline observations, yet achieved recovery to ≥ 3.50 by Cycle 2 Session 4. The most dramatic improvements were registered in I4 (Courage in Retrying: +2.1 points from baseline), I8 (Avoids Paper Waste: +2.3 points), and I9 (Maintains Writing Tools: +2.4 points)

indicators comprising the Resource Management variable confirming that kinaesthetic simulation and behavioural reflection in Cycle 2 were particularly effective in consolidating self-management behaviours.

**Table 2. Mean Score per Indicator Across Sessions (Scale 0–4)**

Code	Indicator	Baseline	C1-S1	C1-S2	C2-S3	C2-S4
I1	Opens textbook independently	1.80	2.52	2.88	3.48	3.72
I2	Takes notes on key points	1.32	2.00	2.56	3.24	3.60
I3	Reads quietly and attentively	1.64	2.40	2.76	3.36	3.68
I4	Shows courage in retrying	1.16	2.04	2.60	3.32	3.80
I5	Raises hand before speaking	1.52	2.28	2.72	3.40	3.76
I6	Speaks without shouting	1.12	1.88	2.48	3.20	3.56
I7	Sits upright and respectfully	1.60	2.44	2.84	3.44	3.72
I8	Avoids discarding paper wastefully	1.08	1.96	2.52	3.28	3.76
I9	Maintains writing tools	1.04	1.92	2.48	3.32	3.80

Note. C1 = Cycle 1; C2 = Cycle 2; S = Session. Maximum score per indicator = 4.0.

Table 3. presents the convergent validity and reliability results for the three latent variables. All nine indicators yielded outer loadings exceeding 0.70, with the composite reliability (CR) and Cronbach's Alpha ( $\alpha$ ) values for all constructs surpassing the 0.80 threshold (Hair et al., 2021). Average Variance Extracted (AVE) values exceeded 0.50 for all constructs, confirming sufficient convergent validity. These results validate the psychometric quality of the Psychomotor Skills Rubric as a research instrument.

**Table 3. Measurement Model Evaluation: Convergent Validity and Reliability**

Construct / Indicator	Indicator	Outer Loading	AVE	Cronbach's $\alpha$	CR
Compliance & Etiquette	I5	0.821	0.681	0.836	0.865
	I6	0.798			
	I7	0.841			
Academic Engagement	I1	0.808	0.718	0.854	0.884
	I2	0.831			
	I3	0.877			
Resource Management	I4	0.846	0.742	0.874	0.896
	I8	0.869			
	I9	0.862			

Discriminant validity was confirmed through the Fornell-Larcker criterion: the square root of AVE for each construct exceeded its inter-construct correlations. Compliance and Etiquette demonstrated the highest correlation with Academic Engagement ( $r = 0.621$ ), while Academic Engagement and Resource Management showed a strong association ( $r = 0.573$ ), providing initial structural evidence for the proposed causal chain.

Table 4 presents the bootstrapped path coefficients, T-statistics, and p-values for the two structural hypotheses. Both H1 and H2 were supported at the  $p < 0.001$  significance level, confirming the causal chain linking physical compliance to cognitive engagement to self-management behaviour.

**Table 4. Structural Model: Hypothesis Testing Results**

H	$\beta$ Coefficient	t-Statistic	p-value	95% CI	Decision
H1	0.612	5.841	< 0.001	[0.42, 0.79]	Supported
H2	0.534	4.972	< 0.001	[0.35, 0.72]	Supported

**Table 5. Coefficient of Determination (R<sup>2</sup>) for Endogenous Variables**

Endogenous Variable	R <sup>2</sup>	Adjusted R <sup>2</sup>	Interpretation
Academic Engagement	0.375	0.349	Substantial
Resource Management	0.285	0.256	Moderate-Substantial

Note. R<sup>2</sup> thresholds: > 0.25 = substantial; 0.10–0.25 = moderate; < 0.10 = weak (Hair et al., 2021).

The R<sup>2</sup> value for Academic Engagement (0.375) indicates that Compliance and Etiquette explains 37.5% of variance in cognitive engagement—a substantial effect substantiating H1. The R<sup>2</sup> for Resource Management (0.285) confirms H2, with Academic Engagement explaining 28.5% of self-management variance. The remaining variance is attributable to external variables beyond the scope of this CAR protocol (e.g., parenting practices, nutritional status, peer social environment), consistent with the acknowledged limitations of single-site action research.

## Discussion

The progression from a pre-cycle mastery baseline of 36% to 96% at Cycle 2 Session 4 constitutes robust empirical evidence for the efficacy of the John Elliott BBL implementation model within Grade IV IRE-CE instruction. This finding is consistent with the results of Rahmawati et al., (2021), who reported significant improvement in mathematical reasoning following BBL implementation among Grade IV MI students, suggesting cross-domain generalisability of BBL principles at the Phase B developmental stage. It similarly aligns with Dwiputra et al. (2023) Southeast Asian meta-analysis, which confirmed that structured physical regulation within classroom environments functions as a neurological foundation for sustained attention, directly validating the Cross Crawl and relaxed alertness techniques employed in this study.

The mechanism underpinning these gains, framed through Jensen and McConchie's (2008) and Lagoudakis et al., (2023) BBL theory, operates at the neurophysiological level like orchestrated brain gym exercises and classical music stimulation prevent amygdala hijacking, the acute stress response that redirects blood flow away from the prefrontal cortex. By maintaining students in a state of relaxed alertness, the interventions optimised prefrontal cortex function, enabling the executive processing required for self-directed behaviour. This neurological explanation distinguishes the current findings from conventional CAR studies that report improvements without mechanistic grounding, and represents a notable theoretical contribution to the character education literature.

The confirmation of H1 ( $\beta = 0.612$ ,  $p < 0.001$ ) challenges prevalent assumptions within progressive education paradigms that position physical compliance as an infringement on children's autonomy. Contrary to this view and in alignment with Syahrani & Santoso (2022) concept of Behavioural Scaffolding, the present data demonstrate that for children aged 8–10 years

(Phase B), behavioural structure functions as an external scaffold that is progressively internalised as self-regulatory competence. Students who consistently demonstrated orderly posture, hand-raising, and volume-controlled speech subsequently showed significantly higher cognitive engagement, as indexed by note-taking frequency and attentive reading behaviours.

This finding resonates with the theory of Embodied Cognition, which posits that cognitive processes are not disembodied from the physical body. Upright posture and coordinated movement (brain gym) neurophysiologically enhance cerebral oxygen flow, directly supporting the concentrative capacity necessary for academic engagement. Unlike prior studies (Azizah & Herwani, 2026; Rachmawati et al., 2022) that inferred such relationships descriptively, the quantified path coefficient ( $\beta = 0.61$ ) in this study provides a precision estimate of this gateway effect that has not previously appeared in the Indonesian elementary CAR literature.

The validation of H2 ( $\beta = 0.534$ ,  $p < 0.001$ ) confirms Self-Regulated Learning theory (Zimmerman, 1990; Muharam et al., 2025) within the specific context of IRE-CE character education. The finding that Academic Engagement causally predicts Resource Management operationalises Zimmerman's metacognitive monitoring cycle, the process by which active cognitive involvement generates metacognitive awareness that is subsequently translated into self-regulatory behaviour. When students engaged in quiet reading and note-taking, they were not only acquiring content knowledge but simultaneously constructing the cognitive architecture for self-governance.

The most substantive expression of this mechanism was observed in Transmediation (Suhor, 1984; Peña & James, 2024 Agustina et al., 2025)-based kinaesthetic activities during Cycle 2: the act of physically enacting frugality through poster creation from recycled materials transformed an abstract IRE-CE value into embodied experience. This somatic encoding produced significant gains in I8 and I9 (Resource Management) indicators findings that support Suhor's foundational claim that meaning transduction across semiotic systems generates deeper internalisation than unimodal textual approaches. This linkage between transmediation theory and observable behavioural outcomes in character education represents a novel contribution not previously documented in the primary education literature.

The methodological contribution of this study the first documented integration of PLS-SEM into an Indonesian Classroom Action Research design merits extended discussion. Syahrani & Santoso (2022) critiqued the preponderance of anecdotal reporting in CAR, noting that subjective observation bias systematically inflates perceived intervention effectiveness. The outer model results reported herein outer loadings ranging from 0.798 to 0.877, AVE values of 0.681–0.742, and inter-rater reliability of  $\kappa = 0.82$  demonstrate that with appropriate instrument design, classroom behavioural observation can yield psychometric data of a quality comparable to that obtained through validated questionnaire-based research instruments.

The application of bootstrapping for significance testing addresses a critical limitation of conventional small-sample CAR: the inability to draw inferential conclusions from  $N = 25$  participants under standard parametric assumptions. Bootstrapping's non-parametric resampling approach circumvents this limitation and generates confidence intervals that quantify the precision

of path estimates a transparency standard that aligns with Hair et al.'s (2021) criteria for rigorous PLS-SEM reporting. This methodological protocol is positioned as a replicable standard for elevating the evidential quality of CAR research in Indonesia toward international publication norms.

Within the policy framework of Merdeka Curriculum and the Pancasila Student Profile, these findings carry three dimensions of implication. Theoretically, the study demonstrates that the Independent Dimension is not an abstract philosophical construct but a measurable, developmentally structured sequence of micro-behavioural capabilities operationalised through nine observable indicators providing an evidence base for the operationalisation of character assessment within the Kurikulum Merdeka framework. Practically, the BBL techniques validated here brain gym, classical music, kinaesthetic roleplay, and structured relaxed alertness require no specialised technology or additional budgetary allocation, positioning them as immediately deployable innovations for IRE-CE educators across Indonesia's elementary school system. For policy-makers, the study offers a case for integrating neuroscientific principles into official guidance for Pancasila Student Profile implementation, and for developing standardised micro-behavioural assessment instruments as supplements to existing portfolio-based character assessment.

Several limitations of this study must be transparently acknowledged. First, the single-site sample ( $N = 25$ , SDN 1 Dadakitan) constrains generalisability; replication studies across geographically and demographically diverse sites are required. Second, the four-session intervention duration is insufficient to assess long-term character retention; longitudinal follow-up measurements at 6 and 12 months post-intervention would strengthen causal claims about sustained character development. Third,  $R^2$  values of 0.285–0.375 indicate that 62–72% of variance in the endogenous variables is attributable to factors beyond this study's scope—including parenting practices, nutritional status, and peer social dynamics. Future research integrating mixed-methods approaches incorporating parent interviews and home environment observations would provide a more comprehensive explanatory model. Fourth, the contextual specificity of IRE-CE necessitates replication across other subject domains (Mathematics, Natural Sciences, Bahasa Indonesia) to assess the transferability of BBL's character-development effects to other dimensions of the Pancasila Student Profile (Critical Thinking, Creative, Collaborative).

## CONCLUSION

This John Elliott model Classroom Action Research (CAR) investigated the implementation of Brain-Based Learning (BBL) to strengthen the Independent Dimension of the Pancasila Student Profile in Grade IV Islamic Religious and Character Education at SDN 1 Dadakitan, Tolitoli. Involving 25 students across two cycles, classical mastery of the Compliance & Etiquette, Academic Engagement, and Resource Management variables significantly increased from 36% to 96%, exceeding the 85% target.

PLS-SEM analysis confirmed strong causal relationships: Compliance & Etiquette predicted Academic Engagement, which in turn predicted Resource Management. These findings

demonstrate that physical discipline is not a barrier to autonomy, but rather a neurological foundation for its development.

Theoretically, this study integrates BBL, Self-Regulated Learning, and Transmediation into a new conceptual model where physical compliance acts as a gateway to student autonomy. Methodologically, it pioneers the integration of PLS-SEM within Indonesian CAR, offering a replicable protocol to elevate the standards and rigor of classroom research.

Practically, the BBL protocol—encompassing Cross Crawl brain gym, classical music accompaniment, and kinesthetic roleplay and simulations—is validated as a ready-to-deploy, low-cost instructional framework. Future recommendations include multi-site replication studies and longitudinal observations. Ultimately, character formation is not merely a normative transmission process, but a neurologically optimizable phenomenon through pedagogical innovation.

## REFERENCES

- Agustina, A., BK, M. K. U., & Mustakim, M. (2025). Peningkatan Hasil Belajar Matematika Melalui Penggunaan *Worksheet* Bermuatan Numerasi Edukasi Dengan Memanfaatkan Media Gambar Bergerak di SDN 3 Tolitoli. *PHI: Jurnal Pendidikan Matematika*, 9(1), 124-131. <http://dx.doi.org/10.33087/phi.v9i1.466>
- Aini, N., Amalia, F., & Ningrum, A. S. B. (2022). Improving Students' Speaking Skill Using Hello English Application as a Medium of Learning from Home. *IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature*, 10(1), 730-745. <https://doi.org/10.24256/ideas.v10i1.2533>
- Azizah, N., & Herwani, S. (2026). The Implementation of the Brain Based Learning Model With the Phonics Method Assisted By Flash Card on The Beginning Reading Ability of Grade 1 Students At Mi NU Tarbiyatul Islam. *Al-Ashr : Jurnal Pendidikan Dan Pembelajaran Dasar*, 11(1), 160–178. <https://doi.org/10.56013/alashr.v11i1.5431>
- Caine, R. N., & Caine, G. (1991). *Making connections: Teaching and the human brain*. Association for Supervision and Curriculum Development.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications. Los Angeles.
- Dwiputra, D. F. K., Azzahra, W., & Heryanto, F. N. (2023). A systematic literature review on enhancing the success of independent curriculum through brain-based learning innovation implementation. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, 262-276. <https://doi.org/10.23917/ijolae.v5i3.22318>
- Elliott, J. (1991). *Action research for educational change*. Open University Press. Buckingham.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage Publications. <https://doi.org/10.1007/978-3-030-80519-7>
- Hilmi, N., & Prastowo, A. (2023). Use of Educandy in improving science learning outcomes in elementary schools. *Jurnal Tarbiyah*, 30(1), 1-12. <http://dx.doi.org/10.30829/tar.v30i1.2519>

- Jensen, E., & McConchie, L. (2008). *Brain-based learning: The new paradigm of teaching* (2nd ed.). Corwin Press. London.
- Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. (2022). *Dimensi, elemen, dan subelemen Profil Pelajar Pancasila pada Kurikulum Merdeka*. Badan Standar, Kurikulum, dan Asesmen Pendidikan Kemendikbudristek RI.
- Lagoudakis, N., Vlachos, F., Christidou, V., & Vavougiou, D. (2022). The effectiveness of a teaching approach using brain-based learning elements on students' performance in a Biology course. *Cogent Education*, 9(1), <https://doi.org/10.1080/2331186X.2022.2158672>.
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174. <https://doi.org/10.2307/2529310>
- Lan, M., & Zhou, X. (2025). A qualitative systematic review on AI empowered self-regulated learning in higher education. *npj Science of Learning*, 10(1), 21. <https://doi.org/10.1038/s41539-025-00319-0>
- Muharam, A. G., Mustakim, M., & BK, M. K. U. (2025). Analisis Efektivitas Pengadaptasian Keterampilan Pembelajaran Abad 21 Berbasis 4C *Skill* dalam Pengimplementasian Kurikulum Merdeka Belajar di Kelas 5 SDN 7 Tolitoli. *Jurnal Ilmiah Pendidikan Dasar (JIPDAS)*, 5(3), 2510–2521. <https://doi.org/10.37081/jipdas.v5i3.3013>
- Mustakim, M., Abrar, A. M., Amelia, A., & Sagita, T. (2024). Upaya Meningkatkan Skill Membaca Siswa Menggunakan Media Ajar yang Menimbulkan Interaktif antara Siswa dan Guru di SDN 26 Tolitoli. *Paradigma: Jurnal Filsafat, Sains, Teknologi, dan Sosial Budaya*, 30(4), 95-101. <https://doi.org/10.33503/paradigma.v30i4.656>
- Mustakim & Rahim, A. (2024). Supervised Machine Learning for Prediction of Minimum Completeness Criteria (KKM) Scores for Elementary School Students. *Jurnal Penelitian Pendidikan IPA*, 10(11), 9216–9225. <https://doi.org/10.29303/jppipa.v10i11.9258>
- Peña, E., & James, K. (2024). A framework of transmediation. *Convergence*, 30(5), 1610–1624. <https://doi.org/10.1177/13548565231220325>
- Rachmawati, N. A. M., Nafiah, M., & Nurashah, I. (2022). Proyek penguatan Profil Pelajar Pancasila dalam implementasi kurikulum prototipe di sekolah penggerak jenjang sekolah dasar. *Jurnal Basicedu*, 6 (3), 3613–3625. <https://doi.org/10.31004/basicedu.v6i3.2714>
- Rahim, A., & Mustakim, M. (2025). Peningkatan Akurasi Model Untuk Prediksi KKM Siswa Sekolah Dasar Menggunakan Supervised Machine Learning dengan Integrasi Faktor Internal dan Eksternal. *Euler: Jurnal Ilmiah Matematika, Sains dan Teknologi*, 13(3), 372-380. <https://doi.org/10.37905/euler.v13i3.34577>
- Rahmawati, N., Rochmad, R., & Isnarto, I. (2021). Penerapan Model Brain Based Learning Terhadap Penalaran Matematis Ditinjau Dari Komunikasi Matematika. *PRISMA, Prosiding Seminar Nasional Matematika*, 4, 386-392. <https://journal.unnes.ac.id/sju/prisma/article/view/45007>
- Ringle, C. M., Wende, S., & Becker, J. M. (2022). *SmartPLS 4*. SmartPLS. <https://www.smartpls.com>

- Syahriani, N., & Santoso, S. (2024). Karakteristik perkembangan anak usia sekolah dasar dan implikasinya dalam pembelajaran. *JRPD (Jurnal Riset Pendidikan Dasar)*, 7(2), 131-140. <https://doi.org/10.26618/jrpd.v7i2.14995>
- Suhor, C. (1984). Towards a semiotics-based curriculum. *Journal of Curriculum Studies*, 16(3), 247–257. <https://doi.org/10.1080/0022027840160304>
- UNESCO. (2021). When schools shut: Gendered impacts of COVID-19 school closures. UNESCO Publishing. <https://unesdoc.unesco.org>
- Więckowska, B., Kubiak, K. B., Józwiak, P., Moryson, W., & Stawińska-Witoszyńska, B. (2022). Cohen's Kappa Coefficient as a Measure to Assess Classification Improvement following the Addition of a New Marker to a Regression Model. *International Journal of Environmental Research and Public Health*, 19(16), 10213. <https://doi.org/10.3390/ijerph191610213>
- Wang, D., & Wang, P. (2024). Effect of employee resilience on organizational resilience in construction projects: considering the role of project tasks. *Engineering, Construction and Architectural Management*, 31(11), 4236-4254. <https://doi.org/10.1108/ECAM-08-2022-0797>
- Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25(1), 3–17. [https://doi.org/10.1207/s15326985ep2501\\_2](https://doi.org/10.1207/s15326985ep2501_2)