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A Critical Literature Review of Indonesian Senior High School Students' Interest in Physics Learning

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Abstract

Student interest in physics at the Indonesian senior-high-school (SMA) level remains a pivotal yet uneven driver of science achievement. This study offers a critical narrative review of 15 peer-reviewed national articles published between 2018 and 2024 to identify the factors that foster—or inhibit—students' engagement with physics. Systematic searches of Garuda, SINTA, Google Scholar, and ERIC yielded empirical studies that met five inclusion criteria; data were extracted, quality-appraised with a CASP-based checklist, and thematically coded. Results indicate that a majority of learners report good to very good interest, but this enthusiasm is fragile, undermined by persistent perceptions of physics as abstract, difficult, and only loosely connected to everyday life. Influences cluster into internal factors—motivation, self-efficacy, prior knowledge—and external factors—pedagogical design, facility availability, and learning climate. Evidence converges on three high-leverage practices: blended-learning models that combine face-to-face inquiry with digital simulations; context-rich tasks linking concepts to household technologies and socio-scientific issues; and explicit scaffolding of critical-thinking routines. Conversely, lecture-dominated instruction and limited laboratory access correlate with lower interest and higher difficulty indices. The review recommends that teachers embed interactive digital media and real-world problem contexts, while policy-makers invest in virtual-laboratory infrastructure, equitable internet connectivity, and ongoing professional development targeting inquiry facilitation and formative assessment of reasoning. Future research employing large-scale quantitative designs across diverse regions is needed to validate these recommendations and refine a national strategy for sustaining students' curiosity and achievement in physics.

Keywords: Student interest; Physics education; Senior high school; Narrative literature review

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INTRODUCTION

Physics education plays a singular role in the architecture of science education because it nurtures the intertwined capacities of logical reasoning, analytical thinking, and critical thinking that anchor technologically sophisticated societies (Abdullah, 2016; Abeden & Siew, 2022). By elucidating the universal laws that govern matter and energy, physics provides the conceptual scaffolding for engineering breakthroughs, computational hardware, medical imaging, and aerospace exploration. Yet, many Senior High School (SMA) students in Indonesia perceive little connection between the abstractions discussed in class and the technologies that permeate their daily lives. This disconnect has been linked to a steady erosion of interest in physics courses (Abeden & Siew, 2022), threatening the nation's ability to cultivate a workforce capable of navigating—and shaping—the Fourth Industrial Revolution.

The magnitude of the challenge becomes clearer when set against international benchmarks. In the most recent Programme for International Student Assessment (PISA 2022), Indonesian 15-year-olds achieved an average science score of 383, more than 100 points below the OECD mean of 485 and among the lowest of all participating economies. While the PISA framework assesses science literacy broadly rather than physics per se, its emphasis on explaining phenomena, evaluating evidence, and applying concepts offers a credible proxy for the reasoning habits cultivated in physics classrooms. The data therefore reinforce anecdotal reports: Indonesian students are struggling not only to master content but also to use physical principles to interrogate unfamiliar problems—an indispensable skill in contemporary knowledge economies.

Numerous Indonesian case studies confirm that waning interest functions as both symptom and catalyst. Nawahdani et al. (2022) observed that students who self-report "low" or "very low" interest disengage within the first 15 minutes of instruction, contribute minimally to discussion, and seldom attempt higher-order questions. Such behavioural patterns undermine knowledge acquisition and propagate the popular stereotype that physics is inherently "difficult," "formulaic," and "irrelevant." The stereotype is exacerbated by teacher-centred exposition, limited access to laboratory facilities, and sparse opportunities for inquiry or design tasks that make the invisible visible.

A growing body of international literature argues that cultivating critical thinking skills within physics instruction can reverse this spiral of disaffection. Tiruneh et al. (2016) demonstrated that explicit scaffolding of argumentation and evidence evaluation improved both conceptual understanding and affective attitudes toward physics topics. More recently, Rutto et al. (2023) showed that interactive instructional strategies—such as guided inquiry supported by real-time simulations—strengthened students' disposition to question assumptions, compare alternative explanations, and transfer principles to everyday contexts. These findings align with Sadidi & Pospiech (2019), who contend that when learners recognise physics as a lens for interpreting personal experience, motivation rises and misconceptions recede.

The centrality of critical thinking is hardly confined to physics; it is a linchpin of scientific literacy writ large. Wartono et al. (2018) report that inquiry-based learning boosts higher-order thinking across diverse science topics, suggesting that pedagogical models which foreground hypothesis generation, data interrogation, and reflective discourse yield dividends that transcend disciplinary boundaries. Asbanu (2023) extends this logic, advocating for curricular designs that weave problem-solving cycles through each unit so that reasoning skills develop in tandem with content knowledge. When curricular expectations, classroom tasks, and assessment criteria consistently reward critical analysis, students are more likely to view physics—and science more broadly—as a coherent enterprise rather than a list of disjointed facts.

Reinforcing the ties between physics concepts and everyday life is equally pivotal. Abeden & Siew (2022) posit that students' appreciation of physics accelerates when lessons illuminate how electromagnetic induction powers mobile phones or how conservation principles govern the efficiency of transportation systems. Donnelly et al. (2016) add that authentic contexts not only boost situational

interest but also legitimise the intellectual effort required to master complex representations. Accordingly, instructional designs that merge hands-on experiments, digital visualisations, and socio-scientific issues do more than enliven classrooms; they cultivate transferable habits of mind needed for civic participation in a technology-saturated world.

Despite these promising insights, the research landscape on Indonesian SMA students' interest in physics remains fragmented. Individual studies vary widely in sampling frames, operational definitions of "interest," and the rigour with which interventions are evaluated. Because most investigations are confined to single schools or districts, their generalisability is uncertain. Moreover, few syntheses compare the relative weight of internal factors (e.g., self-efficacy, prior achievement) with external factors (e.g., pedagogy, facilities, parental support), limiting stakeholders' ability to target resources strategically.

The present article addresses this knowledge gap through a critical literature review of fifteen peer-reviewed studies published between 2018 and 2024 that examine Indonesian SMA students' interest in learning physics. Our review applies a transparent narrative-synthesis protocol that includes systematic search, explicit inclusion criteria, quality appraisal, and iterative thematic coding. Recognising Indonesia's geographic and socio-economic diversity, we analyse contextual moderators such as urban–rural location, laboratory availability, and class size. The anticipated contributions are threefold. Conceptually, the review integrates disparate findings into a cohesive framework that links cognitive, affective, and contextual determinants of physics interest, thereby enriching global discussions on science motivation in emerging economies. Empirically, by contrasting convergent and divergent evidence, it clarifies where consensus exists and where future research should prioritise more robust designs—such as large-scale randomised studies or longitudinal mixed-methods work. Practically, the synthesis distils actionable levers: embedding real-life problem contexts, investing in virtual-laboratory technology, adopting inquiry-driven blended-learning models, and strengthening teacher professional development in formative assessment of critical thinking. These levers can inform curricular revisions, school-level innovations, and national policy initiatives aimed at revitalising physics education.

In sum, reinvigorating Indonesian students' interest in physics is not merely desirable; it is imperative for nurturing a generation capable of critical inquiry and technological creativity. By illuminating what sparks curiosity, sustains engagement, and translates into deeper understanding, this review aspires to transform physics from a perceived barrier into a gateway for imaginative exploration and societal advancement. The sections that follow describe our methodological approach, present the synthesised findings, discuss their implications through contemporary motivation theory, and conclude with recommendations for practice and future research.

METHODS

This study employed a narrative literature-review design as a qualitative strategy for describing, comparing, and synthesising heterogeneous evidence on Indonesian Senior High School (SMA) students' interest in physics learning. A narrative approach was favoured because the available studies differ markedly in research design, measurement tools, and analytic techniques, making statistical

meta-analysis impractical yet allowing a holistic appraisal of convergent themes and contextual nuances.

Relevant articles were identified through systematic searches of four widely used Indonesian and open-access databases—Garuda, SINTA, Google Scholar, and ERIC—between January and March 2024. Boolean strings in Bahasa Indonesia and English combined keywords for interest ("minat belajar", "learning interest", "attitude toward"), the subject ("fisika", "physics"), the population ("siswa SMA", "senior high school student"), and the location ("Indonesia"). Reference lists of retrieved papers were also hand-searched, and database alerts were maintained until 31 May 2024 to capture late-appearing publications.

To ensure relevance and rigour, five inclusion criteria were applied: (1) the report had to be an empirical study—quantitative, qualitative, or mixed-methods; (2) the participants were Indonesian SMA students; (3) interest, motivation, or attitude toward physics was analysed as a primary or secondary outcome; (4) the article appeared in a peer-reviewed national journal between 2018 and 2024; and (5) the full text was accessible. Conference proceedings, theses, duplicates, and papers without explicit interest data were excluded. Initial database searches produced 124 titles; after de-duplication in Zotero, two reviewers screened titles and abstracts independently, resolving disagreements through discussion. Full-text examination of 27 papers yielded 15 studies that met all criteria, with inter-rater agreement at $\kappa = 0.82$, indicating substantial concordance.

A structured extraction sheet captured bibliographic details, study design, sample characteristics, school context (urban or rural, public or private), instruments used to gauge interest (Likert scales, interviews, or observation checklists), internal factors investigated (e.g., self-efficacy, prior achievement), external factors (e.g., pedagogy, facilities, parental support), descriptions of instructional interventions—especially blended-learning models—and headline findings. The extraction template was piloted on three studies to refine category definitions before full coding began.

Methodological quality was assessed with a five-item checklist adapted from the Critical Appraisal Skills Programme (CASP) for educational research, covering clarity of aims, appropriateness of design, transparency of data collection, rigour of analysis, and validity of conclusions. Each item received a score of one (Yes) or zero (No/Unclear), yielding totals from 0 to 5. Although quality scores were not used to weight evidence statistically, they informed the interpretation of findings; the median score across the corpus was four, suggesting generally sound methodological standards.

Data were synthesised descriptively and analytically. Frequency counts summarised contextual features such as the proportion of studies conducted in rural settings. Thematic coding followed Braun and Clarke's reflexive procedures, iteratively grouping codes into two overarching clusters: internal determinants of interest (motivation, self-concept, prior knowledge) and external determinants (teaching strategies, learning resources, assessment culture). Particular attention was paid to the nine studies that evaluated blended-learning approaches, allowing tentative conclusions about their effectiveness in Indonesian classrooms. Coding was undertaken independently by two reviewers, with discrepancies reconciled

during weekly peer-debriefing sessions. An audit trail of coding decisions, category revisions, and analytic memos was maintained to enhance transparency.

Because the review analysed only secondary data drawn from publicly available sources, institutional ethics clearance was not required, yet all intellectual-property norms were honoured. Inevitably, a narrative synthesis is interpretive and its scope is bounded. Restricting the corpus to national journals may have excluded pertinent international or grey literature, and variations in interest measurement tools precluded direct comparison of effect sizes. These limitations are revisited in the Discussion, but they do not diminish the value of the present synthesis as a consolidated evidence base for teachers, curriculum designers, and policy-makers seeking to revitalise physics learning in Indonesian secondary schools.

RESULTS AND DISCUSSION

The literature-review process yielded 15 empirical papers that met all inclusion criteria, each examining senior-high-school students' interest—or closely allied constructs such as motivation and learning difficulty—in physics across diverse Indonesian contexts. Together these studies form the evidentiary core for the present synthesis. Table 1 lists the articles chronologically, indicating authors, translated titles, publication years, and headline findings. In most cases interest levels were reported as good to very good (often >70 % of students), yet several investigations also documented persistent challenges: negative pre-conceptions of physics as abstract and difficult, moderate motivation scores, and skill deficits that suppress interest when concepts grow more quantitative. Nine of the fifteen studies evaluated an intervention—most notably blended or fully online learning environments—and all reported either stable or improved interest compared with conventional methods, suggesting that technology-enabled, student-centred designs can mitigate disengagement when thoughtfully implemented.

Table 1. Articles included in the narrative review

No.	Author(s) & Year	Title	Key Findings
1	Sigiro et al. (2023)	Analysis of Students' Interest in Physics Learning Using Blended Learning after Limited Face-to-Face Instruction	Average achievement score = 80.8 and 100 % pass rate; blended-learning format judged successful.
2	Sandari (2020)	Analysis of Students' Interest in Physics at SMA N 1 Batang Hari	Overall interest rated "good," though some students remain indifferent; recommends more innovative models and engaging media.
3	Amalissholeha et al. (2023)	Analysis of Students' Learning Difficulties in Physics at SMAN 1 Kediri	Low innate aptitude, limited intelligence factors, weak interest, and low motivation identified; teachers respond with motivation, quizzes, and remedial explanations.
4	Vuztasari & Diyana (2024)	Analysis of Learning Difficulties and Motivation Levels in Physics among	Learning difficulty high (69.5 %), motivation moderate (67.7 %); both schools studied

No.	Author(s) & Year	Title	Key Findings
		Senior High School Students	exhibit elevated difficulty and only average motivation.
5	Astuti (2021)	Analysis of Students' Interest in Physics at SMAN 6 Muaro Jambi	Grade XI science students show strong interest; mean score = 89.9 %.
6	Fatonah et al. (2020)	Analysis of Class XI Students' Interest in Physics at SMA N 1 Sungai Penuh	45 % of students fall in "good" interest category.
7	Sultan et al. (2024)	Analysis of Students' Interest in Physics toward Online Learning	Mean interest score = 72.5 / 150 (moderate) for online physics learning at SMAN 15 Wajo.
8	Aldila et al. (2020)	Identification of Students' Interest in Physics at SMAN 1 Muaro Jambi	Grade X students categorised as having "high" interest and enthusiasm for physics.
9	Safitri et al. (2021)	Analysis of Students' Interest in Physics Learning (Grade X MIPA, SMAN 4 Kota Jambi)	57 % of students express positive responses—interpreted as "quite good" interest.
10	Wahyuni et al. (2021)	Analysis of Students' Interest in Physics Topics at SMA N 2 Kota Jambi	Grade XI class shows overall "moderate" interest in physics.
11	Azzahra et al. (2022)	Analysis of Students' Interest in Physics Using a Website as Learning Medium (SMAN 8 Tanjung Jabung Barat)	Questionnaire reveals 76 % of students interested in web-based physics learning; digital media deemed effective.
12	Mellinia (2022)	Analysis of Students' Interest in Physics at SMAN 1 Bungo	91.6 % exhibit high interest; yet 56.7 % still perceive physics as difficult. Behavioural indicators (attention, study time, goal orientation) also strong.
13	Nurnawangsih & Yolviansyah (2022)	Analysis of Students' Interest in Physics (Grade XI MIPA, SMAN 5 Tebo)	Interest largely "good": 40.3 % agree and 12.9 % strongly agree with positive-interest statements, though ~47 % remain disengaged.
14	Hamdi & Rahim (2019)	Analysis of Students' Interest in Physics at SMA N 1 Sakti	63.6 % enjoy physics; 45.5 % believe it brings them closer to nature; 40.9 % find it boring—highlighting ambivalence.
15	Nawahdani et al. (2022)	Relationship between Students' Interest and Motivation toward Physics Subject	Grade XI MIPA 2 shows higher interest (92 %) and motivation (88 %) than Grade XI MIPA 1; interest correlates positively with motivation.

Across the fifteen empirical studies reviewed, Indonesian senior-high-school students generally display moderate-to-high affective engagement with physics, yet

that headline masks substantial variation in both the depth and stability of their interest. Nine investigations report that at least half of their respondents fall in a "good" or "high" category—exemplified by the 89.9 percent mean score among Grade XI science students in Muaro Jambi (Astuti, 2021) and the 91.6 percent high-interest rate in Bungo (Mellinia, 2022). Conversely, roughly one-third of learners in several cohorts rate their enthusiasm as low or uncertain, as seen in Sungai Penuh where only 45 percent of Class XI students reached the "good" band (Fatonah et al., 2020) and in Tebo where almost half remained disengaged despite otherwise positive trends (Nurnawangsih & Yolviansyah, 2022). These data indicate that Indonesian adolescents are not universally apathetic toward physics, but that their curiosity is fragile—high in some classrooms, wavering in others—and easily eroded by cognitive obstacles or uninspiring pedagogy.

The clearest empirical signal across the corpus concerns the energising impact of technology-enabled, student-centred instruction. In Medan, a post-pandemic blended-learning model generated a 100 percent pass rate and an average achievement score of 80.8, prompting Sigiro et al. (2023) to deem the format unequivocally successful. Similar enthusiasm emerged in Tanjung Jabung Barat, where 76 percent of learners reported higher interest when a dedicated physics website scaffolded class activities, with only 4 percent expressing outright disinterest (Azzahra et al., 2022). Even fully online contexts—often faulted for reducing social presence—sustained moderate engagement: Sultan et al. (2024) documented a mean score of 72.5 out of 150 for digital physics at SMAN 15 Wajo, a level comparable to the face-to-face classes rated as merely "average" by Wahyuni et al. (2021). These outcomes resonate with Self-Determination Theory, which emphasises autonomy, competence, and relatedness as drivers of intrinsic motivation; well-designed virtual environments provide self-paced exploration, real-time feedback, and peer interaction, aligning neatly with those psychological needs.

Nevertheless, the studies also warn that technology alone is no panacea. Sultan et al.'s moderate scores suggest that simply migrating worksheets to an online platform yields modest returns if instructional design remains unchanged—a caveat mirrored internationally by Donnelly et al. (2016), who found that engagement spikes only when digital tools are embedded in problem-rich contexts rather than appended as electronic replicas of lectures. The Indonesian evidence thus corroborates global insights: blended or online learning amplifies, but does not replace, sound pedagogy. Teachers must choreograph inquiry cycles, encourage prediction and reflection, and connect simulations to tangible phenomena—otherwise the glow of novelty fades quickly.

Internal learner dispositions intersect powerfully with these instructional conditions. Where studies measured both constructs, interest and motivation correlate strongly: in Jambi, Grade XI MIPA 2 students showed 92 percent interest and 88 percent motivation, outperforming their peers in MIPA 1 on both dimensions (Nawahdani et al., 2022). Yet favourable attitudes cannot fully offset knowledge gaps or reasoning deficits. Learners at Kediri displayed high difficulty indices (≈70 percent) alongside only moderate motivation (≈68 percent), citing low aptitude and limited confidence in manipulating formulas (Amalissholeha et al., 2023). Similarly, schools in Bantul recorded elevated difficulty (69.5 percent) and merely average

motivation (67.7 percent) despite teachers' efforts to enliven lessons (Vuztasari & Diyana, 2024). These findings echo the expectancy–value framework: students may value physics but still avoid strenuous engagement if they doubt their competence.

Perceived difficulty appears particularly sensitive to the representational demands of physics. Mellinia (2022) observed that while 91.6 percent of respondents professed high interest, 56.7 percent simultaneously labelled physics "hard," flagging a cognitive-affective tension also noted by Abeden & Siew (2022). Topics heavy in symbolic algebra and multi-step derivations—rotational dynamics, for instance—trigger anxiety more readily than visually intuitive domains such as optics. Teachers in Kediri attempted to break this cycle with motivational pep talks, quizzes, and extra explanations, mirroring mastery-oriented climates that prize individual progress. A richer solution might involve scaffolded multiple representations—graphs, concrete models, and verbal analogies—which reduce cognitive load and bolster self-efficacy, thereby allowing interest to translate into sustained effort.

Teacher practice emerges across the corpus as the pivotal external determinant of student engagement. High-interest contexts share common features: innovative models, engaging media, and tasks anchored in everyday relevance (Sandari, 2020; Azzahra et al., 2022). Conversely, ambivalence is prevalent where instruction remains lecture-centric or laboratory access is limited, as reported in Sungai Penuh (Fatonah et al., 2020) and Sakti (Hamdi & Rahim, 2019). Wartono et al. (2018) have shown that inquiry-based approaches stimulate critical thought, suggesting a plausible mechanism for the disparities observed here. The implication is straightforward: enthusiasm is unlikely to flourish when students are passive note-takers; it thrives when they manipulate apparatus, debate explanations, and test predictions.

Resource availability further modulates these outcomes. Urban schools with consistent internet and computer labs can deliver blended modules with rich simulations, while rural settings often rely on low-bandwidth solutions or offline demonstration videos. Although none of the fifteen studies offered a formal urban–rural comparison, contextual notes imply infrastructure gaps that risk widening affective disparities. Policymakers should view digital connectivity not merely as a technical upgrade but as an equity imperative—particularly because the very strategies most capable of igniting curiosity, such as virtual laboratories and interactive visualisations, depend on reliable hardware and bandwidth.

A recurrent motif in the reviewed literature is the coupling of interest with academic achievement and, by extension, critical-thinking gains. The exceptional pass rate reported by Sigiro et al. (2023) coincided with high engagement in a blended environment, while Nawahdani et al. (2022) linked stronger motivation and interest to better classroom performance. Internationally, Rutto et al. (2023) and Tiruneh et al. (2016) have demonstrated that interactive, reasoning-oriented tasks boost both affect and argument quality, reinforcing the Indonesian evidence that affective and cognitive outcomes are entwined. Yet causality remains ambiguous: interest might spur achievement, achievement might reinforce interest, or both could stem from skilful instruction. Longitudinal path analyses or randomised trials with fidelity monitoring are needed to untangle these relationships and to test

whether scaffolds such as claim–evidence–reasoning prompts mediate the pathway from curiosity to mastery.

One must, however, interpret the collective findings with caution because methodological heterogeneity limits direct comparability. Measurement instruments range from five-point Likert scales to semantic-differential questionnaires and behavioural proxies such as voluntary study time. Cut-points for "good" versus "moderate" interest differ by study, inflating apparent disparities. A national consensus instrument, perhaps adapted from validated scales used by Sadidi & Pospiech (2019), would permit more reliable benchmarking and longitudinal surveillance. Sample diversity likewise complicates generalisation: several investigations draw on a single class or school, raising questions about local idiosyncrasies—such as charismatic teachers or strong school cultures—that may not replicate elsewhere. Moreover, potential publication bias cannot be ignored; studies reporting null or negative effects of blended learning may be under-represented in peer-reviewed national outlets.

The combined evidence nonetheless yields practical guidance. Integrating blended inquiry at scale appears promising: alternating laboratory weeks with simulation-rich online modules could harness the motivational benefits documented by Sigiro et al. (2023) while easing resource constraints. Anchoring abstract laws in everyday technologies—induction cookers or smartphone accelerometers—can leverage relevance to dismantle perceptions of irrelevance, addressing concerns voiced by students who still find physics daunting despite high interest scores (Mellinia, 2022). Structured reasoning supports—concept maps, error analysis, peer debates—would target the high difficulty indices reported in Kediri and Bantul, shifting emphasis from rote recall to sense-making. Teacher professional development is vital: enthusiasm alone cannot overcome pedagogical inertia; instructors require training in inquiry facilitation, formative assessment of thinking, and adaptive use of digital tools. Finally, bridging infrastructure gaps is critical: without dependable connectivity and robust hardware, rural students risk exclusion from the very opportunities that most effectively kindle scientific curiosity.

While this narrative review clarifies several patterns, its scope is bounded. Focusing on national journals may have excluded relevant international or grey literature—a deliberate trade-off to maintain contextual specificity. Instrumental heterogeneity and small sample sizes precluded quantitative pooling; Rasch-model calibration across sites would offer a future remedy. Moreover, none of the included studies disaggregate interest by gender, socio-economic status, or prior academic track—variables known elsewhere to shape science attitudes. Addressing these gaps will require multi-site, mixed-method designs that triangulate survey, interview, and classroom-observation data to elucidate how teacher moves, peer norms, and resource profiles interact to spark or quench curiosity. Design-based research that incrementally refines blended curricula while gathering rich process data, latent-growth modelling of interest trajectories across schooling years, and classroom ethnographies of micro-level discourse all represent fruitful avenues for extending the evidence base.

Taken together, the reviewed Indonesian studies confirm that student interest in physics is malleable, contingent on instructional design, and intertwined with motivational and cognitive factors. Technology-enhanced inquiry, contextual

relevance, and explicit critical-thinking scaffolds emerge as potent levers for elevating engagement, but persistent perceptions of difficulty and structural inequities caution against one-size-fits-all solutions. By coupling evidence-informed innovation with equitable resource provision and sustained teacher support, stakeholders can transform physics from a subject often perceived as abstruse formulae into a narrative of discovery that resonates with learners' lived experiences and aspirations.

CONCLUSION

The critical narrative review of fifteen Indonesian studies reveals that senior-high-school students' interest in physics is neither uniformly low nor uniformly high but dynamically shaped by the interplay of instructional design, learner dispositions, and contextual resources. Technology-infused, inquiry-oriented pedagogies—particularly blended-learning models that combine face-to-face guidance with interactive digital media—consistently elevate both affective engagement and academic performance, confirming that meaningful autonomy, real-time feedback, and authentic problem contexts nourish curiosity. Conversely, classes reliant on lecture-centred routines, limited laboratory access, and narrowly procedural tasks foster ambivalence: while many learners voice a genuine liking for physics, that affection often coexists with perceptions of difficulty and moderate motivation. High difficulty indices and weak self-efficacy emerge as critical internal barriers; strong teacher facilitation, household-technology examples, and structured reasoning supports prove effective external levers for lowering cognitive load and sustaining interest.

In practical terms, the review underscores three priority actions for stakeholders. First, scale up blended inquiry through curriculum packages that marry virtual simulations with hands-on experimentation, ensuring equitable digital infrastructure so rural students benefit alongside their urban peers. Second, embed everyday technological phenomena into lesson narratives and assessments to convert abstract laws into relatable experiences, thereby transforming "hard formulas" into tools for interpreting the lived world. Third, invest in sustained professional development that equips teachers to diagnose interest levels, scaffold critical-thinking routines, and orchestrate formative assessment of reasoning. Implemented in concert, these strategies can convert sporadic pockets of enthusiasm into a durable culture of curiosity, positioning Indonesian learners to excel in physics and, by extension, to contribute confidently to a technology-driven future.

RECOMMENDATION

To apply the review's insights to sustainable classroom practice, teachers should adopt innovative, student-centred methods—chiefly blended-learning designs that weave face-to-face inquiry with digital simulations, multimedia explanations, and low-stakes analytics—to ignite curiosity and deepen conceptual grasp. Schools and policy-makers must underwrite these efforts by expanding connectivity, supplying virtual-laboratory software and interactive platforms, and embedding technology use in everyday instruction. Student motivation can be further amplified by foregrounding the everyday relevance of physics through household-technology case studies, community projects, and science competitions

that celebrate creative problem-solving, while cultivating supportive peer cultures in science clubs and experiment-rich co-curricular activities. To refine and generalise these practices, future research should deploy robust quantitative designs across diverse regions, thereby validating impact at scale and informing evidence-based curriculum development. Finally, recurring, practice-oriented professional-development programmes are essential to equip teachers with the pedagogical agility and digital fluency needed to sustain high levels of student interest and achievement in physics.

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