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IMPLEMENTATION OF DEEP LEARNING APPROACH IN PHYSICS LEARNING: A MEANINGFUL, MINDFUL, JOYFUL PERSPECTIVE

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ABSTRAK

Penelitian ini dilatarbelakangi oleh kesenjangan antara kebijakan Kurikulum Merdeka yang mengarahkan pembelajaran mendalam dan praktik pembelajaran fisika di lapangan yang masih didominasi metode konvensional, sehingga peserta didik cenderung menjadi pasif. Tujuan penelitian ini yaitu mengidentifikasi pelaksanaan pendekatan *deep learning* dan mendeskripsikan pengalaman belajar peserta didik dalam pembelajaran fisika di SMA Negeri 1 Medan, dengan tiga aspek, yaitu *meaningful, mindful,* dan *joyful learning*. Penelitian ini menggunakan metode kualitatif deskriptif dengan data dari 4 guru fisika dan 24 peserta didik kelas XI yang dikumpulkan melalui observasi kelas, wawancara mendalam, serta dokumentasi perangkat pembelajaran. Data tersebut dianalisis menggunakan triangulasi sumber model Miles dan Huberman, serta segitiga semiotika Peirce untuk memaknai pengalaman belajar peserta didik. Hasil penelitian menunjukkan guru telah melaksanakan 15 indikator *deep learning* meski belum sepenuhnya konsisten; indikator mengaitkan materi dengan kehidupan nyata dan membangun suasana kelas yang interaktif paling konsisten diterapkan, sedangkan integrasi lintas bidang ilmu, menjaga fokus, dan ketekunan terhadap perspektif berbeda masih lemah, salah satunya karena RPP yang digunakan masih bersifat umum dan digunakan bersama oleh beberapa guru. Peserta didik mampu memaknai relevansi fisika dengan kehidupan nyata dan menunjukkan antusiasme tinggi terhadap kegiatan praktik, tetapi masih bersikap dangkal dalam mengaitkan fisika dengan disiplin ilmu lain serta menanggapi pendapat teman secara kritis. Di antara ketiga aspek tersebut, *joyful learning* memberi pengaruh paling kuat terhadap pengalaman belajar peserta didik, diikuti oleh *meaningful learning*, sedangkan *mindful learning* paling lemah. Temuan ini mengindikasikan bahwa pelaksanaan *deep learning* di SMA Negeri 1 Medan masih berada pada tahap berkembang, dengan dimensi konteksual dan interaktif sebagai fondasi yang kuat untuk meningkatkan kedalaman dan pemerataan pengalaman belajar fisika peserta didik.
Kata Kunci: *Deep Learning Approach, Meaningful Learning, Mindful Learning, Joyful Learning, Pembelajaran Fisika*

ABSTRACT

This research is motivated by the gap between the Merdeka Curriculum policy, which emphasizes in-depth learning, and actual physics teaching practices in the field, which remain dominated by conventional methods, thereby making students passive. The purpose of this study is to identify the implementation of the deep learning approach and to describe students' learning experiences in physics at SMA Negeri 1 Medan, with a focus on three aspects: meaningful, mindful, and joyful learning. This research uses a descriptive qualitative method, drawing on data from 4 physics teachers and 24 eleventh-grade students, collected through classroom observations, in-depth interviews, and documentation of learning tools. The data

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were analyzed using source triangulation based on Miles and Huberman's model and Peirce's semiotic triangle to interpret students' learning experiences. The results show that teachers have implemented 15 indicators of deep learning, although not yet fully consistent; the indicators of relating material to real life and creating an interactive classroom atmosphere are most consistently applied, while cross-disciplinary integration, maintaining focus, and perseverance with different perspectives are still weak, partly because the lesson plans used are still general and shared among several teachers. Students can interpret the relevance of physics to real life and show strong enthusiasm for practical activities, but still maintain a superficial approach to connecting physics with other disciplines and to critically responding to peers' opinions. Among the three aspects, joyful learning has the strongest influence on students' learning experiences, followed by meaningful learning, whereas mindful learning has the weakest influence. These findings indicate that the implementation of deep learning at SMA Negeri 1 Medan is still in the developmental stage, with contextual and interactive dimensions serving as a strong foundation for improving the depth and equity of students' physics learning experiences.
Keywords: *Deep Learning Approach, Meaningful Learning, Mindful Learning, Joyful Learning, Physics Learning*

INTRODUCTION

Life in the 21st century demands that every individual master various skills, so the education system needs to prepare students to face global challenges through improving the quality of learning that actively involves students, is personal in nature, and oriented toward deep learning and problem-solving, one of which is through strengthening the 4C competencies (Partono et al., 2021). In line with these demands, the Indonesian government, through Ministerial Regulation of Education, Culture, Research, and Technology (Permendikbudristek) Number 56 of 2022 concerning the Independent Curriculum, establishes a learning policy focused on developing students' competencies and character, providing flexibility to learn and think, and encouraging students to actively and meaningfully build knowledge. One approach aligned with this policy direction is deep learning, which emphasizes meaningful understanding of concepts, the interconnections between concepts, and students' ability to apply knowledge in various life contexts, rather than merely memorizing information (Fitriani & Santiani, 2025). Biggs & Tang (2011) assert that deep learning is achieved when there is harmony among learning objectives, learning activities, and assessments oriented toward meaning, while Hattie & Donoghue (2016) state that deep learning occurs when students integrate, reflect, and apply knowledge to new situations.

The concept of deep learning was first introduced by Marton and Säljö (1976) through phenomenological research at the University of Gothenburg, distinguishing it from surface learning. Surface learning is an approach focused on shallow mastery of information and memorization, characterized by minimal strategies such as memorizing definitions, formulas, or procedures without understanding their interconnections, making the information more easily forgotten because it is not integrated into long-term cognitive structures (Biggs & Tang, 2011). In contrast, deep learning emphasizes understanding the meaning, the connections between concepts, and integrating new knowledge into students' cognitive structures, which occurs when students relate new ideas to previous experiences and knowledge, critically analyze arguments, and seek patterns and relationships among concepts (Biggs & Tang, 2011). Theoretically, deep learning is rooted in cognitivism, which emphasizes the importance of meaningful information processing to store information in long-term memory (Slavin et al.,

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2016), constructivism, which believes that knowledge is actively built by learners through learning experiences, and Ausubel's meaningful learning theory, which states that learning becomes meaningful when new information is connected to the learner's existing cognitive structures through the process of subsumption (Akhiruddin et al., 2020). Therefore, deep learning is not merely about adding information but about forming more durable and applicable conceptual understanding, while also strengthening long-term retention and the ability to transfer knowledge to new situations.

The framework for the deep learning approach, according to the Ministry of Education and Culture (2025), comprises the dimensions of graduate profiles, learning principles, learning experiences, and the learning framework, with three main principles that complement one another. The mindful principle, introduced by Langer (1997), emphasizes that learning is not only about understanding information but also involves full mental and physical engagement, openness to new experiences, and flexible thinking, aligning with the view of deep learning as a holistic approach that connects intellectual, emotional, and value aspects (Hermes & Rimanoczy, 2018). The meaningful principle, introduced by Ausubel (1963), stresses that new information is more effectively understood when linked to the knowledge or experiences already possessed by learners, thereby building meaning, increasing efficiency, and strengthening long-term retention, as well as relating to the relevance of learning activities to real-world contexts from local to global levels (Kovač et al., 2025). The joyful principle, advocated by John Dewey and Howard Gardner, highlights the importance of engaging and relevant learning that connects to real life and involves emotional and intellectual participation of learners, requiring the creation of meaningful and engaging learning environments for optimal learner engagement (Fullan et al., 2018). These three principles are elaborated by Kemendikbud (2025) through fifteen operational indicators: mindful includes comfort in learning, focus and concentration, awareness of thinking processes, openness to new perspectives, and curiosity; meaningful includes real-life context, connection to previous experiences, benefits of learning, links to other fields of knowledge, and sustained interest in learning; while joyful includes interactive learning environments, engaging activities, enthusiasm for learning, motivating challenges, and achievement of learning success (AHA moments). These fifteen indicators serve as the basis for identifying deep learning implementation in this research.

In the Merdeka Curriculum, physics is one of the high school-level subjects that examines natural phenomena through physical and mathematical methods, with the aim of developing students' critical and analytical thinking skills, in addition to providing conceptual knowledge (Amalissholeh et al., 2023). However, the reality in the field shows that physics remains difficult for most students to understand. Physics learning is still dominated by lecture and practice exercises, causing students to tend to be passive and struggle to understand concepts deeply (Hermansyah et al., 2022), worsened by a weak understanding of basic concepts, mathematical skills, and difficulty connecting physics concepts to real-life applications (Kuo et al., 2019). Although teachers have tried various approaches, field practices still reflect teacher-centered learning, so the scientific approach that should foster higher-order thinking skills often becomes a mere formal ritual without deeper meaning (Suardin et al., 2025).

Initial interviews with physics teachers at SMA Negeri 1 Medan indicate that teachers have attempted to implement a deep learning approach, such as creating an interactive learning environment through various instructional media and encouraging students to reflect on their

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thinking processes and connect physics concepts to real-world contexts. However, its implementation has not been optimal or consistent across all aspects of learning due to differences in students' characteristics, readiness levels, and learning habits. Previous research shows that although deep learning has been widely discussed conceptually, studies specifically identifying its practical application in physics teaching at schools remain limited; Fitriani & Santiani (2025) revealed that some physics teachers have tried to apply deep learning elements, but there is no systematic mapping of how this approach is implemented in the classroom, while Sari & Arta (2025) emphasize that previous research has focused more on active or innovative learning models rather than identifying the implementation of deep learning aligned with current policy standards.

Based on the description, there is a gap between policy demands that direct learning toward a deep approach and the practice of physics learning in schools. Therefore, this research is important to conduct in order to identify the implementation of the deep learning approach, particularly the aspects of meaningful, mindful, and joyful learning, in physics education, as well as to describe the profile of students' learning experiences based on these three aspects at SMA Negeri 1 Medan.

RESEARCH METHOD

This study uses a descriptive qualitative approach to identify and describe the implementation of the deep learning approach, specifically the aspects of meaningful, mindful, and joyful learning, in physics education, without testing hypotheses or the effectiveness of the learning on learning outcomes (Sani, 2024). The research was conducted at SMA Negeri 1 Medan during the even semester of the 2025/2026 academic year. The study subjects were selected using purposive sampling and comprised 4 physics teachers who had implemented the deep learning approach, along with one XI class under each teacher's guidance. Six students from each class were purposively selected as informants, for a total of 24. This was done to account for variations in activity levels, academic ability, and learning engagement, so that the data obtained could reflect the diversity of students' learning experiences.

Data were collected through three techniques: classroom observation using observation sheets with 15 deep learning indicators based on the Ministry of Education and Culture (Kemendikbud, 2025), semi-structured in-depth interviews with teachers (8 questions) and students (8 questions) arranged based on aspects of meaningful, mindful, and joyful learning, as well as documentation of learning devices (lesson plans) analyzed using indicators of the stages of deep learning design. The data were analyzed using source triangulation with the Miles and Huberman interactive model, which includes data reduction, data presentation, and conclusion drawing, with data coding following the pattern Source-Subject-Aspects-Serial Number, for example, W-G1-MN-01 for the first teacher interview data on the meaningful aspect. To interpret students' learning experiences, the student interview data were further analyzed using Peirce's semiotic triangle, which explains the triadic relationship among *sign (s)*, *object (o)*, and *interpretant (i)*, thereby allowing for a deeper understanding of the meaning behind students' statements for each deep learning indicator.

RESULT AND DISCUSSION

Result

The research subjects consisted of 4 physics teachers (coded G1–G4) who teach in classes XI-6, XI-1, X-9, and XI-2, as well as 24 students (coded S1–S24) who were selected

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representatively from those four classes. All teachers are civil servants who have implemented the Merdeka Curriculum but use a general lesson plan (RPP) that is shared among several teachers. Data were collected through classroom observations, interviews with teachers and students, and analysis of the RPP. Triangulation of findings across the fifteen deep learning indicators is summarized in Table 1.

Table 1. Triangulation of Deep Learning Implementation & Student Learning

Aspect	Indicator	Implementation Findings (Teachers & Lesson Plans)	Student Learning Experience Summary
Meaningful	Real-life context	The teacher consistently relates the material to real-world phenomena (friction, waves, renewable energy), and the lesson plan includes relevant, contextual examples.	Students interpret physics as a relevant and real science, not just abstract formulas.
	Previous experience connection	The teacher reviews the previous material at the beginning of the lesson; the lesson plan includes a warm-up and ice-breaking activities.	Students gradually feel the connection between materials that helps their understanding.
	Benefits of learning	The teacher emphasizes understanding the concept before the formula; the lesson plan includes case studies and practical projects.	Students relate the benefits of physics to technology and everyday phenomena, developing a sense of competence.
	Relationship with other fields of science	RPP integrates physics with mathematics, chemistry, engineering, geography, biology, and technology, but this is rarely explained explicitly in class.	The new student begins to realize this connection to a limited extent.
	Sustainable interest in learning	The teacher encourages active participation through contextual tasks (for example, relating movies to physics phenomena).	Most students show increased interest; others still have low interest.

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Mindful	Learning comfort	The teacher adjusts the teaching strategy; the classroom atmosphere is orderly and sufficiently conducive.	Students feel more comfortable and relaxed during the learning process.
	Focus and concentration	The teacher uses ice-breaking activities and classroom management strategies, but some students are still easily distracted.	Student focus is conditional and not yet automatic.
	Awareness of the thinking process	The teacher asks the students to explain the reasons behind their answers.	Students can explain the steps and reasons for their answers in order.
	Expressing opinions/questions	The teacher provides space for questions; observations record two-way interactions.	Most students are brave enough to ask questions and express their opinions, although their confidence levels vary.
	Openness to new perspectives	The teacher encourages students to respond to their classmates' opinions; the lesson plan includes group reflections.	Some students listen to their friends' opinions without actively responding.
Joyful	Interactive learning environment	The teacher uses discussions, group work, and peer tutors.	Students enjoy discussions, group work, and presentations.
	Interesting learning activity	The teacher uses experiments, PhET simulations, Kahoot, Mentimeter, and a gallery of works.	Students are enthusiastic about the practical work and the use of interactive media.
	Enthusiasm for learning	The guru builds enthusiasm through ice-breaking activities; however, they are not yet consistent in all activities.	Student enthusiasm fluctuates depending on the type of material and workload.
	Motivating challenge	Guru implements PBL/PjBL and tiered practice questions.	Students are interested in experiments, projects, and solving challenging problems.

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	Achievement of learning success	The teacher involves students in projects, presentations, and portfolios.	Students feel more understanding through presentations and practicals; a sense of satisfaction and confidence arises.

In general, the four data sources on meaningful learning show a pattern of convergence across most indicators: the prepared lesson plans, teachers' classroom practices, teachers' recognition, and students' perceptions support one another. Teachers consistently relate physics material to real phenomena and connect new material with previous content, for example:

"The first thing I do is help them relate it to their daily lives." (W-G1-MN-01), a point reinforced by a student's statement: "The material is very relevant to our lives." (W-S18-MN-01)

However, in indicators of relevance to other fields of science, a gap was found: the lesson plan (RPP) integrates physics with mathematics, chemistry, engineering, geography, biology, and technology, but these connections are rarely explained explicitly in the classroom.

In the context of mindful learning, a convergence pattern is also evident across most indicators, especially comfort in learning, awareness of the thinking process, and courage in expressing opinions. However, the indicators of focus, concentration, and openness to different perspectives reveal a gap between teachers' efforts, such as ice-breaking activities and encouragement to respond to peers' opinions, and actual classroom conditions, as some students are still easily distracted and not yet active in responding to peers' opinions.

In the aspect of joyful learning, the four data sources show a strong pattern of suitability across almost all indicators. Teachers design and implement various interactive activities, such as discussions, experiments, projects, PhET simulations, Kahoot, and Mentimeter, which receive positive student responses. Meanwhile, in the enthusiasm-to-learn indicator, fluctuations are observed depending on the type of material and workload.

To compare the consistency of the implementation of the three aspects by teachers, each indicator is given a score of 3 if all four data sources (teacher interviews, student interviews, classroom observations, and lesson plan analysis) converge without significant gaps, or a score of 1 if gaps are found between planning and classroom practice. The scores for five indicators in each aspect are summed from a maximum of 15 points, as visualized in Figure 1.

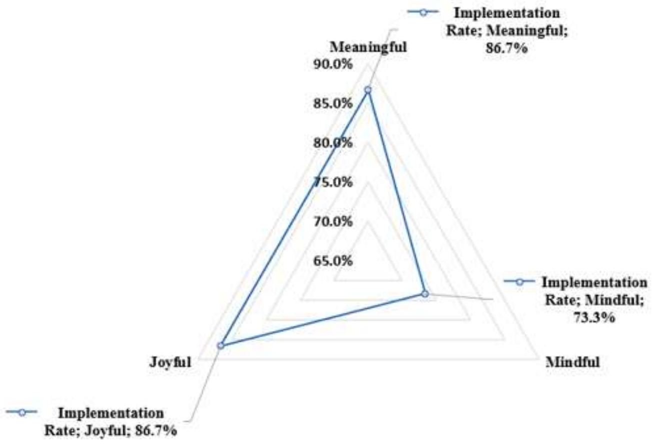

Figure 1. Comparison of the Consistency of Deep Learning Approach Implementation

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As shown in Figure 1, meaningful learning and joyful learning are both the most consistently implemented aspects by teachers (86.7% each), with one gap in each: cross-disciplinary relevance for meaningful learning and fluctuations in enthusiasm for joyful learning. Meanwhile, mindful learning lagged at 73.3% due to two gaps in the indicators of focus-concentration and openness to new perspectives. This pattern indicates that teachers at SMA Negeri 1 Medan are more consistent in relating physics material to real life and designing participatory activities than in fostering sustained focus and openness to students' perspectives.

Analysis of students' learning experiences using Peirce's semiotic triangle shows that in the aspect of meaningful learning, signs in the form of concrete statements from students, such as relating friction to vehicles or Archimedes' law to tire pressure gauges, produce interpretations in the form of awareness that physics is a relevant and tangible science, not just abstract formulas in the classroom. In the aspect of mindful learning, the interpretations formed are generally in the form of emerging metacognitive awareness, but not yet uniform, as seen in some students who can explain the reasoning behind their answers, while others still respond procedurally. In the aspect of joyful learning, the interpretations formed are feelings of happiness, a sense of achievement, and intrinsic motivation that consistently emerge from practical activities and projects.

To compare the influence strength of the three aspects on students' learning experiences, each indicator was given a score based on the consistency of the sign and direction of interpretation across all transcripts: a score of 3 if consistent across all students, a score of 2 if the direction remains positive but varies among students, and a score of 1 if the condition is still conditional or not yet automatic. The scores for the five indicators in each aspect are summed to a maximum of 15 points, as shown in Figure 2.

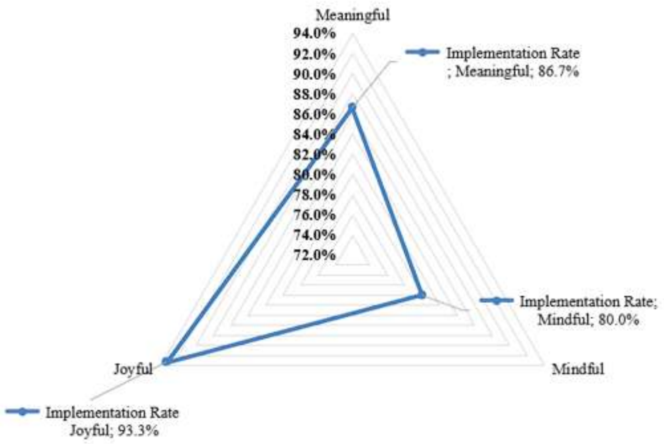

Figure 2. Effects of Meaningful, Mindful, Joyful on Student Learning

As shown in Figure 2, joyful learning received the highest score (14/15, 93.3%), followed by meaningful learning (13/15, 86.7%), while mindful learning received the lowest score (12/15, 80%). This pattern emphasizes that aspects built on concrete, participatory activities (joyful) and on linking material to real life (meaningful) are easier for students to recognize and articulate as learning experiences than the internal, reflective demands of mindful learning, which involve maintaining focus and being open to different perspectives.

Discussion

The findings indicate that indicators of real-life context and connection to prior experiences are most consistently implemented in line with Ausubel et al.'s (1968) meaningful

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learning theory, which states that new information is easier to understand when linked to relevant concepts already possessed by learners (subsumption). For example, teachers who relate the sound-wave material to the experience of hearing an ambulance siren help students understand that the equation $v = f\lambda$ is not just a mathematical formula but a representation of a real phenomenon they encounter daily. These findings provide empirical evidence supporting Fitriani A & Santiani (2025) statement that physics teachers have striven to incorporate elements of deep learning, while also reaffirming that contextual indicators related to real life are the most consistently applied.

Conversely, the gap in indicators of interdisciplinary connectivity, although cognitively understood by teachers and reflected in lesson plans, is consistent with Nurjanah and Suryadi (2025) findings that teachers' readiness to implement deep learning is not yet optimal due to limited facilities, a lack of concrete examples, and teaching habits that still focus on isolated physics material. This gap is important to address because Ausubel et al. (1968) emphasized that knowledge is best understood when connected across domains, while the Ministry of Education and Culture (2025) explicitly encourages cross-disciplinary integration in deep learning.

In the aspect of mindful learning, the strong alignment with indicators of learning comfort and awareness of thinking processes reflects Hermes and Rimanoczy (2018) idea that deep learning is a holistic approach that connects intellectual, emotional, and value aspects, thus requiring teachers to create learning conditions that mentally and physically involve students fully. However, gaps in the indicators of focus-concentration and openness to different perspectives are consistent with Wulan Dari and Darmawan (2025) findings that sustained attention focus and openness to different viewpoints are among the sub-skills of critical thinking that are least consolidated among Indonesian students, even when other thinking aspects have developed quite well. This indicates that the gaps in mindful learning are not specific to physics education at SMA Negeri 1 Medan but reflect a broader pattern of reflective development among Indonesian students.

The strength of implementing joyful learning aligns with Fredrickson (2001) broaden-and-build theory, which states that positive emotions expand individuals' thought and action repertoires while building long-term psychological resources. As a result, activities that generate happiness also enhance students' engagement and depth of learning. This finding is also consistent with Kristiansen et al (2019), who found that face-to-face promotive interactions in cooperative learning consistently strengthen engagement and the depth of learning experiences, as well as with Hermansyah et al (2022), who demonstrated that direct learning assisted by interactive multimedia is more effective in improving physics concept understanding compared to conventional delivery methods.

The comparison of the influence scores of the three aspects on students' learning experiences (joyful 93.3%, meaningful 86.7%, mindful 80%) reinforces the same pattern on the teacher's implementation side: aspects built on concrete and participatory activities (joyful) as well as linking material to real life (meaningful) are easier to translate into the learning experiences felt and articulated by students, while the internal reflective demands of mindful learning, namely maintaining focus and remaining open to different perspectives, are the most difficult for students to develop consistently. This pattern aligns with Isdayanti et al. (2025), who found that learning models emphasizing active and direct engagement are most consistent in improving students' conceptual understanding and problem-solving abilities. Smith & Colby (2007) also emphasize that deep learning is not a single uniform achievement but a composite

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of several different capacities that develop at different rates, depending on how explicitly each capacity is facilitated by the teacher. Therefore, the unevenness found in this study is not a weakness of the deep learning approach itself but a natural characteristic of classrooms that provide uneven pedagogical attention to each dimension. Kovač et al. (2025) also remind us that deep learning is often understood primarily through observable activities and engagement, while its reflective-metacognitive dimension receives less attention, which aligns with the concerns raised in this research.

Findings indicate that students consistently mention activities and describe feelings of happiness, but find it more difficult to articulate maturity of focus or openness to different perspectives. This aligns with Amalissholeh et al (2023), who found that students at SMAN 1 Kediri experience difficulties with conceptual depth and self-monitoring, even though they are able to follow classroom activities and procedures without difficulty. This is consistent with the view of Partono et al (2021) that critical thinking competence within the 4C framework does not develop automatically alongside content activities, but requires specific strategies designed by teachers for reflection and perspective-taking. Therefore, strengthening students' mindful learning experiences likely depends more on deliberate and ongoing facilitation by teachers in reflection and perspective-taking, rather than simply increasing the number of learning activities.

CONCLUSION

This study shows that the implementation of the deep learning approach at SMA Negeri 1 Medan is in the developing stage, with several strengths serving as a foundation for improvement. Physics teachers have carried out all three aspects: meaningful, mindful, and joyful learning, although the consistency levels vary among indicators; teachers actively relate physics concepts to everyday life and create an interactive atmosphere through experiments and projects. However, gaps remain in cross-disciplinary integration, which has not been fully realized in the classroom, as well as in the consistency of focus and student enthusiasm, which still fluctuate. In terms of learning experience, students are beginning to see physics as a relevant science, with some demonstrating metacognitive awareness and high enthusiasm for practical activities, although this depth of understanding is not yet uniform, and some students still have a superficial attitude when connecting physics to other disciplines and respond critically to peers' opinions. Joyful learning has the greatest influence on students' learning experiences, followed by meaningful learning, while mindful learning has the weakest influence, reflecting that interactive and contextual activities are easier for students to internalize compared to ongoing reflection and openness to different viewpoints.

Based on these findings, it is recommended that physics teachers undergo structured deep learning training that specifically targets indicators of cross-disciplinary integration and openness to new perspectives, as well as integrating strategies that encourage students to reflect on their learning process, not just the content being studied. Future research is suggested to adopt a quantitative approach, such as correlational or quasi-experimental methods, to examine the relationship between the level of deep learning implementation (meaningful, mindful, joyful) and students' learning outcomes and intrinsic motivation, thereby complementing the qualitative findings of this study with more generalizable recommendations.

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