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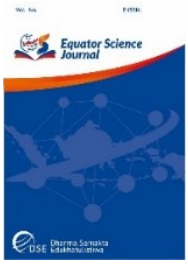

Physics Teachers' Ability to Reflect on Learning: A Case Study in Palu City

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ABSTRACT
This study aims to map the learning-reflection ability of Physics teachers in Palu City, Central Sulawesi, at both the planning and implementation levels, and to analyse the influence of Guru Penggerak (Teacher-Mover) status on the quality of reflection displayed. The study employs a qualitative approach with a multiple case study design involving seven Physics teachers from seven public senior high schools, purposively selected on the principle of maximum variation. Data were collected through document analysis of lesson plans (RPP/Teaching Modules), 21 non-participant classroom observations, and triangulation interviews with 21 students. The main instrument was a review-and-observation sheet based on twenty reflection indicators synthesised from the frameworks of Schön, Hatton and Smith, and the revised Bloom taxonomy. The results show that the average reflection ability of the teachers reached only 19% at the planning stage and 21% at the implementation stage, both of which fall within the very low category according to the Larrivee framework. Reflection questions were dominated by ritualistic closed formats at the descriptive-writing level, with four metacognitive indicators not appearing at all across the participants. Guru Penggerak teachers consistently displayed higher reflective capacity (28%) than regular teachers (18%), particularly in the closing stage of the lesson. These findings indicate that academic qualifications and long teaching experience are not automatically correlated with reflective ability, and underscore the importance of developing a standardised reflection toolkit based on Social Emotional Competence to support the implementation of the Kurikulum Merdeka.

INTRODUCTION

The quality of education is a central issue within the national education system, and teachers are the principal determining factor in attaining it. One of the key indicators of professional teacher competence is the ability to reflect on the teaching practices that the teacher has implemented (Collin et al., 2013; Smith, Geng, & Black, 2016). Learning reflection is not merely a simple evaluative process; rather, it is a metacognitive activity that drives teachers to analyse, question and continuously improve their teaching practice (Beauchamp, 2015).

Several studies have demonstrated the significant contribution of reflective practice to the enhancement of teaching quality. Beauchamp (2015) emphasised that reflection is an essential component of teacher professional development that directly affects the quality of instruction and student learning outcomes. Farrell (2022) found that teachers who consistently engage in reflection tend to be more adaptive in responding to students' needs and are able to develop more innovative learning strategies. Furthermore, Larrivee and Cooper (2006) demonstrated a positive correlation between the level of teacher reflectivity and the ability to manage classrooms effectively.

Although studies in various international contexts have confirmed the benefits of reflection, its implementation still faces real challenges. Several studies have reported that teachers' skills in carrying out learning reflection remain at a low level (Cook et al., 1995; Hatton & Smith, 1995; Toh, 2001). A study by Nurjannah et al. (2019) at Universitas Tadulako, Palu, found that the reflection skills of prospective teacher students were in the low category. Simoncini et al. (2014) even concluded that reflective practice is rarely examined or explicitly taught in teacher education programmes.

In Indonesia, the urgency of teachers' reflective ability has been further reinforced by the government through Permendikbudristek Number 16 of 2022 concerning Process Standards for Early Childhood, Primary, and Secondary Education. This regulation explicitly states that learning assessment may be carried out through self-reflection on the planning and process of learning. This policy positions reflection as a professional competency standard that every educator is required to possess.

In Palu City, Central Sulawesi, no systematic investigation has yet been conducted into the reflective ability of Physics teachers. This information gap constitutes an obstacle for stakeholders in formulating well-targeted teacher development policies. The present study addresses this gap by producing a comprehensive mapping of the reflective ability of Physics teachers in senior high schools in Palu, encompassing the planning and implementation of reflective activities in their teaching.

This study is important because the ability to reflect on learning has a direct impact on the improvement of teachers' content and pedagogical knowledge (Nguyen et al., 2014). Effective reflection enables teachers to identify gaps between learning objectives and the actual achievements of students, thereby driving continuous improvement. Specifically, this study aims to: (1) produce a mapping of the forms of reflective activities and reflection questions used by Physics teachers in their teaching; (2) analyse the linguistic characteristics and typology of reflection questions that emerge at the three stages of learning (introduction, core, and closing); and (3) explore the influence of Guru Penggerak status on the quality of reflection displayed by teachers.

METHOD

Research Design

This study employed a qualitative approach with a multiple case study design complemented by descriptive quantitative analysis (Creswell & Poth, 2018). The multiple case study design was chosen with reference to the frameworks of Yin (2018) and Stake (2006). Each Physics teacher was treated as a single case, so the study examined seven cases in parallel. Descriptive quantitative analysis was integrated into the qualitative design to enable cross-case comparison through aggregated percentages of reflection indicators.

Participants and Sampling

The study was conducted at seven public senior high schools in Palu City, Central Sulawesi Province, Indonesia. Palu was selected as the research site on three considerations: (1) it represents a medium-sized city in eastern Indonesia that has so far been underexplored in the reflective practice literature; (2) field accessibility for the research team from Universitas Tadulako; and (3) the existence of the Guru Penggerak Programme (PGP), which has been running since its first cohort, allowing the identification of Guru Penggerak teachers as a comparison group.

Participants were selected through purposive sampling guided by the principle of maximum variation (Patton, 2015) to obtain rich information across contextual variations. Based on the selection criteria, seven Physics teachers were chosen from seven different public senior high schools in Palu. Participant identities were anonymised using pseudonyms (Suri, Riki, Arman, Vina, Rara, Ita, Lana). The detailed characteristics of the participants were as follows: three male and four female; teaching experience ranging from 5 to 18 years (median 14 years); five held a master's degree and two a bachelor's degree; two held Guru Penggerak status and implemented the Kurikulum Merdeka, while the remaining five implemented the 2013 Curriculum.

Research Instruments

The main construct of the study was Physics teachers' learning-reflection ability, operationalised into two sub-constructs—reflection planning and reflection implementation—and supplemented by an analysis of the characteristics of reflection questions. The instruments consisted of a document-review sheet, a structured observation sheet, and a semi-structured student interview protocol. The document-review and observation sheets were both built on twenty reflection indicators, which constitute the main instrument of the study. The development of these twenty indicators was based on the synthesis of three theoretical frameworks: (1) Schön's (1983, 1987) reflective practice model, which distinguishes between reflection-in-action and reflection-on-action; (2) the level-of-reflection typology of Hatton and Smith (1995); and (3) the three-stage learning structure (introduction, core, closing) that applies within the 2013 Curriculum and the Kurikulum Merdeka in Indonesia.

Table 1. Twenty Indicators of Learning-Reflection Ability

No.	Reflection Indicator	Stage	Construct Dimension
1	Asking about the material previously learned	Introduction	Cognitive – Recall
2	Asking what students already know from the previous session's material	Introduction	Cognitive – Comprehension
3	Asking how students studied the previous session's material	Introduction	Metacognitive – Strategy
4	Asking what else students wish to learn from the previous session	Introduction	Affective – Epistemic Interest
5	Asking what students know about the material to be learned	Introduction	Cognitive – Diagnostic
6	Asking about everyday applications of the newly learned material	Core	Cognitive – Application
7	Asking whether there are examples related to the material just discussed	Core	Cognitive – Application
8	Giving a quiz to clarify students' knowledge	Core	Cognitive – Evaluative
9	Asking whether there are questions related to the material just discussed	Core	Metacognitive – Clarification

No.	Reflection Indicator	Stage	Construct Dimension
10	Asking whether anything is not yet understood about the new concept	Core	Metacognitive – Monitoring
11	Asking which part of the theory is difficult to understand	Core	Metacognitive – Obstacle Identification
12	Asking which part students wish to study further and the reasons why	Core	Affective – Epistemic Interest
13	Asking whether today's session was enjoyable	Closing	Affective – Emotional
14	Asking about the importance of the material learned	Closing	Axiological – Meaning
15	Asking about students' interest and the most interesting part of the lesson	Closing	Affective – Interest
16	Asking about students' satisfaction with today's session	Closing	Affective – Satisfaction
17	Asking what students wish to learn further from today's material	Closing	Affective – Epistemic Interest
18	Asking what motivates students	Closing	Affective – Motivational
19	Giving questions to clarify students' understanding	Closing	Cognitive – Evaluative
20	Asking about the attainment of learning objectives	Closing	Evaluative – Self

Note: The construct dimension serves as the basis for the multidimensional typology of reflection questions analysed in the Results section.

Instrument validation was carried out through three stages. First, content validity was assessed by two Physics-education experts from Universitas Tadulako, who provided input on the representativeness of the indicators, the clarity of the wording, and the conformity with the theoretical framework. The expert-judgement results yielded a content validity index (CVI) of 0.91, which, according to Polit and Beck (2006), falls in the very-good category (CVI ≥ 0.80). Second, construct validity was tested through the traceability of each indicator back to the relevant theoretical literature. Third, a readability test was conducted through a pilot study with one Physics teacher who was not part of the main participants, resulting in minor revisions to the instruction wording.

Data Collection Procedure

Data collection followed a six-stage procedure: (1) pre-fieldwork (instrument development, validation, pilot study, permissions, participant selection); (2) document data collection from lesson plans and teaching modules; (3) classroom observation of three sessions per participant (21 sessions in total); (4) triangulation interviews with three students per classroom (21 students in total); (5) data analysis through inductive–deductive coding; and (6) member checking and reporting.

Document analysis was conducted on the RPP (for users of the 2013 Curriculum) or the Teaching Modules (for users of the Kurikulum Merdeka) collected from the seven participants. Each document was analysed using the same twenty-indicator review sheet, focusing on four aspects: (1) the explicit presence of the indicator in the document; (2) the richness of detail (whether accompanied by sample questions); (3) the relation to the learning stage; and (4) consistency with the stated learning objectives. Classroom observations were non-participant in nature: the researcher attended each class as an

observer without being involved in learning activities. Recording was carried out structurally with the additional support of narrative field notes. Semi-structured interviews with three students per classroom were selected by the class teacher based on representativeness across academic ability (high, medium, low). Each interview lasted 15–25 minutes and was recorded with the written consent of both students and parents.

Data Analysis

Data analysis used a combined inductive–deductive content-analysis approach (Elo & Kyngäs, 2008). The deductive approach was used for coding based on the twenty predetermined indicators, while the inductive approach was used to develop categories of question characteristics from authentic observational data. Each indicator was coded into one of three categories: ✓ (Fully implemented, weight 1.0), ◐ (Partial, weight 0.5), or — (Not yet observed, weight 0). Numerical weights were adopted to enable aggregate-percentage computations that can be compared across participants and across stages. The percentage of reflection ability for each participant was calculated using the following formula:

Reflection Percentage (%) = (Σ indicator weights ÷ number of indicators) × 100%

Percentages were calculated at three aggregation levels: (1) per individual indicator; (2) per learning stage (introduction, core, closing); and (3) across all 20 indicators. These percentages were then classified into ability categories ranging from very low (0–25%) to very high (>90%–100%), following Hatton and Smith (1995)—from pre-reflective through descriptive writing, descriptive reflection, dialogic reflection, and critical reflection. In addition to the quantitative percentage analysis, an inductive thematic content analysis was conducted on the reflection questions collected from observation transcripts, following the six phases of Braun and Clarke (2006). Source triangulation was performed by comparing findings from three sources: (1) document analysis of RPP/Teaching Modules; (2) classroom observations; and (3) student interviews.

RESULTS AND DISCUSSIONS

Planning of Reflective Activities in the Lesson Plans

The review of the seven lesson plans (RPP/Teaching Modules) revealed significant variation in the planning of reflective activities across teachers. Overall, none of the participants had comprehensively planned reflective activities in their lesson-planning documents. Table 2 maps the ability to plan reflective activities in the RPP (2013 Curriculum) or Teaching Modules (Kurikulum Merdeka).

Table 2. Mapping of Reflective Planning Ability across Participants (%)

Stage	Suri	Riki	Arman	Vina	Rara	Ita	Lana	Mean
Introduction	30	0	20	30	30	20	20	21%
Core	25	0	33	33	33	0	33	23%
Closing	0	0	13	13	13	38	13	13%
Total	**18%**	**0%**	**23%**	**25%**	**23%**	**23%**	**20%**	**19%**

Note: Percentages computed with weights ✓ = 1; ◐ = 0.5; — = 0. Italicised participants (Ita and Lana) are Guru Penggerak teachers.

Three findings stand out from the planning analysis. First, four indicators were entirely absent (0%) across all participants: asking how students studied the previous material; asking what else students wish to learn from the previous material; asking which part students wish to study further; and asking what motivates students. These four indicators correspond to the metacognitive and epistemic-interest dimensions in the twenty-indicator framework. Second, Riki—the only participant with a

bachelor's degree and the shortest teaching experience (5 years)—did not plan any reflective activity (0%). Third, the highest planning percentage was achieved by Vina (25%), still well below the 50% threshold conventionally considered a minimum competence threshold.

Implementation of Reflective Activities in the Classroom

Table 3 presents the results of the classroom-observation phase, which captured the actual implementation of reflective activities across 21 classroom sessions.

Table 3. Mapping of Reflective Implementation Ability across Participants (%)

Stage	Suri	Riki	Arman	Vina	Rara	Ita	Lana	Mean
Introduction	30	0	20	30	40	20	40	27%
Core	25	0	33	33	33	8	50	27%
Closing	0	0	0	0	0	38	25	8%
Total	**20%**	**0%**	**18%**	**20%**	**23%**	**28%**	**28%**	**21%**

Note: Percentages aggregated from 21 classroom observations (three per participant).

Table 4 recapitulates the average percentages of reflective ability per learning stage, disaggregated by Guru Penggerak status.

Table 4. Recapitulation of Reflective Ability per Learning Stage

Learning Stage	Planning – All	Planning – GP	Planning – Non-GP	Implementation – All	Implementation – GP	Implementation – Non-GP
Introduction	21%	20%	22%	27%	30%	26%
Core	23%	14%	27%	27%	25%	27%
Closing	13%	28%	6%	8%	28%	0%
Overall Mean	**19%**	**21%**	**18%**	**21%**	**28%**	**18%**

Note: GP = Guru Penggerak (n = 2: Ita, Lana). Non-GP = regular teachers (n = 5: Suri, Riki, Arman, Vina, Rara).

The Planning–Implementation Gap

Comparing planning and implementation reveals two distinct patterns. At the introduction stage and the core stage, the implementation percentage exceeded the planning percentage by +6% and +4%, respectively, indicating emergent reflection. At the closing stage, however, the implementation percentage fell below the planning percentage by 5 percentage points, indicating an implementation gap in which planned reflective activities did not translate into classroom practice. The overall mean gap was a modest +2 percentage points.

Linguistic Characteristics of Reflective Questions

Inductive thematic coding of the observation transcripts identified four patterns of verbal behaviour at the apperception stage: (a) asking about previous material while allowing pause and waiting for students' responses (Suri, Rara, Lana); (b) posing rhetorical questions and immediately answering them without waiting for student responses (Vina); (c) connecting material with students' previous experiences (Vina, Rara); and (d) no apperception question at all, with the teacher moving directly into the explanation of new material (Riki).

Clarification questions in the core stage were dominated by closed-format, ritualistic prompts. Examples include: "Anything to ask?" (Suri); "Anything not yet understood? So we can repeat" (Vina); "Any questions or not, dear?" (Rara); and "Has the difference between base, derived, and units been

understood?" (Lana). These questions are linguistically classified as closed, yes/no formats with a ritualistic function rather than an authentic diagnostic function.

Reflection questions at the closing stage appeared only for the two Guru Penggerak teachers (Ita and Lana). Their reflection sheets, built on Social Emotional Competence (SEC), encompass five dimensions: (1) cognitive–conceptual (e.g., "Today we learned about …"); (2) affective–emotional (e.g., "How do you feel after studying today?"); (3) metacognitive–strategy (e.g., "What challenges do you still encounter? How do you practise to overcome those challenges?"); (4) evaluative–self (e.g., "What will you do to improve your learning outcomes?", supported by a star-shading technique); and (5) axiological–meaning (e.g., "Is studying measurement important? Why is it important?"). This five-dimension typology constitutes the most substantive original contribution to the literature on closing-stage reflection.

Summary of Core Findings

The study revealed that the average reflective ability of Physics teachers in Palu City was still very low, reaching only 19% at the planning stage and 21% at the implementation stage. Four important reflection indicators were entirely absent across all participants, namely asking how students study, what they wish to learn further, which part they would like to study in greater depth, and what motivates them. In comparison, Guru Penggerak teachers, specifically Ita and Lana, consistently demonstrated higher reflective ability than regular teachers, particularly at the closing stage, where their planning reflection reached 38% compared to 5% among regular teachers, and their implementation reflection reached 31% while regular teachers showed 0%. In the core stage, clarification questions were mostly limited to closed formats such as “Any questions?”, which tended to function merely as rhetorical closings rather than authentic triggers for reflection. The findings also indicated that holding a master’s degree and having more than ten years of teaching experience did not positively correlate with the quality of reflection demonstrated by the teachers. Furthermore, the written reflection sheets developed by Ita and Lana based on Social Emotional Competence (SEC) represented the only practices that achieved the dialogic-reflection level according to the Hatton and Smith (1995) taxonomy.

The finding that the average reflective ability of Physics teachers reached only 19% at the planning stage and 21% at the implementation stage—well below the 50% threshold conventionally regarded as the minimum competence threshold (Larrivee, 2008)—indicates that reflection has not yet become a professional habitus among Physics teachers in Palu City. This finding is consistent with the cross-context pattern reported by Hatton and Smith (1995), namely that 60–70% of teacher reflection remains at the descriptive-writing level: a description of action without pedagogical justification. Özüdoğru (2021) also found that the reflections of prospective teachers were dominated by the descriptive-reflection and descriptive-writing levels, with no achievement of dialogic or critical reflection. Given that the participants in the present study were in-service teachers with more than ten years of experience, this low profile makes an important empirical contribution: low reflective capacity is not solely a phenomenon among prospective teachers but is also persistent among career teachers with decades of service.

The linguistic characterisation of clarification questions supports this interpretation. Questions such as "Anything to ask?" (Suri) or "Any questions or not, dear?" (Rara) constitute what Anderson and Krathwohl (2001) call reproductive questions—questions that do not demand cognitive elaboration and do not open dialogic space. Furthermore, the closed format of these questions was not followed by probing questions to dig into students' reasoning, learning strategies, or epistemic frameworks. This type of question is known as pseudo-formative assessment: an activity that appears formative on the surface but substantively does not yield diagnostic data usable for instructional improvement (Black & Wiliam, 2009).

The implications of this low reflection profile must be analysed through the lens of Schön (1983, 1987), who distinguished reflection-in-action from reflection-on-action. Reflection-in-action—reflection that takes place simultaneously with the act of teaching—was partly manifested in spontaneous clarification questions, as shown by Vina when, in the middle of a thermometer experiment, she asked, "Can you use the apparatus?" However, this manifestation was sporadic and unstructured. Meanwhile, reflection-on-action—systematic reflection at the end of a lesson that reconstructs experience into professional knowledge—was almost absent except for the two Guru

Penggerak teachers. Schön (1987) emphasised that without reflection-on-action, teachers' knowing-in-action remains in the realm of tacit knowledge that is difficult to evaluate or improve. As a consequence, the cycle of teachers' professional development stalls in the repetition of the same practice year after year—what may be called the pedagogical plateau.

Most strikingly, holding a master's degree and having long teaching experience were not automatically correlated with high reflective capacity. Suri (M.Ed., 12 years), Arman (M.Ed. in Physics Education, 18 years), Vina and Rara (17–18 years of experience) displayed reflection percentages similar to, or even lower than, Riki (B.Ed., 5 years)—simply because Riki engaged in no reflection at all. This pattern aligns with the counter-intuitive findings of Mthembu and Mthimkhulu (2024), who showed that Physics teachers with longer experience tend to be more rigid and less open to new pedagogical approaches, including reflective practice. This finding strengthens the argument that academic qualification and teaching experience alone are not sufficient as predictors of reflective capacity; rather, dedicated professional development—of the type offered by the Guru Penggerak programme is required.

Two theoretically interesting phenomena emerged in the planning–implementation gap analysis. First, at the introduction stage, a positive gap of +6 percentage points was observed between implementation and planning—meaning that some teachers displayed apperception questions that had not been written into the lesson plan. Lana, for example, spontaneously connected the material to students' everyday measurement experiences, even though such linking was not detailed in her teaching module. This phenomenon is consistent with the concept of emergent practice developed by Mason (2002), whereby teachers who are "sensitive" to classroom dynamics can spontaneously generate practice that exceeds the written plan. Nevertheless, the sporadic nature of this emergent reflection is also its weakness: without explicit articulation in the planning document, such reflection depends on individual intuition and is difficult to replicate or evaluate (Korthagen, 2017).

Second, the apperception questions that emerged were dominated by convergent formats that only activate recall memory. Phrases such as "What do you know about …?", "Have any of you ever heard of …?", and "What is …?" found among the participants are structurally located at the remembering level—the most basic level of the revised Bloom taxonomy (Anderson & Krathwohl, 2001). These questions, while administratively fulfilling the apperception requirement, fail to perform a diagnostic function for exploring students' prior conceptions or preconceptions of physical phenomena. Without diagnostic questions designed to surface such misconceptions, Physics teaching risks building new constructs on faulty foundations.

In contrast, Ita displayed a qualitatively different approach. Her question sequence—"Have you ever performed any measurements?", "What measurements have you performed?", "What measuring instruments did you use?"—follows the structure of funnelling questions that move from general to specific. This structure allows the teacher to map students' real experiences before building new concepts, and is theoretically aligned with Costa and Kallick's (2008) recommendation of intentional questioning as a metacognitive activity that makes teachers more aware of their students' thinking potential. Equally important, Ita's questions also connect to the Social Emotional Competence (SEC) framework—in particular the dimension of self-awareness—so that her reflection carries an affective as well as a cognitive load. This practice illustrates how the Kurikulum Merdeka, when internalised substantively, can enrich a teacher's pedagogical repertoire.

Closing-Stage Reflection as the Key Locus

Reflection at the closing stage is the most critical locus in this study, and at the same time the locus with the lowest aggregate percentage (planning 9% and implementation 6% at the aggregate level for regular teachers). The negative gap (−3 percentage points) at the closing stage indicates an implementation gap: what was planned was already minimal, and what was implemented was even less. This phenomenon deserves attention because, according to Boud, Keogh, and Walker (1985), closing reflection is the principal window for students to consolidate concepts, evaluate themselves, and plan further learning.

The multidimensional typology of closing-stage reflection questions designed by Ita and Lana provides this study's original contribution to the development of holistic reflection instruments. In the cognitive–conceptual dimension, the question "Today we learned about …" fulfils the recap function,

which according to Lew and Schmidt (2011) facilitates the consolidation of short-term memory into long-term memory. In the affective–emotional dimension, questions such as "How do you feel after studying today's material?" (Lana) and "My feelings after studying …" (Ita) display what Fund and Madjar (2018) called motivational reflection. Their study found that reflection combined with science learning has a positive effect on motivational aspects, including students' interest and emotional engagement—two dimensions crucial in Physics learning, a subject that students often perceive as difficult and abstract.

The metacognitive–strategy dimension in Ita's question—"What challenges do you still encounter? How do you practise to overcome those challenges?"—is the most theoretically complex practice. This type of question is a form of metacognitive prompting that, according to Pintrich (2002), is a core strategy for building self-regulated learning. In the context of Physics learning, metacognition is a significant predictor of problem-solving ability, particularly in the transition from a surface to a deep approach to learning. Ita's practice of linking this question with the SEC self-management strand reflects substantive pedagogical understanding. The evaluative–self dimension displayed by Lana through the star-shading technique offers a unique innovation: a form of visual self-assessment recommended by Black and Wiliam (2009) as part of formative assessment for learning. The advantages of this visual technique are that it is easier for high-school students—still in the phase of building their academic identity—to comprehend, and it provides aggregate data for the teacher on students' self-perception of effort. Finally, the axiological–meaning dimension in Ita's question—"Is studying measurement important? Why is it important?"—encourages students to examine the relevance of the material to their lives, a component of Future Time Perspective (FTP) that Andriessen et al. (2006) linked with long-term achievement motivation.

Integrating these five dimensions, it can be concluded that the written reflection sheets developed by Ita and Lana are not merely an administrative instrument but a multidimensional pedagogical tool with the potential to elevate students' level of reflection from descriptive to dialogic. The fact that this practice emerged exclusively among Guru Penggerak teachers underscores the programme's role in transforming the reflective paradigm of Physics teachers.

The Influence of the Guru Penggerak Programme

One of the sharpest findings of this study is the consistent gap between the reflective ability of Guru Penggerak teachers (Ita and Lana) and that of their regular colleagues. At the closing stage, the percentages for Guru Penggerak teachers reached 38% (planning) and 31% (implementation), while regular teachers reached only 5% and 0%, respectively. The same pattern, with smaller magnitudes, recurred at the introduction and core stages. These differences are noteworthy as an indication of the partial success of the Guru Penggerak Programme of the Indonesian Ministry of Education, Culture, Research, and Technology—particularly in developing reflective capacity, which is included among the programme's core competencies. Nevertheless, even Guru Penggerak teachers' reflective capacity—at an average of 28%—remains far from the ideal threshold of 75% (dialogic reflection). This indicates that the Guru Penggerak Programme has made progress, but its design and intensity require further reinforcement so that reflection truly becomes a stable professional habitus among its alumni.

CONCLUSION AND SUGGESTION

Based on the findings, four conclusions can be drawn. First, the reflective ability of Physics teachers in Palu City is in the very-low category, with averages of 19% at the planning stage and 21% at the implementation stage. Second, linguistically and typologically, teachers' reflection questions are dominated by ritualistic closed formats at the descriptive-writing level in the Hatton and Smith taxonomy. Questions such as "Anything to ask?" or "Has it been understood?", which structurally function as rhetorical closings (pseudo-formative assessment), fail to perform the diagnostic function of exploring students' prior conceptions and misconceptions of physical phenomena. Four reflection indicators related to the metacognitive and epistemic-interest dimensions—how students study the material, what they wish to learn further, which part they wish to deepen, and what motivates them—

did not appear at all across the participants. Third, Guru Penggerak status was positively correlated with reflective capacity: Guru Penggerak teachers displayed a consistently higher percentage (28%) than regular teachers (18%), particularly at the closing stage—although even Guru Penggerak teachers' capacity remains far below the ideal. Fourth, this study produces a theoretical contribution in the form of a multidimensional typology of reflection questions that enriches the unidimensional framework of Hatton and Smith. The five identified dimensions—cognitive, affective, metacognitive, evaluative, and axiological—are explicitly mapped onto the Social Emotional Competence of the Kurikulum Merdeka, thus opening the way for practical integration into Physics teaching modules. The empirical contribution of this study lies in providing a baseline profile of Physics teachers' reflective capacity in eastern Indonesia, a region previously underrepresented in the literature, while its practical contribution lies in providing the foundation for the development of a standardised reflection toolkit as a follow-up output.

The implications of these findings are systemic and can be formulated as four recommendations. First, in-service teacher training focused on questioning skills for reflection needs to be developed, using video-based lesson analysis and microteaching approaches that have been shown effective in the literature. Second, standardised SEC-based reflection sheets with the multidimensional typology should be integrated into Physics teaching modules so that reflection becomes a mandatory and auditable component. Third, cross-school lesson-study communities of practice should be built to facilitate critical-friend feedback. Fourth, the reflective-practice component of the Guru Penggerak Programme should be expanded into a component that is embedded across all schemes for teacher professional development, including certification and the PPG (Pendidikan Profesi Guru).

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REFERENCES

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

Andriessen, I., Phalet, K., & Lens, W. (2006). Future goal setting, task motivation and learning of minority and non-minority students in Dutch schools. *British Journal of Educational Psychology, 76*(4), 827–850. https://doi.org/10.1348/000709906X148150

Beauchamp, C. (2015). Reflection in teacher education: Issues emerging from a review of current literature. *Reflective Practice, 16*(1), 123–141. https://doi.org/10.1080/14623943.2014.982525

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5

Boud, D., Keogh, R., & Walker, D. (1985). *Reflection: Turning experience into learning*. Kogan Page.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Collin, S., Karsenti, T., & Komis, V. (2013). Reflective practice in initial teacher training: Critiques and perspectives. *Reflective Practice, 14*(1), 104–117. https://doi.org/10.1080/14623943.2012.732935

Cook, P. F., Young, J. R., & Evensen, N. (1995). The reflective practitioner: Teacher as researcher. *Journal of Teacher Education, 46*(3), 167–175.

Costa, A. L., & Kallick, B. (2008). *Learning and leading with habits of mind: 16 essential characteristics for success*. ASCD.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing, 62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Farrell, T. S. C. (2022). Reflective practice for language teachers. In C. Chapelle (Ed.), *The concise encyclopedia of applied linguistics* (2nd ed., pp. 789–795). Wiley-Blackwell. https://doi.org/10.1017/9781009028783

Fund, Z., & Madjar, N. (2018). The influence of scaffolded computerised science problem-solving on motivational aspects. *International Journal of Science Education, 40*(18), 2233–2256. https://doi.org/10.1080/09500693.2018.1530797

Hatton, N., & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education, 11*(1), 33–49. https://doi.org/10.1016/0742-051X(94)00012-U

Korthagen, F. (2017). Inconvenient truths about teacher learning: Towards professional development 3.0. *Teachers and Teaching, 23*(4), 387–405. https://doi.org/10.1080/13540602.2016.1211523

Larrivee, B. (2008). Development of a tool to assess teachers' level of reflective practice. *Reflective Practice, 9*(3), 341–360. https://doi.org/10.1080/14623940802207451

Larrivee, B., & Cooper, J. M. (2006). *An educator's guide to teacher reflection*. Cengage Learning.

Lew, M. D. N., & Schmidt, H. G. (2011). Self-reflection and academic performance: Is there a relationship? *Advances in Health Sciences Education, 16*(4), 529–545. https://doi.org/10.1007/s10459-011-9298-z

Mason, J. (2002). *Researching your own practice: The discipline of noticing*. RoutledgeFalmer. https://doi.org/10.4324/9780203471876

Mthembu, S. G., & Mthimkhulu, S. M. (2024). Reflective practice among experienced Physics teachers: A cross-context analysis. *Journal of Science Teacher Education, 35*(2), 142–161.

Nguyen, Q. D., Fernandez, N., Karsenti, T., & Charlin, B. (2014). What is reflection? A conceptual analysis of major definitions and a proposal of a five-component model. *Medical Education, 48*(12), 1176–1189. https://doi.org/10.1111/medu.12583

Nurjannah, N., Supriyatman, S., & Kade, A. (2019). University students' self-reflection ability on thermal insulation concepts. *Journal of Physics: Conference Series, 1280*(5), 052024. https://doi.org/10.1088/1742-6596/1280/5/052024

Özüdoğru, F. (2021). The levels of reflection in pre-service teachers' reflective journals. *International Online Journal of Education and Teaching, 8*(2), 1226–1242.

Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). SAGE.

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory Into Practice, 41*(4), 219–225. https://doi.org/10.1207/s15430421tip4104_3

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health, 29*(5), 489–497. https://doi.org/10.1002/nur.20147

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. Jossey-Bass.

Simoncini, K., Lasen, M., & Rocco, S. (2014). Professional dialogue, reflective practice and teacher research: Engaging early-childhood pre-service teachers in collegial dialogue about curriculum innovation. *Australian Journal of Teacher Education, 39*(1), 1–17. https://doi.org/10.14221/ajte.2014v39n1.1

Smith, R., Geng, G., & Black, P. (2016). Teachers as reflective practitioners. In R. Smith & G. Geng (Eds.), *The challenge of teaching* (pp. 29–42). Springer. https://doi.org/10.1007/978-981-10-2571-6_4

Stake, R. E. (2006). *Multiple case study analysis*. Guilford Press.

Toh, K. A. (2001). Reflection in teacher education. *Educational Research for Policy and Practice, 2*(1), 31–39.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE.