Professional Noticing Journal for Evidence-Linked Decisions and Teacher Learning

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This paper introduces the Professional Noticing Journal (PNJ), a learner-centred artefact that keeps attention on students and enables professional noticing. Drawing on two lesson study teams, we show how PNJ entries anchored teaching decisions in student evidence and interpretations, surfaced recurring issues (tool use, units and language, and "answers without explanation"), and prompted targeted responses. Teams converged on portable routines—brief tool onboarding, visible anchors, just-in-time reviews, a Result–How–Meaning talk frame, and a non-tech route. The PNJ also served as a boundary object, coordinating roles and post-lesson discussions.

Introduction

Improving mathematics instruction depends on teachers' capacity to notice and respond to student thinking. Research on professional noticing conceptualises this work as attending to strategies, interpreting understandings, and deciding how to respond (Jacobs et al., 2010; Sherin et al., 2011). Professional development has advanced methods for sharpening attention and interpretation, often with video or structured discussion (Santagata, 2011; van Es & Sherin, 2002, 2008). Yet a persistent gap remains: translating noticing into clear, content-specific next moves during live lessons and documenting how those moves arise from evidence. In Lesson Study (LS), post-lesson discussions also tend to drift from student data toward general advice unless talk is anchored by shared artefacts (Fernandez & Yoshida, 2004; Lewis et al., 2009).

In this paper, we propose a simple artefact to address this gap. The Professional Noticing Journal (PNJ) is a one-page artefact that asks observers to write about learners across four linked components: Observation, Interpretation, Decision, Reflection (O–I–D–R). Conceptually, the PNJ is designed to (a) support a simple traceability check from observation and interpretation to the proposed move, and (b) record brief carry-forward notes in the Reflection column that can inform subsequent planning. We frame the PNJ as a boundary object intended to coordinate roles and phases within LS while keeping attention on students (Akkerman & Bakker, 2011; Star & Griesemer, 1989).

To analyse what kinds of teacher knowledge, appear in PNJ entries, we use Mathematical Knowledge for Teaching (MKT) as an interpretive lens (Ball et al., 2008) to examine whether and how knowledge-in-use becomes visible.

This study examines the PNJ in two mathematics research lessons from the Philippine curriculum—Grade 7 discounts/percentages and Grade 9 quadratic functions in vertex form—as the first analysed cases in a larger programme on artefact-mediated LS. The study addresses the following research questions:

1. How does the PNJ surface student thinking and teachers' knowledge-in-use in written entries and in the post lesson analysis and discussion (PLAD)?
2. What carry-forward notes do teachers record, and how are these used in post-lesson discussion?
3. To what extent do written decisions explicitly cite prior observations and interpretations?

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Theoretical Framing

Professional Noticing of Students Mathematical Thinking

Professional noticing conceptualises in-the-moment teacher expertise as three interrelated skills: attending to students' strategies, interpreting what those reveal about understanding, and deciding how to respond (Jacobs et al., 2010; Sherin et al., 2011). Much of this work has used video- or artifact-based tasks to cultivate selective attention and sense-making (van Es & Sherin, 2002, 2008) and to structure PD routines that sharpen analyses of student thinking (Santagata, 2011). A persistent challenge is turning noticing into traceable, warranted pedagogical moves in live lessons and collaborative settings such as Lesson Study. Tools that require written observation, interpretation, and decision (O-I-D) can externalise tacit thinking, discipline post-lesson talk, and build shared repertoires. The PNJ extends this literature by adding an explicit Reflection column to capture portable principles or routines and by making the O→I→D linkage inspectable.

Mathematical Knowledge for Teaching (MKT)

MKT frames the knowledge used in the work of teaching mathematics (Ball et al., 2008) and is employed here as an interpretive lens for the PNJ entries and post-lesson discussion. The analysis attends to Subject Matter Knowledge (SMK)—including common, specialised, and horizon aspects where relevant—and to Pedagogical Content Knowledge (PCK), comprising Knowledge of Content and Students (KCS) and Knowledge of Content and Teaching (KCT), as well as Knowledge of Content and Curriculum (KCC) (Hill et al., 2008). Coding marks instances where these components are made visible in the written/spoken record and notes sequences in which one component appears to inform another (e.g., evidence about student thinking informing the selection or sequencing of representations), without presupposing which components will be most salient. The framework is used descriptively— to characterise knowledge-in-use as it becomes public through PNJ records and team talk—rather than to rate quality or quantity of knowledge.

Lesson Study as Context for Generating Practical Knowledge

Lesson Study is a collaborative, iterative process in which teachers study, plan, enact, and analyse research lessons to improve instruction (Fernandez & Yoshida, 2004; Lewis et al., 2009). Because Lesson Study aims to centre discussion on evidence of student thinking and to accumulate sharable instructional knowledge across cycles, it provides the collaborative context in which PNJ records are generated and then used to inform subsequent teaching. That is, by design, the PNJ targets this need: it serves as a learner-centred record during observation and as a scaffold for focused, evidence-linked post-lesson discussion.

Boundary Objects and Design-Based Research

Tools that travel across roles and settings must be robust enough to be shared and flexible enough to be locally adapted, qualities captured by boundary objects (Akkerman & Bakker, 2011; Star & Griesemer, 1989). We therefore position the PNJ as a boundary object—a portable, refinable artefact that coordinates attention across observers, teachers, and facilitators via the shared structure Observation → Interpretation → Decision → Reflection. Methodologically, the work aligns with Design-Based Research (DBR), which iteratively co-designs, tests, and refines mediational tools in naturalistic settings to generate practical solutions and theoretical insight (Cobb et al., 2003). DBR guides the design choices that keep the PNJ learner-centred, require interpretive warrants for decisions, and capture reusable routines in the Reflection column.

Method

This study forms part of a larger programme on teacher learning in artefact-mediated LS, using a qualitative multiple-case design. We report two illustrative LS cycles in mathematics to examine how the PNJ works in practice. Specifically, we analyse how the PNJ (a) surfaces evidence of student thinking, (b) makes pedagogical decisions traceable to that evidence and its interpretations, and (c) captures brief “carry-forward” routines in reflections.

The two cases presented are purposively selected for pedagogically distinct topics—Grade 7 discounts/percentages and Grade 9 quadratic functions (vertex form)—to probe the PNJ’s functioning across grade levels, content demands, and representational resources.

The participants

Data were collected in ordinary school settings during two research lessons in the Philippines: Case 1 (Grade 7; discounts/percentages) and Case 2 (Grade 9; quadratic functions in vertex form). For analytic purposes, cases are labelled using a two-part code indicating case number and grade level (eg., 1-G7 denotes Case 1 LS in Grade 7; 2-G9 denotes Case 2 LS in Grade 9). Case 1 involved an LS team of 8 mathematics teachers, while Case 2 involved 4 mathematics teachers from nearby schools. All teams completed an introductory training course on doing LS, including an orientation to using the PNJ during observation and discussion. The trainers served as a ‘knowledgeable other’ who provides expert guidance during the LS process, and facilitator. No identifying information about individuals or schools is reported.

The Two Case Lessons

The Grade 7 lesson unfolded in five episodes. First, a learner facilitated a quick drill on basic arithmetic using teacher-made cards (e.g., 6+4, 30−2), with volunteers responding and the teacher confirming correctness. Second, the class briefly recalled decimal–percent equivalents; again, students supplied answers and the teacher verified without extended explanation. Third, students worked with a GeoGebra applet *Discount Activity 1* (geogebra.org/m/kmsmndvn), in which sliders controlled the original price (0–1200) and discount rate (0–50%). The applet displayed corresponding bar representations of the original and discounted prices, allowing students to observe how changes in discount rate affected the selling price. In groups, they populated a table (original price, discount rate, selling price), then addressed follow-up questions aimed at noticing patterns (e.g., how selling price changes with discount rate). Selected entries were recorded on the board before discussion. Fourth, the teacher introduced concise definitions of discount and selling price, with students reading them aloud. Fifth, students used the same applet to complete a second table tied to images with given prices and discount rates—each group handled one row—then answered prompts leading to conjectures for computing discount amount and selling price. Groups presented their results on the board, and the teacher facilitated a brief whole-class consolidation to formulate the general procedure.

The Grade 9 lesson introduced transformations of the quadratic parent function $y=a(x-h)^2+k$ by examining the parameters a, h, and k. It opened with real-world parabolic images to motivate the topic, followed by a brief review of the parent function $y=x^2$ and its invariants (upward opening, vertex at (0,0), symmetry). Students then worked in groups on shared tablets using Desmos across three focused episodes: vertical shifts (k) with $y=x^2+k$, noting the vertex moves up/down while shape and symmetry remain; horizontal shifts (h) with $y=(x-h)^2$, identifying vertex movement to (h,0) and the direction rule from the sign; and the multiplier a with $y=ax^2$, concluding |a| narrows, $0<|a|<1$ widens, and negative a reflects across the x-axis. Groups recorded observations in small tables. The lesson closed with a synthesis task in which students, without technology, predicted and sketched graphs in vertex form $y=a(x-h)^2+k$, identifying the vertex at (h,k) and articulating how a, h, and k each affect the graph.

Data sources

The study drew on two streams of evidence from the two LS teams: (a) the Professional Noticing Journals completed individually by the team members (6 for Grade 7 and 5 for Grade 9) during the research lesson and immediately afterward, and (b) verbatim transcripts of the teams' post-lesson analysis and discussion (PLAD). All artefacts were anonymised. The PNJ is a one-page template that structures Observation → Interpretation → Decision → Reflection (O→I→D→R) and requires entries about learners, not the teacher. Prompts ask observers to: (1) record what students did/said, (2) infer what this suggests about understanding, (3) state a pedagogical decision, and (4) note a brief principle or routine to carry forward. Figure 1 shows an excerpt from one of the PNJ's that we analysed.

Figure 1

Verbatim Professional Noticing Journal entry from case 1

PROFESSIONAL NOTICING JOURNAL

Name: [redacted] **Date**: August 11, 2025

Lesson/Topic: Solve Money Problems Involving Percentages **School of Implementation**: [redacted]

EPISODES	**(#1) OBSERVING** *What caught your attention about what the learner(s) said and did in this episode?*	**(#2) INTERPRETING** *What could this (your entry in #1) mean in relation to their understanding?*	**(#3) DECISION MAKING** *What pedagogical decision may be made in relation to #1 and #2?*	**(#4) REFLECTING** *What insights have you gained based on your answers in #1, #2, and #3?*
Episode 1 (Activitating Prior Knowledge)	The students were unable to cite decimals correctly. For example, 23.5% was expressed as zero point 123 rather than 123 thousandths.	If this misconception is not corrected right away, the learners will bring it with them, and what they remember will be used repeatedly.	Numeracy and literacy go hand in hand. It is extremely crucial in Mathematics to utilize mathematical words.	Learners will only recall what their teachers have taught them. Improvement in numeracy is dependent on how we teach and communicate knowledge to students.
Episode 2 (Task 1)	Learners initially worked independently exploring the applet. Their expressions reflect curiosity and excitement. They ignore the instructions and proceed directly to explore the applet. There was no discussion on what their final answer would be. They are excited to write down their own findings in the activity sheet.	Exploring the applet for the first time and observing what happens when they move the slider draws learners' interest in using the gadget and discovering how it works. It's just that they only move the slider for discounts, thus their original prices are all ₱1,200.	Because this is the first time the students will use the applet, the teacher must thoroughly explain the three procedures before instructing them to form groups. Activity sheets must be distributed first so that students figure out what tasks must be performed before being told to bring in their gadget.	Clear instructions and an activity sequence are critical to learners' understanding of the work at hand. Because each learner is unique, the facilitators play an important role in their success.

Analytic strategy

We conducted qualitative thematic analysis in two coding cycles across both data sources (PNJ entries and PLAD transcripts) using a single, shared codebook.

Cycle1: Structural and open coding. For PNJ sheets, each entry was treated as four linked components—Observation (O), Interpretation (I), Decision (D), Reflection (R)—and inductively open-coded within component to capture salient features of what teachers noticed, how they made sense of it, what moves they proposed, and what principle/routine they recorded. For PLAD, transcripts were segmented into idea units (speaker turns or clauses that advanced a distinct point). Each unit was tagged O, I, D, or R when it functioned as an observation about students, an interpretation of understanding, a proposed/past teaching move, or a generalisable takeaway. The same open-coding scheme used for PNJ components was applied to PLAD units.

Cycle 2: Theme development. First-cycle codes from both sources were clustered into shared, practice-proximal themes to support cross-case comparison: tools/onboarding, prior knowledge, language & units/representations, reporting & discourse, and access/logistics. Themes were refined through iterative memoing and constant comparison.

Horizontal alignment (within-source coherence). For PNJ, we examined horizontal alignment across O→I→D→R within each entry, marking explicit textual links (e.g., a

Decision that cites or paraphrases a recorded Observation/Interpretation) and classifying linkages as present/absent. For PLAD, we analysed local discourse segments for O→I→D→R sequences, noting whether later turns explicitly took up earlier observations (e.g., "Given what we saw about % vs ₱…"). Alignment summaries were produced at the case level.

Traceability of pedagogical moves. For every Decision in both PNJ and PLAD, coders checked whether the move explicitly referenced (a) at least one prior Observation (D→O) and (b) an Interpretation where present (D→[O+I]). Counts and proportions were computed separately for PNJ and PLAD to describe warranting practices, and representative excerpts were selected.

To enhance credibility and dependability, two researchers co-developed the O/I/D/R codebook and thematic tag definitions using a small PNJ subset, iteratively refining examples and decision rules. A sample of PNJ lines and adjacent PLAD segments was independently double-coded and then reconciled through discussion; disagreements were used to clarify boundaries between codes and to revise the guide. For decisions, we conducted a traceability audit that checked whether each recorded move was explicitly warranted by prior observations and, where present, interpretations, verifying links against the original PNJ text and corresponding PLAD excerpts. Triangulation was supported by convergence between written PNJ entries and spoken references in PLAD, and analytic transparency was maintained through a running log of codebook revisions, rationale for merges/splits, and exemplar selection. All artefacts were anonymised; the focus of analysis remained on aggregated patterns of professional learning rather than evaluation of individuals.

Ethical considerations

Clearance was granted by the Schools Division of Pasig who requested the training. Prior to participation in the training course, teachers provided informed consent for the use of data generated during the training and its associated Lesson Study activities. For students present during classroom observations, parental consent was secured in advance. All PNJs and post-lesson discussion transcripts were anonymised, and no student names or other identifying details are reported. The analysis focused on teachers' professional learning and aggregated patterns across cases rather than on the evaluation of individual teachers or students.

Results

Surfacing student thinking and teachers' knowledge-in-use in PNJs (RQ1)

Results show that the journal consistently surfaces evidence of students' mathematical thinking alongside teachers' knowledge-in-use. Across both cases, teachers attended to how learners engaged with representations, tools, and explanations, and interpreted these observations in ways that informed content-specific pedagogical decisions.

In Case 1 (Grade 7 percentages/discounts), PNJs frequently documented learners' correct numerical responses that were not supported by explanations, confusion between decimal and percentage representations, and difficulty manipulating the GeoGebra applet used to explore different discount contexts. These observations were interpreted as indicators of weak conceptual grounding and limited familiarity with digital tools. As detailed in the Figure 1 excerpt, the Grade 7 entry documents weak conceptual grounding, such as misnaming 23.5% as "zero point 123", and limited tool familiarity when students distractedly played with the applet rather than following task instructions. These specific observations directly informed the teacher's pedagogical decisions, which reflected teachers' knowledge-in-use, such as planning brief pre-task onboarding for tool use, clarifying terminology through examples, and restructuring tasks such that learners are required to explain not only the results but also meanings.

In Case 2 (Grade 9 quadratic functions in vertex form), PNJs highlighted learners' reliance on Desmos to identify features of graphs, partial recall of properties of the parent function, and occasional mistakes in naming or describing parameters. These were interpreted as signs that geometric representations supported access to key ideas but that prerequisite knowledge needs reinforcement. Pedagogical decisions emphasised retaining dynamic representations supplemented with explicit recall of function properties and non-technology tasks to consolidate understanding.

Table 1 summarises the recurring themes in the PNJs across the two cases (coded as 1-G7 for Case 1, Grade 7, and 2-G9 for Case 2, Grade 9), linking observed student thinking to interpretations and corresponding pedagogical moves proposed by observers. The table represents recurring patterns across entries rather than exhaustive enumeration of all PNJs.

Table 1

Recurring observations, interpretations, decisions, and reflections (O–I–D–R) across cases

Observation/Surfaced student thinking	Interpretation of understanding	Pedagogical Decisions	Carry-forward Reflections	Case Code
Correct answers given without explanation	Computation detached from meaning	Structure reporting using a Result-How-Meaning frame	Structure discourse that foregrounds explanations	1-G7
Difficulty manipulating GeoGebra sliders	Limited tool familiarity constraining access to concepts	Micro-onboarding prior to task engagement	Tool fluency supports conceptual access	1-G7
Confusion between decimal and percent forms	Weak conceptual grounding in representations	Clarify terminology through examples	Precision in mathematical language (naming) matters	1-G7
Reliance on Desmos to identify graph features	Digital (visual) tools support access but mask gaps in recall	Retain dynamic representations with explicit recall	Representations should be paired with sense-making	2-G9
Incorrect naming of parameters and properties	Partial understanding of function features	Reinforce prerequisite knowledge and language	Prior knowledge must be activated purposefully	2-G9

Carry-forward routines articulated in PNJ reflections (RQ2)

As summarised in Table 1, reflection entries in the PNJs articulated carry-forward routines that abstracted across specific lesson episodes. Rather than recounting isolated observations or decisions, these reflections named principles that addressed recurring instructional challenges, such as the importance of structuring classroom discourse to foreground explanations, and micro-onboarding of digital mathematics tools particularly when they are central to the lesson. Reflections also highlighted the importance of reviewing prerequisite knowledge and skills aligned with the main lesson, and purposeful recall activities that are directly tied to the object of learning.

In post-lesson analyses and discussion, the LS team members and the observers took up these routines as shared reference points when considering revisions and subsequent implementations. Taken together, the reflection entries show how the PNJ functions not only as an artifact for noticing and decision-making but also as a mechanism for carrying forward reusable instructional routines beyond the immediate lesson.

Traceability of pedagogical decisions across PNJ entries (RQ3)

To address RQ3, PNJ entries were examined for horizontal alignment across Observation, Interpretation, and Decision components only. Alignment focused on whether pedagogical decisions meaningfully took up recorded observations of learner activity and corresponding interpretations of understanding. Reflection entries were excluded from this analysis because they are designed to capture carry-forward generalisations.

Table 2

Horizontal alignment of PNJ entries by case

Alignment category	**Definition**	**Case 1 (G7) n=24**	**Case 2 (G9) n=16**
Fully aligned	Observation and interpretation are explicitly taken up in the pedagogical decision	16 (66.7%)	15 (93.8%)
Partially aligned	Observation and interpretation are coherent, but the decision addresses only part of the interpreted issue	0 (0%)	0 (0%)
Weakly aligned	Observation is present, but the decision is generic or weakly connected	0 (0%)	0 (0%)
Misaligned	Observation and interpretation do not meaningfully inform the decision	8 (33.3%)	1 (6.2%)

As shown in Table 2, most PNJ entries in both cases demonstrated full alignment across O–I–D, indicating that pedagogical decisions were coherently grounded in documented student evidence and interpretations. In Case 1 (Grade 7), two-thirds of entries were fully aligned, while the remaining entries were classified as misaligned, reflecting decisions that were generic or not clearly informed by the specific observations and interpretations recorded. In Case 2 (Grade 9), nearly all entries were fully aligned, with only one entry classified as misaligned.

Discussion and Conclusion

Across both lessons, the PNJ helped teachers keep their focus on students. Entries paired what learners did and said with what that might mean, and then named a teaching move to try next. In Grade 7 (percentages/discounts), teachers often saw correct answers with no explanation, mix-ups between decimals and percents, and struggles with the GeoGebra applet. Their decisions followed from this: give a short tool onboarding before the task, use concrete examples to fix language, and ask groups to report Result → How → Meaning. In Grade 9 (vertex form), teachers noted reliance on Desmos, partial recall of the parent function, and slips in naming parameters; they chose to keep the dynamic graphs but add quick recall prompts and a no-tech follow-up so ideas would stick. This pattern fits what the noticing literature aims for—attend, interpret, decide (e.g., Jacobs et al., 2010)—and, viewed through Mathematical Knowledge for Teaching, shows KCS → KCT links: evidence about student thinking leading to content-specific moves (Ball et al., 2008).

The horizontal alignment check supports this reading: most entries were fully aligned from Observation to Interpretation to Decision (Table 2). As illustrated in Figure 1, teachers translated immediate observations, into targeted decisions and reusable, carry-forward routines, recognising that "clear instructions and an activity sequence are critical to learners' understanding". Where entries were misaligned (more in Grade 7), decisions tended to be general next steps rather than a direct take-up of the recorded evidence. A simple fix is to model a one-sentence warrant ("Because we saw X and think it means Y, we will do Z") and to add a PNJ prompt, "Which student evidence triggered this decision?"

There were two features of the PNJ that added clear value. First, the Reflection column captured short, reusable routines—brief tool onboarding, visible anchors for language/units or parameter–feature links, just-in-time reviews, the Result–How–Meaning frame, and a non-tech route—that teams re-used in post-lesson discussions and future lessons. Second, the PNJ acted as a shared tool that kept our conversations anchored to what students did and what we should do next, addressing a common LS challenge of drifting away from student evidence.

We studied two cases and worked from written and spoken records, so we did not track enactment or learner outcomes; this limits how far we can generalise. Even so, we invite teams to adopt the PNJ, open debriefs with a brief O–I–D check, and institutionalise the common routines above. Our future research will extend the analysis to additional topics, grade bands, and schools; use a comparative design to contrast PNJ-guided debriefs with conventional protocols; and trace enactment by following the uptake of carry-forward routines into subsequent lessons across cycles. We will also test whether stronger O–I–D alignment in PNJs predicts improvements in the quality of student explanations and representations over time, using common indicators and inter-rater reliability checks. Finally, we will examine when SMK and KCC become visible (planning vs. PLAD) and how facilitation practices mediate the PNJ's work as a boundary object.

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