



Optimizing *IPAS* learning to improve learning outcomes through the application of the teaching at the right level approach integrated with quizizz

Darinda Sofia Tanjung  ¹, Nanda Julfa Rezeki ¹, Lolly Jean C. Simbulas ²

¹ Universitas Katolik Santo Thomas, Medan, Indonesia, 20132

² University of the Immaculate Conception, Davao City, Philippines, 8000

Article info	Abstract
Keywords; classroom action research, ethnic and cultural diversity, ipas, learning outcomes teaching at the right level	This classroom action research examined whether the Teaching at the Right Level (TaRL) approach could improve fourth-grade students' learning outcomes in IPAS, especially on the topic of ethnic and cultural diversity, at UPT SDN 066047 Medan Helvetia. The study involved 14 students and was conducted in two cycles. The mean score increased from 57 in the pre-cycle to 76 in Cycle I and 89 in Cycle II, while classical mastery improved from 43% to 79% and finally to 100%. The study addresses a gap in the Indonesian elementary education literature, where TaRL has been discussed more often in literacy and numeracy than in interdisciplinary IPAS learning for lower- and middle-grade students. Its contribution lies in showing how diagnostic grouping, focused reinforcement, and cycle-based reflection can be operationalized in a real classroom to improve conceptual understanding of a contextually meaningful IPAS topic. The findings suggest that TaRL is not only effective at improving test performance but also a useful adaptive pedagogical strategy for elementary classrooms with heterogeneous readiness levels. The study therefore provides empirical support for differentiated instruction in IPAS and offers a practical reference for teachers seeking more responsive classroom interventions.

* Corresponding Author.

E-mail address: darinda_tanjung@ust.ac.id (Darinda Sofia Tanjung)

DOI: <http://dx.doi.org/10.33578/jpfkip.v15i2.481-493>

Received 31 January 2026; Received in revised form 20 March 2026; Accepted 18 April 2026

Available online 29 April 2026

e-ISSN 2598-5949 | p-ISSN 2303-1514 © The Authors.

1. Introduction

IPAS in elementary school is expected to do more than transmit factual knowledge. It should help children interpret social and natural realities, connect classroom ideas with lived experience, and develop the habits of observation, comparison, questioning, and explanation. Those expectations become especially demanding when students are asked to understand ethnic and cultural diversity, a topic that is conceptually rich and socially meaningful. The topic

asks young learners to move beyond memorizing labels. They must recognize differences, identify relationships, and understand why diversity matters in everyday civic life.

In practice, that expectation is not always matched by classroom conditions. In many elementary classrooms, students enter the lesson with varying prior knowledge, differing levels of language readiness, and varying confidence in participating. When instruction is delivered uniformly, students who already understand the material move on, while those still consolidating basic concepts are left behind. This pattern has been documented well beyond Indonesia. In India, Banerjee, Cole, Duflo, and Linden (2007) showed that targeted remedial instruction substantially improved the performance of students who had previously lagged. In Kenya, Duflo, Dupas, and Kremer (2011) likewise found that instruction aligned more closely with students' actual learning levels produced benefits, particularly for lower-achieving pupils.

Recent international research has reinforced the same broader message from different angles. A meta-analysis in primary education by Deunk et al. (2018) found that differentiated instruction can generate small to moderate academic gains when adaptation is purposeful rather than merely cosmetic. Goddard, Goddard, and Kim (2015) showed that school-level norms supporting differentiated instruction are positively associated with student achievement. At the level of teacher development, Valiandes and Neophytou (2018) and Kahmann, Droop, and Lazonder (2022) argued that differentiation becomes more meaningful when teachers are supported in diagnosing learning needs and translating those diagnoses into concrete classroom decisions.

This line of work is particularly relevant to IPAS because it combines conceptual understanding, contextual interpretation, and discussion-based learning. Adaptive Teaching in science-related settings has also been linked to improved student understanding. Hardy, Meschede, and Mannel (2022), for example, reported that adaptive classroom discourse in elementary science predicts stronger conceptual learning. Inquiry-oriented reviews by Pedaste et al. (2015) and Dah, Noor, Kamarudin, and Azziz (2024) similarly suggest that elementary learners benefit when instruction is sequenced, scaffolded, and responsive to their level of understanding rather than imposed as a fixed one-size-fits-all routine.

A second development in the international literature concerns engagement. Hwang, Chiu, and Chen (2015) found that contextually embedded game-based learning can improve achievement and motivation in social studies. Broader syntheses by Bai, Hew, and Huang (2020), Sailer and Homner (2020), and Wang and Tahir (2020) suggest that gamified or quiz-based environments are most useful when they support feedback, participation, and repeated retrieval. In other words, technology is not inherently transformative. It becomes useful when it strengthens adaptive pedagogy. That state-of-the-art matters here because it shifts the focus away from tools alone and toward the instructional logic that organizes them.

Within the Indonesian context, studies on TaRL have grown rapidly, but much of the evidence still clusters around literacy, numeracy, or broad descriptions of implementation. Studies examining TaRL in elementary IPAS, especially in culturally grounded material, remain relatively limited. Even when IPAS is addressed, the literature often reports endpoint improvement without showing how mastery develops across cycles of classroom action. What remains underexplored, therefore, is not simply whether TaRL works in general, but how diagnostic grouping, leveled support, and iterative reflection operate in a real elementary IPAS classroom on a conceptually layered topic such as ethnic and cultural diversity.

The present study was designed to address that gap. Rather than treating TaRL as a slogan, the study operationalizes it as a sequence of diagnostic assessment, grouping by readiness, differentiated instruction, targeted reinforcement, and reflective revision across two classroom

action cycles. Its originality lies in this concrete classroom-level enactment and in its close tracking of student progress from the pre-cycle to Cycle II. The study does not claim novelty by inventing a new theory. Its contribution is more grounded than that. It offers situated empirical evidence on how TaRL can be adapted for fourth-grade IPAS in an Indonesian public elementary school.

Accordingly, this study aims to analyze improvements in fourth-grade students' IPAS learning outcomes on the topic of ethnic and cultural diversity through the Teaching at the Right Level approach. The study also seeks to clarify the pedagogical value of cycle-based refinement, thereby contributing to current discussions on differentiated instruction, adaptive pedagogy, and classroom-based improvement within elementary education.

2. Literature review

2.1 Teaching at the right level and differentiated instruction

Teaching at the Right Level (TaRL) is an instructional approach that begins with a simple proposition: Teaching should start from the learner's current level of understanding rather than from age, grade label, or curriculum pace alone. Pratham popularized the approach in India and has since been discussed as a practical model of targeted instruction for heterogeneous classrooms (Banerji & Chavan, 2016). In pedagogical terms, TaRL is closely aligned with differentiated instruction because both emphasize diagnosis, adaptation, scaffolding, and flexible grouping.

Differentiated instruction, however, should not be reduced to giving students different worksheets. Deunk et al. (2018) note that differentiation is most effective when it combines targeted grouping, adjusted content or process, and sustained monitoring. Valiandes and Neophytou (2018) further show that teachers need structured professional learning to make such an adaptation pedagogically coherent. In this respect, TaRL offers a more operational classroom pathway: assess, group, teach, monitor, regroup, and reinforce.

2.2 IPAS learning, conceptual understanding, and inquiry

IPAS at the elementary level is interdisciplinary. Students are expected to understand social relations, everyday phenomena, and the connection between concepts and context. Such learning demands gradual conceptual construction, not mere exposure to content. Inquiry-oriented scholarship helps explain why. Pedaste et al. (2015) identify inquiry as a staged process involving orientation, conceptualization, investigation, conclusion, and discussion. Dah et al. (2024) add that inquiry can improve science learning, but only when Teaching provides sufficient structure, interaction, and support.

For topics such as ethnic and cultural diversity, conceptual growth depends on students' ability to connect examples, compare patterns, and discuss meaningfully with peers and teachers. This makes readiness-sensitive Teaching especially important. If students are not yet secure in foundational ideas, higher-level discussion may become superficial. TaRL is relevant here because it allows the teacher to pace conceptual work based on students' actual readiness.

2.3 Learning outcomes and formative feedback

Learning outcomes in school settings refer not only to final scores but to evidence of cognitive progress across a sequence of instructional experiences. In classroom action research, those outcomes are interpreted through repeated cycles of planning, action, observation, and reflection. The value of this design lies in its responsiveness. Teachers can diagnose obstacles,

revise instruction, and test whether the revision improves student understanding in the next cycle.

International evidence on gamified and quiz-based learning also highlights the role of frequent feedback. Hwang et al. (2015) reported gains in learning achievement and motivation in social studies when game-based contexts were used meaningfully. Bai et al. (2020), Sailer and Homner (2020), and Wang and Tahir (2020) show that gamified feedback can strengthen learning performance and engagement when it supports repetition, progress visibility, and timely correction. These findings do not replace differentiated instruction; they reinforce the importance of feedback-rich environments within it.

2.4 Theoretical framework

This study is grounded in a practical conceptual framework that combines differentiated instruction, adaptive Teaching, and mastery-oriented learning. First, differentiated instruction holds that students with different readiness levels should not be taught at the same pace or with the same support structure (Deunk et al., 2018). Second, adaptive Teaching emphasizes the teacher's ability to diagnose understanding in real time and adjust discourse, scaffolding, and task difficulty accordingly (Hardy et al., 2022). Third, mastery-oriented learning assumes that stronger outcomes emerge when students consolidate prerequisite understanding before moving to more demanding tasks.

Applied to the present study, the framework works as follows: baseline diagnosis identifies readiness; readiness grouping makes instructional support more precise; leveled tasks and guided discussion reduce the mismatch between instruction and student capacity; ongoing formative checks allow regrouping and reinforcement; and repeated cycles of reflection improve instructional fit. From this perspective, improved learning outcomes are expected not because TaRL is inherently superior in every context, but because it narrows the gap between what is taught and what students are actually ready to learn.

3. Method

This study employed classroom action research (CAR) conducted collaboratively with the fourth-grade classroom teacher at UPT SDN 066047 Medan Helvetia. The study involved 14 fourth-grade students and focused on IPAS learning on ethnic and cultural diversity. CAR was selected because the main problem was instructional rather than merely descriptive: the class showed uneven prior understanding, low mastery, and limited engagement, all of which required iterative pedagogical improvement rather than a single one-off intervention.

The research was conducted in two cycles, each comprising planning, action, observation, and reflection. Figure 1 presents the general flow of the action research process used in this study. In the planning stage, the teacher and researcher identified learning obstacles, prepared diagnostic tasks, designed grouped activities, and determined cycle targets. In the action stage, students were grouped according to their demonstrated readiness and received learning activities adjusted to their level. Observation focused on participation, responsiveness, and difficulties encountered during instruction. Reflection was then used to revise grouping patterns, explanations, reinforcement strategies, and classroom management for the next cycle.

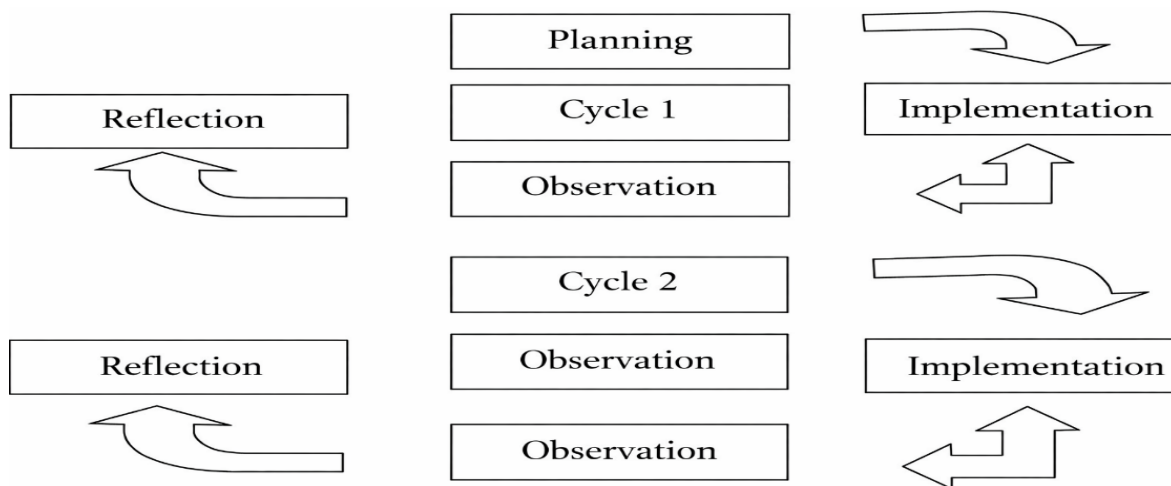


Figure 1. Research flow

The intervention followed TaRL's core logic. At the beginning of each cycle, students' current understanding was identified through diagnostic assessment, after which instruction and reinforcement were adjusted to the learners' readiness levels. The principal quantitative instruments were the pretest and posttest in each cycle, while classroom observations and reflective notes were used to support the interpretation of learning progress across the action cycles.

Student achievement was interpreted using the school's Learning Objective Achievement Criteria (KKTP). Table 1 presents the mastery categories used to judge whether individual students had reached mastery, whereas Table 2 summarizes the interpretation used to assess classical learning mastery at the class level.

Table 1. KKTP categories

Achievement Category	Score Range (0–100)	Status
Very Good (VG)	86 – 100	Mastery
Good (G)	76 – 85	Mastery
Fair (F)	66 – 75	Mastery
Needs Improvement (NI)	≤ 65	Not Mastery

Table 2. Interpretation of traditional learning outcomes

Score Interval	Quality Level	Letter Grade
90% – 100%	Very Good	A
80% – 89%	Good	B
70% – 79%	Fair	C
60% – 69%	Poor	D
≤ 59%	Very Poor	E

To determine the magnitude of improvement in students' learning outcomes, the normalized gain (N-gain) statistic was calculated using the following formula:

$$g = \frac{S_{postes} - S_{pretetes}}{S_{maks} - S_{pre}}$$

Table 3 shows the criteria used to classify the normalized gain score and to interpret the magnitude of improvement from one cycle to the next.

Table 3. Gain index criteria

N-Gain Index (g)	Category
$g < 0.3$	Low
$0.3 \leq g < 0.7$	Moderate
$g \geq 0.7$	High

From an ethical standpoint, the study was conducted as a classroom-based instructional improvement in a natural school setting. No student names are reported in the revised narrative, and the findings are presented in aggregate form to protect participant privacy while preserving the pedagogical value of the analysis.

4. Results

4.1 Pre-cycle

At the beginning of the pre-cycle study, it was found that students in grade IV of UPT SDN 066047 Medan Helvetia, in the subject of IPAS (Science and Technology), on the topic of Ethnic and Cultural Diversity, had not met the minimum score required under the Learning Objective Achievement Criteria (KKTP). This was evident during the pretest on Ethnic and Cultural Diversity, where 8 students were categorized as needing guidance, 3 as adequate, 2 as good, and 1 as very good. In percentage terms, 57.14% of students did not meet the KKTP.

4.2 Cycle i implementation

Based on the implementation of cycle I in the study, the mastery of student learning outcomes in the pretest was 798 (average 57), with a highest score of 85 and a lowest score of 35, for a mastery rate of 43%. Based on the learning outcomes measurement, most students have not mastered the material taught at the beginning of the lesson. After the students participated in the teacher-led learning in Cycle I, the posttest results showed a total score of 1064, an average of 76, a high of 95, a low of 65, and a student mastery level of 79%. This data is shown in Table 4 below.

Table 4. Learning outcomes for cycle i

	Cycle I	
	Pretest	Posttest
Total Score	798	1064
Average Score	57	76
Minimum Score	35	65
Maximum Score	85	95
Mastery Percentage	43%	79%

In this case, students' learning outcomes showed an increase in learning completeness after being given action in cycle I using the Teaching at the Right Level (TaRL) learning approach. The interpretation of student learning completeness at 79% is considered good, according to the

success criteria adapted from the framework proposed by Arifin (2016), which considers the range of 70%-79% as moderately successful. The increase in student learning outcomes given treatment in cycle I with the implementation of learning using the Teaching at the Right Level (TaRL) approach was in the moderate category according to the calculation of the N -Gain value of 0.4, which, when interpreted according to (Hake, 1998), means that the classification criteria for a gain index of $0.3 \leq \text{gain index (g)} < 0.7$ is in the moderate category.

4.3 Implementation of cycle II

Based on the research in cycle II, it was found that the completeness of student learning outcomes in the pretest was 1064, with an average of 76; the highest score was 95 and the lowest was 65, for a completeness rate of 79%. These results were obtained from the scores at the end of learning in cycle I. After the students participated in the teacher-improved learning in cycle II, the posttest results showed a total score of 1250, an average score of 89, a highest score of 100, and a lowest score of 80, with a student mastery level of 100%. These data are shown in Table 5 below.

Table 5. Learning outcomes for cycle II

	Cycle II	
	Pretest	Posttest
Total Score	1064	1250
Average Score	76	89
Minimum Score	65	80
Maximum Score	95	100
Mastery Percentage	79%	100%

In this case, student learning outcomes improved from cycle I, where the learning completeness percentage was only 79% of the total number of students, to 100% in cycle II. The interpretation of student learning completeness in Cycle II was 100% and can be considered very good because it was in the very good quality category according to the success criteria adapted from the framework proposed by Arifin (2016), which states that a range of 90% to 100% is considered very good success.

The increase in learning outcomes of students who received treatment in cycle II with the implementation of learning using the Teaching at The Right Level (TaRL) approach, which had been improved, was in the moderate category according to the calculation of the N -Gain value of 0.6, which, when interpreted in accordance with, means that the classification criteria for a gain index of $0.3 \leq \text{gain index (g)} < 0.7$ is in the moderate category. It is known that the improvements in cycles I and II were both in the moderate category, but cycle II was assessed as having improved more because the N-Gain in cycle II was 0.6, whereas in cycle I it was 0.4.

4.4 Comparison of cycles I and II

The results of the study in the form of a comparison of student learning outcomes were obtained from IPAS learning outcome data using the Teaching at the Right Level (TaRL) approach in cycles I and II, as shown in Table 6 and Figure 3 below.

Table 6. Comparison of learning outcomes in cycles I and II

No	Indicator	Cycle I		Cycle II	
		Pretest	Posttest	Pretest	Posttest
1	Average Score	57	76	76	89
2	Minimum Score	35	65	65	80
3	Maximum Score	85	95	95	100
4	Mastery Level (%)	43%	79%	79%	100%

5. Discussion

The results show that TaRL improved learning outcomes in a measurable and educationally meaningful way. The increase from a mean of 57 in the pre-cycle to 89 in Cycle II is not merely a numerical gain. It suggests that when instruction is aligned with students' actual readiness, more students can enter the lesson productively, remain engaged, and reach conceptual mastery. This pattern is consistent with the logic of targeted instruction documented in India and Kenya, where students who were previously underserved by grade-level Teaching benefited when instruction was better matched to their learning level (Banerjee et al., 2007; Duflo et al., 2011).

The present findings also extend the discussion of differentiated instruction. Deunk et al. (2018) argue that differentiation becomes effective when it is purposeful, monitored, and supported by instructional decisions that go beyond superficial grouping. That argument is visible in the current study. The first cycle generated improvement, but it did not yet eliminate learning gaps. The second cycle, which refined explanation, reinforcement, and grouping decisions, produced much stronger class-wide mastery. This shows that differentiation is not a static technique. It is a responsive process. In that sense, the study supports the view that teachers need diagnostic sensitivity as much as they need pedagogical tools (Valiandes & Neophytou, 2018; Kahmann et al., 2022).

Another important point concerns subject matter. Much of the TaRL literature has emphasized literacy and numeracy, whereas IPAS requires students to interpret relationships among concepts, examples, and lived social realities. The improvement observed here indicates that TaRL is also relevant for conceptually layered IPAS topics when classroom tasks are sequenced appropriately. This aligns with findings on adaptive Teaching in elementary science, where contingent support and responsive discourse have been linked to stronger conceptual understanding (Hardy et al., 2022). It also resonates with inquiry-oriented work showing that students learn more effectively when exploration is scaffolded rather than left entirely unguided (Pedaste et al., 2015; Dah et al., 2024).

The study further suggests that engagement and understanding should not be sharply separated. In many classrooms, students struggle not only because the content is difficult but also because the instructional approach prevents active participation. International studies on game-based or quiz-supported learning show that feedback-rich, contextual, and participatory learning environments can strengthen both motivation and academic performance (Hwang et al., 2015; Bai et al., 2020; Sailer & Homner, 2020; Wang & Tahir, 2020). The present study did not test a digital platform as a separate variable. Even so, its results reinforce the same principle: students learn more effectively when instruction makes progress visible, reduces intimidation, and allows repeated success at an appropriate level of challenge.

From the standpoint of contribution to the field, this study offers three useful insights. First, it provides classroom-based evidence that TaRL can be used in elementary IPAS, not only in foundational literacy or numeracy. Second, it shows that the approach's strength lies in

diagnostic grouping and iterative refinement, not in grouping alone. Third, it demonstrates that full class mastery is more likely when action research is used to improve instructional fit across cycles. These points matter for journals concerned with elementary pedagogy because they connect adaptive instruction, classroom-based evidence, and subject-specific learning improvement.

At the same time, the argument must remain proportionate. The study involved one class with 14 students and a short intervention window. The gains are convincing within that context, but they do not justify a broad universal claim. The findings are best understood as strong contextual evidence. They show what TaRL can do in one elementary IPAS classroom when the approach is carefully implemented, systematically observed, and reflectively revised. That is a significant contribution, but it is still bounded by scale and duration.

6. Conclusion and implications

6.1 Conclusion

The study concludes that the Teaching at the Right Level approach improved fourth-grade students' IPAS learning outcomes in ethnic and cultural diversity at UPT SDN 066047 Medan Helvetia. Improvement was visible across all major indicators. The class size increased from 57 in the pre-cycle to 76 in Cycle I and 89 in Cycle II. Classical mastery rose from 43% to 79% and then to 100%. The N-gain scores in both cycles were moderate, but the higher value in Cycle II indicates that instructional refinement strengthened learning consolidation.

These findings support the view that TaRL can serve as an adaptive pedagogical strategy for elementary IPAS when it is implemented through diagnostic assessment, readiness-based grouping, leveled support, and reflective revision across cycles. The study also contributes to the literature by showing that TaRL is relevant to conceptually demanding social-contextual material, not only to literacy and numeracy.

Several limitations should be acknowledged. The study involved a single class and a relatively short implementation period. The data relied primarily on classroom-based achievement measures, so the study does not show whether the gains were sustained over time. Future studies should involve larger samples, more varied IPAS topics, delayed posttests, and, where possible, stronger documentation of ethical procedures and inter-rater evidence for classroom observations.

6.2 Implications

Practically, the findings suggest that elementary teachers should not wait until students fail repeatedly before adapting instruction. Early diagnosis, flexible grouping, and targeted reinforcement can reduce learning gaps before they become entrenched. For school leaders, the study points to the importance of creating a school climate that supports differentiation, collaborative reflection, and evidence-based improvement in everyday Teaching.

Theoretically, the study strengthens the connection among TaRL, differentiated instruction, adaptive Teaching, and mastery-oriented learning. It shows that these ideas are not competing frameworks. In classroom practice, they can work together. Methodologically, the study also underscores the value of classroom action research as a rigorous, practitioner-based approach to improving learning within the actual conditions of schooling.

Statement of Transfer of Responsibility

The preparer/editor did not received the necessary data or information required to complete and verify the following sections: Credit authorship contribution statement, declaration of competing interest, data availability statement, ethical approval/ethical declaration, acknowledgements, and AI disclosure statement. Accordingly, full academic and legal responsibility for the content and accuracy of these statements is hereby transferred to the authors, including any consequences arising from non-compliance with the target journal's policies and applicable ethical standards.

References

- Abdullah, R. (2017). Learning from the perspective of teacher creativity in utilizing learning media. *Lantanida Journal*, 4(1), 35–49. <https://doi.org/10.22373/lj.v4i1.1866>
- Ambarwati, N. F., Suyanti, R. D., Loh, A., Sembiring, R. K. B., Tanjung, D. S., & HS, D. W. S. (2025). Innovate integration of guided inquiry learning (GIL) and project-based learning (PjBL) to enhance students' science literacy. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 14(4), 569–583. <https://doi.org/10.33578/jpfkip.v14i4.p569-583>
- Annadzili, M. D., Asep, N., & Umi, K. (2024). Efforts to improve student learning activities using the TaRL approach in IPAS learning. *Journal of Education and Development*, 12(2), 129–134.
- Ardini, S. N. (2021). Implementation of Teaching at the Right Level to improve literacy and numeracy skills in elementary schools. *Journal of Elementary Education*, 12(2), 123–130.
- Arifin, Z. (2016). *Learning evaluation: Principles, techniques, and procedures* (8th ed.). Rosda Karya.
- Arikunto, S. (2016). *Research procedures: A practical approach*. Rineka Cipta.
- Badar, N., & Bakri, A. (2022). Analysis of the implementation of approaches and learning models in Indonesian language subjects for Grade IV elementary school. *PGSD: Journal of Elementary School Teacher Education*, 1(1).
- Bai, S., Hew, K. F., & Huang, B. (2020). Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. *Educational Research Review*, 30, Article 100322. <https://doi.org/10.1016/j.edurev.2020.100322>
- Banerjee, A. V., Cole, S., Duflo, E., & Linden, L. (2007). Remedying education: Evidence from two randomized experiments in India. *The Quarterly Journal of Economics*, 122(3), 1235–1264. <https://doi.org/10.1162/qjec.122.3.1235>
- Banerji, R., & Chavan, M. (2016). *Teaching at the Right Level: Evidence from India*. Pratham Education Foundation.
- Dah, N. M., Noor, M. S. A. M., Kamarudin, M. Z., & Azziz, S. S. S. A. (2024). The impacts of open inquiry on students' learning in science: A systematic literature review. *Educational Research Review*, 43, Article 100601. <https://doi.org/10.1016/j.edurev.2024.100601>
- Damanik, J. A., Sipayung, R., Tanjung, D. S., Gaol, R. L., Pinem, I., & Rajesh, V. (2025). The effect of the TGT cooperative learning model assisted by snakes and ladders on the mathematics learning outcomes of second-grade students. *Jurnal PAJAR (Pendidikan dan Pengajaran)*, 9(6), 739–751. <https://doi.org/10.33578/pjr.v9i6.297>
- Damayanti, T., Herpratiwi, H., Rohman, F., & Nurhanurawati. (2025). Cultivating critical thinking: The development and impact of PBL worksheets in elementary science learning.

- Primary: Jurnal Pendidikan Guru Sekolah Dasar, 14(6), 1011–1025. <https://doi.org/10.33578/jpfkip.v14i6.1011-1025>
- Deunk, M. I., Smale-Jacobse, A. E., de Boer, H., Doolaard, S., & Bosker, R. J. (2018). Effective differentiation practices: A systematic review and meta-analysis of studies on the cognitive effects of differentiation practices in primary education. *Educational Research Review*, 24, 31–54. <https://doi.org/10.1016/j.edurev.2018.02.002>
- Duflo, E., Dupas, P., & Kremer, M. (2011). Peer effects, teacher incentives, and the impact of tracking: Evidence from a randomized evaluation in Kenya. *American Economic Review*, 101(5), 1739–1774. <https://doi.org/10.1257/aer.101.5.1739>
- Faradila, A., Priantari, I., & Qamariyah, F. (2023). Teaching at the Right Level as a manifestation of Ki Hadjar Dewantara's thinking in the new paradigm of education. *Jurnal Pendidikan Non Formal*, 1(1), 10. <https://doi.org/10.47134/jpn.v1i1.101>
- Fathikhin, N., Davi, A., & Purwaningtijas. (2024). Learning with the TaRL approach to improve students' interest and learning outcomes in IPAS. *National Seminar on Social Sciences, Education, Humanities (SENASSDRA)*, 3(1), 586–591.
- Fathurrohman, P., & Sutikno, S. (2017). Teaching and learning strategies through the integration of general and Islamic concepts. *PT Refika Aditama*.
- Fitriani, S. N. (2022). Analysis of student literacy improvement using the ADABTA method through the TaRL approach. *BADAA: Scientific Journal of Primary Education*, 4(1), 180–189. <https://doi.org/10.37216/badaa.v4i1.580>
- Fitriyeni, F., Mustika, D., Sari, B. K., & Muslimah, D. (2026). Profile of science process skills of elementary teacher education students in science learning at primary schools. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 15(1), 106–121. <https://doi.org/10.33578/jpfkip.v15i1.106-121>
- Goddard, Y. L., Goddard, R. D., & Kim, M. (2015). School instructional climate and student achievement: An examination of group norms for differentiated instruction. *American Journal of Education*, 122(1), 111–131. <https://doi.org/10.1086/683293>
- Habeahan, S. J., Silaban, P. J., Ambarawati, N. F., Gaol, R. L., & Tanjung, D. S. (2023). The effect of the joyful learning method on third-grade students' learning outcomes in mathematics. *Jurnal PAJAR (Pendidikan dan Pengajaran)*, 7(5), 986–1001. <https://doi.org/10.33578/pjr.v7i5.9543>
- Hardy, I., Meschede, N., & Mannel, S. (2022). Measuring adaptive Teaching in classroom discourse: Effects on student learning in elementary science education. *Frontiers in Education*, 7, Article 1041316. <https://doi.org/10.3389/feduc.2022.1041316>
- Harefa, D., Gee, E., Ndruru, M., Sarumaha, M., Ndraha, L. D. M., Ndruru, K., & Telaumbanua, T. (2020). Application of the cooperative script learning model to improve IPAS learning outcomes. *JKPM (Journal of IPAS Education Studies)*, 6(1), 13.
- Hwang, G.-J., Chiu, L.-Y., & Chen, C.-H. (2015). A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses. *Computers & Education*, 81, 13–25. <https://doi.org/10.1016/j.compedu.2014.09.006>
- Juliana, Tanjung, D. S., Nieves, C. A. F., & Elango, D. (2025). Implementing pop-up book-assisted STAD cooperative learning model to improve students' descriptive writing skills. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 14(4), 528–538. <https://doi.org/10.33578/jpfkip.v14i4.p528-538>
- Kahmann, R., Droop, M., & Lazonder, A. W. (2022). Meta-analysis of professional development programs in differentiated instruction. *International Journal of Educational Research*, 116, Article 102072. <https://doi.org/10.1016/j.ijer.2022.102072>

- Kusuma, J. K., & Hamidah. (2019). The effect of the Arias and cooperative script learning models on interest and IPAS learning outcomes. *Scientific Journal of IPAS Education*, 2(1), 64–69.
- Pasaribu, Y. O. P., Abi, A. R., Tanjung, D. S., Silaban, P. J., Purba, F. J., & Elango, D. (2026). The effect of the Picture and Picture cooperative learning model on the learning outcomes of fifth-grade students in science at SD Negeri 060834 Medan Petisah. *Jurnal PAJAR (Pendidikan dan Pengajaran)*, 10(1), 14–25. <https://doi.org/10.33578/pjr.v10i1.336>
- Pedaste, M., Mäeots, M., Siiman, L. A., de Jong, T., van Riesen, S. A. N., Kamp, E. T., Manoli, C. C., Zacharia, Z. C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47–61. <https://doi.org/10.1016/j.edurev.2015.02.003>
- Pozas, M., Letzel, V., Lindner, K.-T., & Schwab, S. (2021). DI (Differentiated instruction) does matter! The effects of DI on secondary school students' well-being, social inclusion and academic self-concept. *Frontiers in Education*, 6, Article 729027. <https://doi.org/10.3389/feduc.2021.729027>
- Rahmawati, D. N., Ika, R. A., Idam, R. W. A., & Harni. (2024). Efforts to improve IPAS learning outcomes on the material of ethnic and cultural diversity using the Teaching at the Right Level (TaRL) learning model. *Social, Humanities, and Educational Studies*, 7(3), 476–481.
- Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational Psychology Review*, 32, 77–112. <https://doi.org/10.1007/s10648-019-09498-w>
- Shabrina, Z., Sukoriyanto, & Anang, B. W. (2024). Systematic literature review: Teaching at the Right Level (TaRL) approach to students' IPAS learning outcomes. *Journal of Mathematics and Natural Sciences and Their Learning*, 4(8), 1–8.
- Simanullang, R. F., Silaban, P. J., HS, D. W. S., Tanjung, D. S., & Juliana. (2023). The effect of the numerical literacy learning model on fifth-grade students' mathematics learning outcomes at SD Negeri 156320 Simpang Tiga 2. *Jurnal PAJAR (Pendidikan dan Pengajaran)*, 7(4), 854–870. <https://doi.org/10.33578/pjr.v7i4.9471>
- Simbolon, R., Tanjung, D. S., Juliana, Silaban, P. J., Purba, F. J., & John, J. A. (2025). The effect of the quantum teaching model on student learning outcomes in IPAS subjects in Grade IV of SDN 155712 Tumba Jae 2. *Jurnal PAJAR (Pendidikan dan Pengajaran)*, 9(6), 729–738. <https://doi.org/10.33578/pjr.v9i6.330>
- Siregar, A. (2020). Implementation of Teaching at the Right Level to improve learning outcomes in science for lower-grade students. *Indonesian Journal of Elementary Education*, 5(2), 45–56.
- Situmorang, K. D., Sinaga, R., Marianus, S. M., & Tanjung, D. S. (2022). The effect of the mind mapping learning model on student learning outcomes in the theme Our Friendly Environment for Grade V at SDN 173417 Pollung and SDN 173420 Pollung. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 11(5), 1335–1347. <https://doi.org/10.33578/jpfkip.v11i5.9051>
- Suharyani, S., Suarti, N., & Astuti, F. (2023). Implementation of the Teaching at the Right Level (TaRL) approach in improving children's numeracy literacy skills at SD IT Ash-Shiddiqin. *Journal of Educational Technology: Journal of Research and Development in Learning*, 8(2), 470–479. <https://doi.org/10.33394/jtp.v8i2.7590>
- Suryosubroto, B. (2009). Teaching and learning process in schools. PT Rineksa Cipta.

- Tanjung, D. S., & Juliana. (2023). The effect of giving rewards on fifth-grade elementary students' mathematics learning outcomes. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 12(6), 1396–1406. <https://doi.org/10.33578/jpfkip.v12i6.9038>
- Tanjung, D. S., Ambarwati, N. F., Juliana, & Prayuda, M. S. (2024). Application of the problem-based learning model to improve students' learning outcomes and critical thinking ability in mathematics lessons in primary school. *Jurnal PAJAR (Pendidikan dan Pengajaran)*, 8(3), 307–318. <https://doi.org/10.33578/pjr.v8i3.9660>
- Tanjung, D. S., Juliana, & HS, D. W. S. (2023). Improving fourth-grade students' learning outcomes using the discovery learning method in Indonesian at SD Negeri 200111 Padangsidempuan. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 12(5), 1302–1313. <https://doi.org/10.33578/jpfkip.v12i5.9943>
- Tanjung, D. S., Pinem, I., Mailani, E., & Ambarwati, N. F. (2024). Classroom action research. PT Sonpedia Publishing Indonesia.
- Tanjung, D. S., Tamba, R. S. H., Sinaga, V., & Tarihoran, A. C. (2025). Application of project-based learning model to improve science learning outcomes of Grade VI-B elementary school students. *School Education Journal PGSD FIP UNIMED*, 15(1), 61–70. <https://doi.org/10.24114/sejpgsd.v15i1.67455>
- Tomlinson, C. A. (2001). How to differentiate instruction in mixed-ability classrooms. ASCD.
- Valiandes, S., & Neophytou, L. (2018). Teachers' professional development for differentiated instruction in mixed-ability classrooms: Investigating the impact of a development program on teachers' professional learning and on students' achievement. *Teacher Development*, 22(1), 123–138. <https://doi.org/10.1080/13664530.2017.1338196>
- Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning: A literature review. *Computers & Education*, 149, Article 103818. <https://doi.org/10.1016/j.compedu.2020.103818>
- World Bank. (2018). Improving learning outcomes with targeted instruction: TaRL in Africa. World Bank.
- Wulandari, Hasyim, A., Kartika, C. S., & Nurul, H. (2024). Implementation of the Teaching at the Right Level (TaRL) approach to improve IPAS learning outcomes of fourth-grade students. *Social, Humanities, and Educational Studies*, 7(3), 1982–1987.
- York, R. O. (2016). Statistics for human service evaluation. Sage Publications.