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Reciprocal Group (RG) sheets: Its effect to students' skills in solving worded problems involving normal distribution

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Abstract

The Reciprocal Group (RG) Sheets allows students to exchange ideas, ask questions freely, clarify relevant information, explain solutions in meaningful ways and express feeling about their learning making the instruction dynamic, interesting and meaningful. This study focused on the effectiveness of the RG Sheets in improving the skill level of students in solving worded problems involving Normal Distribution. It utilized the validated researcher-made test. Tests such as t-test dependent and t-test independent were utilized as tools for analysis. It found out that before the intervention, the skill level of the students in both groups did not differ significantly and had a very low remark. However, after the intervention, the students in the experimental group improved drastically to an outstanding skill level while students in the controlled group shifted to a fairly satisfactory skill level. It concluded that the integration of the RG Sheets is effective in improving the skill level of the students. It recommended that teachers must begin to adopt the utilization of the RG Sheets as an alternative and viable instructional method in teaching mathematics specifically lesson on Normal Distributions.

Keywords: learning intervention, mathematics education, reciprocal teaching, teaching approach, teaching effectiveness

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1. Introduction

Mathematics educational interventions are vital for fostering problem-solving skills, providing structured support that enables students to understand complex concepts and connect more deeply with mathematics. As a crucial discipline, mathematics greatly influences national progress and plays an essential role in fields such as engineering, science, commerce, and industry (Isah & Hamza, 2023). This shows that mathematics is not confined to numbers and equations, but rather connects what is learned in school to the challenges and decisions people face in daily life. Its importance extends beyond the classroom, as it gives individuals the skills to solve everyday problems, think creatively, and make informed decisions in real-world situations.

Beyond academic success, mathematics education also promotes equitable learning opportunities, equipping students with the knowledge and skills necessary for everyday life (Hasibuan et al., 2019). Essential processes within mathematics education, such as modeling, investigating, and problem-solving, foster a comprehensive understanding of mathematical principles (Nugraheni & Marsigit, 2021). Problem-solving is a fundamental skill that students must develop to analyze complex situations, apply mathematical concepts, and derive solutions essential for academic success and real-world challenges. According to Tambychik and Meerah (2010), as cited by Suseelan et al. (2023), problem-solving tasks enhance students' mathematical understanding, reasoning abilities, and communication skills while fostering interest and curiosity.

Despite its importance, educators and students face persistent challenges in developing these skills. The 2018 Programme for International Students Assessment (PISA) highlighted this issue, revealing that the Philippines scored only 353 out of 79 participating nations in math and science, significantly below the OECD average of 489 (San Juan, 2019). Less than 1% of students achieved a Level 5 or higher, indicating a struggle to model complex situations mathematically and evaluate strategies effectively. Similarly, the 2019 Trends in International Mathematics and Science Study (TIMSS) showed that the Philippines scored significantly lower than other countries in grade 4 math and science assessments, with scores of 297 in mathematics and 249 in science (Magsambol, 2020). These low scores highlight the urgent need for interventions in mathematics education. Additionally, a study by Tambychik and Meerah (2010), as cited by Hariri et al. (2024), reported that students lack essential math skills, including number facts and visual-spatial abilities. These deficiencies limit their problem-solving skills, contributing to poor performance.

Research highlights the significant challenges students face in problem-solving, raising concerns about the competencies of tertiary students. In the subject "Mathematics in the Modern World," which emphasizes practical applications of mathematical concepts, students struggle with global issues related to problem-solving, particularly with word problems involving normal distribution. Many find it challenging to identify regions under a normal curve, compute z-scores, and solve worded problems related to normal distribution (Al-Qadri et al., 2021). Mastery of these competencies is crucial for accurately analyzing and interpreting statistical data. Such proficiency not only helps students succeed in their academic journey but also empowers them with practical skills they can carry into real-life situations, enabling them to make sound decisions, solve problems, and engage in meaningful research.

This study is primarily anchored on Vygotsky's Sociocultural Theory, which underscores the role of social interaction, scaffolding, and collaborative dialogue in learning. Through Reciprocal Group (RG) Sheets, students engage in guided peer discussions that promote shared understanding and deeper comprehension of statistical concepts, particularly Normal Distribution.

In addition, the study is grounded on Polya's Problem-Solving Framework, which provides a systematic approach to solving mathematical problems: (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and (4) reviewing the solution. The RG Sheets operationalize these stages by encouraging students to collectively analyze, strategize, solve, and evaluate their solutions to worded problems. This process not only improves the way students solve problems but also helps them realize the value of working together, supporting one another, and learning as a team—experiences that make learning more meaningful and lasting.

On the same vein, cooperative and collaborative learning fosters active participation and meaningful engagement with peers (Darling-Hammond, 2019). Utilizing Reciprocal Group (RG) Sheets encourages this collaborative approach, allowing students to share ideas, listen to others, and refine their argumentative skills while fostering accountability in group work. At Ilocos Sur Polytechnic State College-Main Campus, students struggle with basic skills like computing z-scores and identifying regions under the normal curve, leading to poor performance. Recent assessments revealed a high failure rate, averaging 33.75%, in the topic during the second semester of the academic year 2022-2023. In response, the teacher-researcher believes that cooperative work using RG Sheets can provide students with opportunities to exchange ideas, ask questions, clarify concepts, and articulate their learning experiences. Therefore, the researcher aimed to investigate the effectiveness of RG Sheets in improving students' skills in solving worded problems involving normal distribution, which are crucial for mastering higher-level statistical concepts and enhancing overall performance in mathematics.

2. Materials and Methods

A true-experimental pretest–posttest control group design was employed. Two groups were used: a control group, which received traditional instruction, and an experimental group, which utilized Reciprocal Group (RG) Sheets. Both groups completed pretests and posttests to evaluate the intervention's effectiveness. Participants were randomly assigned to ensure group equivalence. The table below presents the distribution of respondents.

Table 1
Respondents of the Study

Respondents	N	Total
Experimental	25	25
Control	25	25
Total	50	50

Fifty students participated, with 25 assigned to the experimental group and 25 to the control group. Inclusion was limited to students who scored 20 or below in the pretest to establish homogeneity. Participation was voluntary, and informed consent was obtained. Students were assured of confidentiality and that their decision to participate would not affect their academic standing. Ethical clearance was secured from the College Research Director. The primary instrument was a researcher-developed 50-item test (25 multiple-choice, 5 problem-solving). Content validity was established by three Mathematics professors (validity score = 4.56). Reliability testing using the Kuder-Richardson Formula 20 (KR-20) yielded a coefficient of 0.80, indicating high internal consistency.

During implementation, the experimental group used RG Sheets to collaboratively solve normal distribution word problems, while the control group received traditional teaching. Both groups took the pretest before the intervention and the posttest afterward. Further, data were analyzed using both descriptive and inferential statistics. Means, frequencies, and percentages summarized student performance, while t-tests for dependent samples compared pretest and posttest results within groups, and t-tests for independent samples compared outcomes between groups.

3. Results and Discussion

Problem 1. What is the skill level of students in the control and experimental groups in solving worded problems involving normal distribution before using the Reciprocal Group (RG) Sheets?

Table 2
Skill level of the experimental group and control group in solving worded problems involving normal distribution before using the Reciprocal Group (RG) Sheets

	Mean	Description
Experimental	8.96	DME
Control	9.60	DME

Score range	Description
40.01-50.00	Outstanding (O)
30.01-40.00	Very Satisfactory (VS)
20.01-30.00	Satisfactory (S)
10.01-20.00	Fairly Satisfactory (FS)
0.00-10.00	Did not meet expectations (DME)

The table shows that both the experimental and control groups fell below expectations, with mean scores of 8.96 and 9.60, respectively. Students struggled to identify variables for z-score calculations, often confused population and sample means, and had difficulty using the z-table and calculating shaded regions. At first, the students felt anxious when the z-table conversion was introduced, appearing unsure whether they could truly understand it or merely recall fragments from Senior High School. The overwhelming array of numbers, unfamiliar Greek symbols, and uncertainty about the operations for finding areas under the normal curve left them struggling, which eventually reflected in their low performance. These results show the need for focused support to help students bridge their learning gaps. Going back to the basics and revisiting key concepts in greater depth can give them the confidence and understanding they truly need. Teachers should offer step-by-step guidance and adopt active teaching strategies to simplify abstract concepts. The curriculum may also require updates, such as using the right instructional materials to better cover the Normal distribution and related statistical concepts. These efforts matter because the instructional materials can make learning less intimidating, helping students truly understand the lessons and gain confidence in using statistics in real life. These findings align with Mason & Otero (2021) and suggest a broader issue in how statistics is taught, emphasizing the need for educational reforms and better instructional strategies.

Problem 2. What is the skill level of students in the control and experimental groups in solving worded problems involving normal distribution after using the Reciprocal Group (RG) Sheets?

The second problem of the study is to determine the skill level of students after the integration of RG Sheets.

Table 3
Skill level of the experimental group and the control group in solving worded problems involving normal distribution after using the Reciprocal Group (RG) Sheets

	Mean	Description
Experimental	40.16	O
Control	10.04	FS

Score range	Description
40.01-50.00	Outstanding (O)
30.01-40.00	Very Satisfactory (VS)
20.01-30.00	Satisfactory (S)
10.01-20.00	Fairly Satisfactory (FS)
0.00-10.00	Did not meet expectations (DME)

Table 3 shows the skill levels of the experimental and control groups in solving Normal distribution problems after using RG Sheets. The control group improved slightly, scoring an average of 10.04, indicating limited progress in identifying variables, shading areas, or calculating probabilities. The experimental group, however, improved significantly, with a mean score of 40.16 ("Outstanding"), demonstrating deep understanding of modeling problems, calculating areas, and performing transformations.

In the control group, students were introduced to the normal curve through traditional teaching methods and were later tasked with solving word problems. Although their performance showed slight improvement, the progress remained limited, likely due to the absence of structured instructional guides and diversified teaching strategies. While some students attained higher scores through the teacher's explanations and their own initiative, the overarching objective of developing a solid conceptual understanding was not fully achieved. This shortfall is significant, as such understanding is fundamental for accurately and confidently solving word problems involving the normal distribution.

On the other hand, the experimental group demonstrated significant improvement. The use of RG Sheets provided them with an avenue to clarify difficult concepts and address areas of confusion. The visual materials, together with guiding questions, made it easier for them to engage in discussions with their groupmates, which in turn enhanced their ability to solve word problems involving the normal distribution. They became more familiar with the correct symbols used in each formula, more confident in the steps to follow, and more accurate in arriving at the correct answers. Most importantly, they developed a deeper understanding of the concepts. The approach also proved to be more engaging compared to the traditional method of teaching. Visual and example-based teaching methods can make the normal distribution more intuitive and engaging, enhancing student motivation and understanding beyond traditional lecture approaches (Joven Regondola & Astorga, 2025).

These might have been due to the fact that RG Sheets are highly effective in bridging knowledge gaps and developing problem-solving skills. The study highlights the need for structured, interactive, and collaborative approaches in teaching to enhance students' grasp of mathematical concepts. Traditional methods alone appear insufficient for preparing students for complex problem-solving tasks. The results also indicate a need for curriculum reforms to incorporate tools like RG Sheets, allowing for more practical application of mathematical knowledge. Instructional materials should address common difficulties and include interactive, collaborative learning components to reinforce key concepts. These conclusions corroborate with YILMAZ & International Consortium for Research in Science & Mathematics Education (ICRSME) (2024), validating the effectiveness of RG Sheets. If future studies do not support these findings, alternative strategies may be needed.

Problem 3: Is there a significant difference in the skill level of the students in the experimental and control groups during

a. pretest;

Table 4. a
Significant difference in the skill level of the students in the experimental and control groups during the pretest

Respondents	Mean	t-computed	t-critical	Remarks
Experimental	8.96	0.76	2.01	Not Significant
Control	9.60			

*Significant at 0.05 level

The table shows that the t-computed value of 0.76 is less than the t-critical value of 2.01 at the 0.05 significance level, meaning the null hypothesis is not rejected. There is no significant difference in the pre-test scores of the experimental and control groups, indicating both groups had similar baseline knowledge of Normal Distribution.

Although these concepts were introduced in high school, only a small portion of that knowledge remained, as seen in the students' low scores. This reflects the need for them to be more mindful and committed in revisiting these lessons if they hope to handle more complex problems involving the normal distribution. At the same time, it shows the importance of providing them with clear guidance and supportive materials to make learning more meaningful and lasting. These findings highlight the need for equal learning opportunities and foundational mastery of basic statistical concepts before advancing. More collaborative activities and discussions should help students better grasp and retain key concepts. Instructional materials should focus on clear explanations, examples, and practice problems to build from basic to advanced understanding.

This aligns with Herrera (2016), who found no significant difference in pre-test scores, underscoring the importance of baseline assessments to measure the effectiveness of instructional interventions. If future studies show no difference in baseline skills, more emphasis should be placed on foundational learning. If differences are found, targeted interventions will be needed.

Building a strong foundation in statistical knowledge is crucial for students to succeed in solving worded problems and other mathematical tasks.

b. post-test

Table 4.b
Significant difference in the skill level of the students in the experimental and control groups during the post-test

Respondents	Mean	t-computed	t-critical	Remarks
Experimental	40.16	39.99*	2.01	Not Significant
Control	10.04			

*Significant at 0.05 level

The table shows a significant difference between the post-test scores of students exposed to traditional methods and those using RG Sheets, with a t-computed value of 39.99, much higher than the t-critical value of 2.01. This means that the experimental group performed better, likely due to their active role in discussions and problem-solving, which enhanced their understanding and confidence in mathematics. The improvement can be attributed to students taking the lead in managing group dialogues, asking questions, and gradually building a deeper understanding of Normal distribution problems. This process encouraged critical thinking, predictions, and visualization, helping students arrive at correct answers. The RG Sheets enabled students to become more engaged in collaborative learning while also improving their approach to problem-solving. The materials created opportunities for them to clarify misconceptions, ask meaningful questions, and exchange ideas, which facilitated arriving at correct solutions through teamwork. In this process, they demonstrated a deeper grasp of the concepts, as evidenced by their accurate use of the z-table, recognition of the symbols for population and sample means, and ability to justify their answers with confidence. Overall, the RG Sheets served as a structured guide that made learning more collaborative and meaningful.

These results have important implications for teaching mathematics and developing instructional materials. The RG Sheets approach promotes active, collaborative learning, where students take charge of their learning, enhancing problem-solving skills. Teachers should adopt student-centered methods involving questioning, dialogue, and critical thinking. Further, the findings highlight a more dynamic mathematics curriculum that replaces conventional methods with interactive tools like games and group activities. Instructional materials should encourage active participation, critical thinking, and problem-solving, helping students develop the confidence and skills to excel in mathematics (Siller & Ahmad, 2024). This study aligns with Hays (n.d.), who emphasized that intervention and varied teaching methods, like group activities, can significantly improve student performance in learning competencies.

Problem 4. Is there a significant difference between pre-test and post-test in the;

a. control groups?

The fourth problem in this study is to determine if there exists a significant difference between the pretest and posttest of the control and experimental groups.

Table 5. a
Significant difference between the pretest and posttest in the control group

	Mean	t-computed	t-critical	Remarks
Pretest	9.60	1.16	2.06	Not Significant
Posttest	10.04			

*Significant at 0.05 level

Before the study, both groups took a test on solving worded problems involving Normal Distribution, which was repeated after the study. The comparison of their scores is shown in Table 5. a. The results revealed no significant improvement in students' skills. The mean difference was 0.44, with a t-computed value of 1.16, lower than the t-critical value of 2.06 at a 0.05 significance level, indicating that students struggled with key concepts such as using variables and computing probabilities. This means that traditional teaching methods may not be sufficient, and teachers must go beyond basic instructions with more in-depth, interactive teaching approaches. Instruction should focus on developing problem-solving skills through critical thinking and understanding, not just computation.

In today's learning environment, students should not be confined within the four walls of the classroom but rather be given opportunities to collaborate and engage meaningfully with their peers. The traditional way of teaching, however, often relies on rigid classroom setups where students sit passively, focused mainly on listening and memorizing. Such arrangements restrict interaction, discourage active participation, and hinder the development of higher-order thinking skills. By contrast, classrooms designed for collaboration emphasize fluid, active teaching. With flexible furniture, movable seating, and multiple work surfaces, both students and teachers can restructure the learning space spontaneously, making it more responsive to group activities and fostering learner autonomy (Ralph, 2024).

Collaborative learning, therefore, addresses the gaps left by traditional methods. It transforms the classroom from a static, teacher-centered environment into a dynamic, interactive space where students actively engage in their learning. This approach not only strengthens mastery of concepts but also develops communication, teamwork, problem-solving, and the confidence to apply knowledge in varied contexts—skills that conventional methods often overlook. Instructional materials should provide detailed explanations, visual aids, and interactive elements to help students grasp concepts like Normal Distribution. This aligns with Dangle and Sumaoang (2021), who stressed that deep understanding, not just computational skills, is essential for problem-solving. Future studies could confirm the need for instructional methods that emphasize comprehension or explore alternative approaches to enhance students' problem-solving abilities.

b. experimental group

Table 5.b
Significant difference between the pretest and posttest in the experimental group

	Mean	t-computed	t-critical	Remarks
Pretest	8.96	40.15*	2.06	Not Significant
Posttest	40.16			

*Significant at 0.05 level

The table shows a mean difference of 31.2, with a t-computed value of 40.15, significantly greater than the t-critical value of 2.01 at the 0.05 level. This means that there is a significant improvement in the experimental group's ability to solve Normal Distribution problems. RG Sheets greatly boosted students' performance, moving from below expectations to outstanding levels. The success is attributed to the strategy's focus on group interdependence, modeling, and questioning, fostering conceptual understanding with less reliance on direct instruction. Direct instruction from the teacher helps students learn the basics of solving word problems, but on its own, it often falls short in giving students a deeper and lasting understanding. While it provides clear guidance at the start, it sometimes leaves students dependent on the teacher for answers. Collaborative learning, on the other hand, lets students explore, reason, and solve problems more actively (Sun et al. 2022).

This was clearly seen in the use of RG Sheets. The materials gave students a chance to talk through their ideas, ask questions, and explain their reasoning to one another. They became more confident in saying what they think and know, instead of waiting for the teacher to supply the answers. With RG Sheets, the teacher shifted into the role of a guide, while the students did most of the thinking and problem-solving themselves. In the process, they not only solved the problems correctly but also understood the concepts more deeply. These results highlight the effectiveness of cooperative, student-centered approaches in teaching problem-solving.

Educators should integrate interactive activities that encourage collaboration, discussion, and problem-solving to deepen students' understanding of complex mathematical concepts. The findings also support the development of instructional materials that promote active, collaborative learning, such as RG Sheets. This approach aligns with prior research by Yan (2024), emphasizing strategies that predict, clarify, and visualize to improve skills in Normal Distribution.

Problem 5. What is the percentage of students with improved performance in:

a. control group;

Table 6.a.1
Number of students in the control groups with improved scores

Number of students with improved performance: 13/25 = 52%

The results show that while 52% of students improved in solving Normal Distribution problems, most only reached a "Pass" level. Though many identified the correct variables for z-scores, they struggled with graphing, shading regions, and calculating probabilities. A few students' scores increased significantly, while others saw little or no change, and some even declined.

These findings highlight the need for diverse teaching approaches, as "one approach doesn't fit every student." Teachers should use a variety of instructional strategies to cater to different learning styles and needs, ensuring more consistent skill development. Research identifies several primary learning styles—visual, auditory, kinesthetic, and reading/writing—and recommends multimodal instruction, which integrates these methods to address the diverse needs of learners. For example, visual learners benefit from diagrams and videos, auditory learners from discussions and recordings, and kinesthetic learners from hands-on activities. Building on this, differentiated instruction extends beyond accommodating learning styles by systematically tailoring content, processes, and assessments to individual students. This approach provides learners with options for engaging with material and demonstrating understanding, thereby respecting their unique strengths and preferences. Empirical studies suggest that when instruction aligns with students' learning needs, it promotes higher levels of engagement, sustained motivation, and improved learning outcomes (Impact Teachers, 2023).

The results support the creation of versatile instructional materials, incorporating visuals, audio, and interactive elements to better support students' diverse strengths and weaknesses. Previous studies agree that educational interventions should be tailored to individual needs, and this study emphasizes the importance of flexibility in teaching strategies to meet those needs effectively.

b. experimental group;

Table 6.b.1
Number of students in the experimental groups with improved scores

Number of students with improved performance:	22/25 = 88%

The findings show that 88% of students improved their skills in solving word problems involving Normal Distribution, demonstrating progress in variable handling, conversions, identifying shaded regions, and calculating probabilities. This means that the RG Sheets intervention was effective for most students. However, some students showed no improvement or even declined, suggesting that RG Sheets did not align with their learning needs. These results highlight the need for differentiated instruction, as RG Sheets primarily cater to kinesthetic-logical learners. Teachers should use varied methods to meet diverse student needs, ensuring all students have a path to success. Instructional materials should also be versatile, incorporating visual aids, auditory explanations, and hands-on activities to support different learning styles.

This aligns with previous research, such as Mason & Otero (2021), which emphasizes the importance of interactive and flexible instructional strategies. The findings reinforce the need for adaptable teaching methods and materials to support a broader range of learners.

4. Conclusion

The study findings focus on the importance of cooperative learning approaches, especially through the use of the RG Sheet, in increasing problem-solving skills and engagement in mathematics education. Such an important lesson learned goes a long way for educators, curriculum developers, and educational policymakers. Cooperative learning strategies in mathematics instruction will enable educators to establish an engaging and interactive classroom environment that will encourage students to own their learning. This alteration will not only help students understand more complex concepts, like Normal Distribution, but also hone their skills for thinking and working in teams, an essential value for students to face real-world challenges. Therefore, schools and other educational institutions should look forward to implementing such innovative learning styles that promote student-centered learning. Such programs would be looked upon to enhance academic performance, besides providing students with a lot of experience in preparation for future academic and workplace challenges and expectations.

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5. References

AL-Qadri, A. H., Zhao, W., Li, M., Al-khresheh, M. H., & Boudouaia, A. (2021). The prevalence of the academic learning difficulties: An observation tool. *Heliyon*, *7*(10), e08164. https://doi.org/10.1016/j.heliyon.2021.e08164

Alcantara, E., & Marie, J. (2017, November 29). *Critical Thinking and Problem-Solving Skills in Mathematics of Grade-7 Public Secondary Students*.

Dangle, Y. R. P., & Sumaoang, J. D. (2020). *The Implementation of Modular Distance Learning in the Philippine Secondary Public Schools*. https://www.dpublication.com/wp-content/uploads/2020/11/27-427.pdf

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for Educational Practice of the Science of Learning and Development. *Applied Developmental Science*, *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Hariri, D. D., Mahmudah, H., Wibawa, F. S., & Kania, N. (2024). Unraveling the connection: A systematic review of learning styles and mathematics achievement. *Pedagogical Research*, *10*(1), em0232–em0232. https://doi.org/10.29333/pr/15681

Hasibuan, A. M., Saragih, S., & Amry, Z. (2019). Development of Learning Materials Based on Realistic Mathematics Education to Improve Problem-Solving Ability and Student Learning Independence. *International Electronic Journal of Mathematics Education*, *14*(1), 243–252.

Hays, R. (n.d.). The effectiveness of instructional games: A literature review and discussion november 2005. https://apps.dtic.mil/sti/tr/pdf/ADA441935.pdf

Impact Teachers. (2023, June 6). *Teaching Students with Different Learning Styles*. Impact Teachers. https://impactteachers.com/blog/teaching-students-with-different-learning-styles/

Isah, A., & Hamza, B. (n.d.). *Mathematics Education, a Tool for National Development*. Retrieved September 10, 2025, from https://arcnjournals.org/images/4272142537813.pdf

Joven Regondola & Astorga, J. M. (2025). Effect of Implementing Visual Learning Materials on Academic Engagement Among Grade 6 Students. *Journal of Arts, Humanities and Social Science*, *2*(2), 256–264. https://doi.org/10.69739/jahss.v2i2.767

Magsambol, B. (2020, December 9). *PH lowest among 58 countries in math, science – global assessment*. RAPPLER.https://www.rappler.com/philippines/filipino-students-lagging-behind-math-science-timms-i

nternational-results-2019/

Mason, L., & Otero, M. (2021). Just how effective is direct instruction? *Perspectives on Behavior Science*, *44*(2-3). https://doi.org/10.1007/s40614-021-00295-x

Nugraheni, L. P., & Marsigit, M. (2021). Realistic mathematics education: An approach to improve problem-solving ability in primary school. *Journal of Education and Learning (EduLearn)*, *15*(4), 511–518. https://doi.org/10.11591/edulearn.v15i4.19354

Ralph, M. (2024, February 16). *Designing Your Classroom for Collaborative Teaching*. Edutopia. https://www.edutopia.org/article/designing-classrooms-collaborative-teaching/

San Juan, R. (2019). *Philippines lowest in reading comprehension among 79 countries*. The Philippine Star. https://www.philstar.com/headlines/2019/12/03/1974002/philippines-lowest-reading-comprehension-among-79-countries

S. Tuba, J., & B. Roble, D. (2020). Developing Students' Mathematics Achievement Using Three-Tiered Instructional Model. *American Journal of Educational Research*, *8*(11), 873–877. https://doi.org/10.12691/education-8-11-7

Siller, H.-S., & Ahmad, S. (2024). Analyzing the Impact of Collaborative Learning Approach on Grade Six Students' Mathematics Achievement and Attitude Towards Mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, *20*(2), em2395em2395. https://doi.org/10.29333/ejmste/14153

Sun, J., Anderson, R. C., Lin, T.-J., Morris, J. A., Miller, B. W., Ma, S., Thi Nguyen-Jahiel, K., & Scott, T. (2022). Children's engagement during collaborative learning and direct instruction through the lens of participant structure. *Contemporary Educational Psychology*, *69*(69), 102061. https://doi.org/10.1016/j.cedpsych.2022.102061

Suseelan, M., Chew, C. M., & Chin, H. (2022). Research on Mathematics Problem Solving in Elementary Education Conducted from 1969 to 2021: A Bibliometric Review. *International Journal of Education in Mathematics, Science and Technology*, *10*(4), 1003–1029. https://doi.org/10.46328/ijemst.2198

Tambychik, T & Meerah, S. (2010). Students' Difficulties in Mathematics Problem-Solving: What do they Say? Procedia - Social and Behavioral Sciences. 8. 142-151. (2020). Sciepub.com. https://www.sciepub.com/reference/343069

Vale, I., & Barbosa, A. (2023). Active learning strategies for effective mathematics teaching and learning. *European Journal of Science and Mathematics Education*, *11*(3), 573–588. https://doi.org/10.30935/scimath/13135

Yan, Y. (2024). Research on the Construction Path of College Students' Social Practice Teaching Base under the Background of "Special Innovation Integration + Competition Innovation Integration" -- Taking "Zhanjiang University of Science and Technology - Xingyang Industrial Practice Teaching Base" as an Example. *Communications in Humanities Research*. https://doi.org/10.54254/2753-7064/34/20240108

Yilmaz, N. (n.d.). Pre-service teachers' subject matter knowledge about normal distribution. *Electronic Journal for Research in Science & Mathematics Education*, *28*(2), 69–99. Retrieved September 10, 2025, from https://files.eric.ed.gov/fulltext/EJ1450164.pdf