Journal of Research and Advances in Mathematics Education

Volume 10, Issue 2, April 2025, pp. 81 – 89
DOI: 10.23917/jramathedu.v10i2.7058
p-ISSN: 2503-3697, e-ISSN: 2541-2590

Effects of Buddy system on year 9 students' mathematical discernments and performance

Siti Nur Amalina Jamil[1], Masitah Shahrill[1*], Yurizka Melia Sari[2]

[1] *Sultan Hassanal Bolkiah Institute of Education, Universiti Brunei Darussalam, Brunei Darussalam*
[2] *Universitas Negeri Surabaya, Surabaya, Indonesia*

Citation: Jamil, S. N. A., Shahrill, M., & Sari, Y. M. (2025). Effects of Buddy system on year 9 students' mathematical discernments and performance. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, 10(2), 81-89. https://doi.org/10.23917/jramathedu.v10i2.7058

ARTICLE HISTORY:
Received 4 November 2024
Revised 21 March 2025
Accepted 25 April 2025
Published 30 April 2025

KEYWORDS:
Buddy system
Cooperative learning
Peer support
Secondary mathematics
Student perceptions

ABSTRACT

Cooperative learning is a student-centred approach that enhances engagement and understanding. This study investigates the effectiveness of the Buddy system, a cooperative learning strategy, in improving Year 9 students' mathematical performance in converting between decimals, fractions, and percentages (DFP), and explores their perceptions of the system. Conducted in Brunei, where the Buddy system is relatively underexplored, the study employed a mixed-methods design using pre- and post-tests, questionnaires, and student reflection journals across three intervention cycles. Results showed an overall improvement in test scores, though a few students experienced slight score declines. Students generally viewed the Buddy system positively, citing peer guidance, emotional support, and collaborative learning as key benefits. While the findings support the system's potential within this specific context, further research is needed to assess its applicability across subjects or educational levels.

INTRODUCTION

Mathematics remains a challenging subject for many secondary students, particularly in mastering the conversion between decimals, fractions, and percentages (DFP). Misunderstanding these foundational concepts can negatively impact broader mathematical competencies, including problem-solving, ratios, and data interpretation (Hong et al., 2020; Sweeney & Quinn, 2000). Despite repeated curriculum exposure, students often treat these forms as unrelated, leading to confusion and underperformance (Pagni, 2004).

One proposed solution to improve conceptual clarity and engagement is cooperative learning, which emphasizes peer interaction and student-centered instruction. Research consistently shows that cooperative strategies can enhance mathematical understanding, motivation, and problem-solving skills (Gillies, 2016; Hossain et al., 2012; Johnson & Johnson, 2019). Among these strategies, the Buddy system, where students work in consistent pairs to support each other's learning, has shown promise in enhancing both academic and social outcomes (Balan, 2015; Mohd Zahid et al., 2021; Reid et al., 2016).

However, most studies on the Buddy system focus on areas like language learning or support for students with disabilities (e.g., Adams, 2016; Motzo, 2016), with limited evidence of its application in mathematics education. Moreover, the pedagogical relevance and implementation of such systems in Southeast Asian classrooms, especially in Brunei Darussalam and Indonesia, remain underexplored. Although informal peer support may occur in classrooms, there is a notable lack of formalized Buddy system interventions documented in these contexts (Abdul Malak, 2015; Wahat, 2020). However, recent Bruneian research has highlighted the growing importance of collaborative

*Corresponding author: masitah.shahrill@ubd.edu.bn

and digitally supported pedagogies, particularly during education system transitions (Johari et al., 2024), reinforcing the relevance of peer learning strategies such as the Buddy system. Gan and Shahrill (2019) and Shahrill et al. (2022, 2023) noted that structured peer teaching approaches are still largely absent in Brunei's mathematics classrooms, where informal or private tutoring tends to dominate the support landscape.

To address this gap, this study implemented a Buddy system intervention within Year 9 mathematics classes in Brunei, focusing on DFP conversions, a persistent area of difficulty for students. The research is grounded in Cooperative Learning Theory (Johnson et al., 1991; Slavin, 2011), which emphasizes positive interdependence, individual accountability, and promotive interaction. In line with this framework, we employed action research to allow the teacher-researcher to improve practice and reflect on the intervention's impact iteratively (Feldman et al., 2018; Ulvik, 2014).

By examining both student performance and perceptions, this study aims to evaluate the feasibility and potential benefits of a Buddy system in mathematics learning in the Southeast Asian context. The findings may inform future pedagogical practices in Brunei and similar educational settings. Based on the objectives of this study, the following questions were addressed:

1. How does the Buddy system affect students' mathematical performance in converting between decimals, fractions, and percentages?
2. What are the students' perceptions of the Buddy system?

METHODS

Research design

This study adopted an action research approach, embedded within a mixed-methods framework. Action research was chosen not only for its practicality in classroom-based inquiry, but also because it allows the teacher-researcher, in this case, a pre-service teacher (the first author), to reflect on and improve their own teaching practice while engaging students in meaningful learning experiences. The study was grounded in the classic model developed by Kurt Lewin (1946), who described action research as a dynamic cycle involving planning, action, observation, and reflection. These iterative steps were repeated across three lesson cycles to allow gradual refinement of the intervention based on student responses and classroom outcomes.

Participants and setting

The participants were 30 Year 9 students from a secondary school in Brunei. The school was selected due to its accessibility and the first author's practicum placement, which aligns with the authentic and context-sensitive nature of action research. The students came from a mixed-ability mathematics class and were already grouped by the school administration. No selection or streaming based on academic performance was involved. Working within this existing classroom structure helped preserve the ecological validity of the study while providing a real-world setting for the intervention.

Instruments

Three data collection tools were used to explore the effects of the Buddy system on students' performance and perceptions: pre- and post-tests, a questionnaire, and a reflection journal. The pre- and post-tests were specifically developed to assess students' understanding of conversions between decimals, fractions, and percentages. Each test consisted of a mix of procedural and application-based questions, and experienced mathematics educators reviewed both for content validity. Before full implementation, the items were trialled with a similar Year 9 group to ensure clarity and appropriate difficulty.

The second instrument was a short questionnaire adapted from Balan (2015), which focused on student perceptions of the Buddy system. The questionnaire comprised eight items rated on a four-point Likert scale. To better fit the Bruneian classroom context, minor adjustments were made to the wording of some items. A reliability test showed a Cronbach's alpha of 0.81, indicating good internal consistency.

The final instrument, the reflection journal, was used to capture students' qualitative responses after each intervention cycle. These journals included both closed (yes/no) and open-ended

questions, allowing students to express how they worked with their Buddy, what kinds of support they received, and how the experience influenced their learning.

Intervention procedures

The intervention unfolded across three classroom cycles, each focusing on a specific aspect of DFP conversion. In the first cycle, students worked with their assigned Buddy to practice converting between percentages and decimals. The second cycle extended this to percentage-to-fraction and fraction-to-decimal conversions. In the third cycle, students created collaborative mind maps that combined the learning from the previous lessons, providing both consolidation and a visual record of their understanding.

Throughout the sessions, the Buddies were encouraged to engage in active problem-solving with minimal teacher intervention. One student from each group was selected to present their group's answers and explain their reasoning to the rest of the class, helping to reinforce both accountability and peer teaching. After the final cycle, the students completed the post-test, filled in the perception questionnaire, and submitted their completed reflection journals.

Ethical considerations

The Faculty's Research Ethics Committee granted ethical approval for the study. Formal permission was also obtained from the relevant department at the Ministry of Education in Brunei and the participating school. Informed consent was sought and received from all students and their parents or guardians prior to data collection. To ensure confidentiality, pseudonyms were used instead of students' real names, and any identifying information was removed from all research outputs. Participation in the study was entirely voluntary, and students were informed that they could withdraw at any time without penalty.

Data analysis

Quantitative data from the pre- and post-tests were analysed using paired-sample t-tests to examine overall differences in student performance before and after the intervention. In addition, Wilcoxon signed-rank tests were used to explore changes within subgroups. Descriptive statistics were used to summarise the responses from the perception questionnaire. For the qualitative data, responses from the reflection journals were analysed thematically. Open coding was used to identify recurring ideas, which were then grouped under broader themes such as "guidance," "support," and "cooperative learning." These themes provided more profound insights into how students experienced the Buddy system in a real classroom context.

FINDINGS

Addressing RQ1: Performance outcomes

The first research question focused on the effectiveness of the Buddy system in improving students' performance in converting between decimals, fractions, and percentages (DFP). As shown in Table 1, students' post-test scores increased significantly compared to their pre-test scores. The paired-sample t-test results in Figure 1 confirmed this improvement was statistically significant, with a p-value below 0.05. Further analysis using the Wilcoxon signed-rank test in Figure 2 and Figure 3 supported the positive effect of the intervention, with the majority of students showing improved ranks after participating in the Buddy system.

However, four students did not show improvement. According to Table 1, Angela, Kazuha, and Daisy each recorded a one-point drop in their post-test scores, while Kizzy showed a two-point decline. Although these regressions were relatively small, they are essential to note. Review of their journal reflections indicated moments of confusion, difficulty contributing ideas, or reliance on their partners for explanations. These cases highlight that while peer learning often promotes understanding, its effectiveness can vary depending on interpersonal dynamics, individual confidence, and the level of active participation. This reinforces the need for structured peer support and teacher monitoring during implementation (Abdul Latif et al., 2024; Adeniji & Rukayya, 2022;

Measure 1		Measure 2	t	df	p	Mean Difference	SE Difference	95% CI for Mean Difference		Cohen's d	SE Cohen's d
								Lower	Upper		
Pre-Test	-	Post Test	−4.282	26	< .001	−1.815	0.424	−2.686	−0.944	−0.824	0.177

Note. Student's t-test.

Figure 1. Paired samples t-test result of pre-test and post-test scores

Measure 1		Measure 2	W	z	df	p	Hodges-Lehmann Estimate	Rank-Biserial Correlation	SE Rank-Biserial Correlation
Pre-Test	-	Post Test	6.000	−2.589		0.010	−1.500	−0.846	0.316

Note. Wilcoxon signed-rank test.

Figure 2. Wilcoxon's signed-rank test result of pre-test and post-test scores for Group A

Measure 1		Measure 2	W	z	df	p	Hodges-Lehmann Estimate	Rank-Biserial Correlation	SE Rank-Biserial Correlation
Pre-Test	-	Post Test	10.000	−2.481		0.014	−2.000	−0.780	0.305

Note. Wilcoxon signed-rank test.

Figure 3. Wilcoxon's signed-rank test result of pre-test and post-test scores for Group B

Table 1
Students' pre-test and post-test results

Name	Group No.	Pre-Test	Post-Test	Score Difference	Name	Group No.	Pre-Test	Post-Test	Score Difference
		Group A					Group B		
Laney	1	14	16	2	Onyx	8	5	12	7
Angela	1	17	16	-1	Bat	8	17	17	0
Wix	2	14	15	1	Zyla	9	9	9	0
Haze	2	15	16	1	Kizzy	9	14	12	-2
Kazuha	3	17	16	-1	Ixora	10	10	15	5
Kiwitakop	3	14	–	–	Zeon	10	11	12	1
Cynthia	4	16	17	1	Bamtori	11	9	15	6
Taylor	4	14	16	2	Nachu	11	13	14	1
Jennifer	5	14	16	2	Bear	12	9	11	2
Tulip	5	12	15	3	Lolly	12	11	17	6
Rhys	6	15	17	2	Bonbon	13	10	11	1
Slyvie	6	13	15	2	Moon A	13	11	14	3
Sage	7	14	17	3	Daisy	14	10	9	-1
Polly	7	–	17	–	Lily	14	11	12	1
					Macha	14	10	12	2
					Arin	15	–	16	–
					Emms	15	–	14	–

Legends:
0–8 Need support
9–11 Progressing
12–17 Surpass

Mahmud & Wulandari, 2023). Meanwhile, the qualitative analysis of students' journals revealed two key themes that help explain the observed academic performance: Guidance and Support. Meanwhile, the qualitative analysis of students' journals revealed two key themes that help explain the observed academic performance: Guidance and Support.

Table 2
Students' responses on the Buddy system's effectiveness level

Items on Buddy system	Mean	Description	Interpretation
1. Did Buddy system stimulate your interest in learning mathematics?	3.419	Agree	Moderately Effective
2. Did Buddy system help you to understand converting between Decimal, Fraction and Percentage?	3.645	Strongly Agree	Very Effective
3. Did Buddy system enhance your mathematical skills by performing calculations or using formulas?	3.355	Agree	Moderately Effective
4. Did Buddy system motivate you to learn mathematics?	3.323	Agree	Moderately Effective
5. Did Buddy system provide you support and help when you are stuck solving mathematical problems?	3.645	Strongly Agree	Very Effective
6. Did Buddy system help you establish good rapport and working relationships?	3.516	Strongly Agree	Very Effective
7. Is Buddy system a good method to help you study mathematics?	3.581	Strongly Agree	Very Effective
8. Did Buddy system boost your self-esteem and confidence in learning mathematics?	3.290	Agree	Moderately Effective

Guidance

Students expressed appreciation for how their Buddies helped them understand specific steps and strategies during problem-solving:

> *"She (Buddy) helped me change 1.36 to a percentage."* (Ixora-1)
> *"My friend teaches me simple techniques to understand."* (Daisy-1)
> *"I learn new things from her (Buddy) and know how to solve that maths question."* (Nachu-1)

Support

The emotional and cognitive reassurance provided by Buddies was another recurring theme:

> *"My Buddy helps me whenever I have a problem or am confused or stuck on a question."* (Wix-1)
> *"She (Buddy) helped me understand more regarding a few questions I was confused with. She also corrected some of my mistakes."* (Zeon-1)
> *"She (Buddy) helps more on it by explaining. I got confused about fractions and decimals."* (Bonbon-1)

Addressing RQ2: Students' perceptions

The second research question explored students' perceptions of how the Buddy system affected their learning. As shown in Table 2, students responded positively across all items. Most of the items had mean scores above 3.4 on a 4-point Likert scale, corresponding to "Agree" or "Strongly Agree" in the descriptive ratings. The items with the highest mean scores were those related to understanding conversions between decimals, fractions, and percentages (M = 3.645), receiving help when stuck on mathematical problems (M = 3.645), and perceiving the Buddy system as a good method to study mathematics (M = 3.581). Each of these was interpreted as "Very Effective," indicating strong endorsement of the intervention's practical value (Lestari et al., 2023).

Cooperative learning

Students described how collaboration in Buddy and group-based tasks helped them develop teamwork, communication, and joint responsibility:

> *"She (Buddy) helped me with the mind map, and our teamwork is great."* (Taylor-3)
> *"We planned the mind map together. We divided the examples into two to easily combine them once we're done."* (Rhys-3)
> *"We both agreed on something together."* (Haze-3)

DISCUSSION

These reflections suggest that dialogic peer explanations often use more accessible language and personalised approaches, supporting conceptual clarity and procedural accuracy (Li et al., 2021; Purnomo et al., 2022). This also aligns with Gillies (2020), who found that peer scaffolding enhances student learning in mathematics when Buddies assist each other through dialogue and modelling.

Such emotional and cognitive support is echoed in classroom experiments where peer-assisted models improved persistence and reduced anxiety (Adeniji & Rukayya, 2022; Kurniawan & Saleh, 2023). Overall gains in this small sample (n = 30) mirror broader meta-analytic evidence that cooperative strategies reliably boost mathematics achievement (Mahmud & Wulandari, 2023) and structured peer-assisted learning benefits algebra problem solving (Putra & Abdullah, 2020).

Nonetheless, the teacher-researcher's dual role may have introduced Hawthorne effects; future studies with randomised control groups are recommended. The cultural alignment of peer strategies with Bruneian classroom norms may have further supported successful implementation. According to Hofstede's (2010) cultural dimensions, collectivist learning environments are especially well-suited to peer-based interventions such as the Buddy system. Other local studies further confirm positive student perceptions of supplemental peer learning (Shahrill et al., 2023).

Collectively, the quantitative improvements and rich qualitative themes corroborate the growing body of evidence that cooperative learning, whether through structured TGT, peer tutoring, or technology-enhanced formats, enhances engagement and achievement in mathematics (Gillies, 2020; Li et al., 2021; Mahmud & Wulandari, 2023). The Buddy system offers a culturally congruent, low-cost strategy that, when guided and monitored, can yield both cognitive and affective benefits for secondary students in Brunei and comparable contexts.

This is further supported by evidence from Southeast Asian contexts, where peer-based formative strategies influenced both instructional design and assessment practices in language education (Trang et al., 2024), indicating the potential cross-disciplinary relevance of structured peer models. This also aligns with prior studies demonstrating the value of structured peer learning in improving engagement, confidence, and classroom cohesion (e.g., Balan, 2015; Mohd Zahid et al., 2021; Reid et al., 2016).

CONCLUSIONS

This study investigated the effectiveness of a Buddy system in supporting Year 8 Bruneian students' ability to convert between decimals, fractions, and percentages (RQ1) and explored their perceptions of the intervention (RQ2). The findings indicate that most students showed measurable improvement in their post-test performance, and the system was perceived positively by nearly all participants. Quantitative gains were complemented by qualitative insights that revealed three dominant themes: guidance, support, and cooperative learning. These themes were reflected in students' reflection journals and helped explain how the Buddy system contributed to conceptual understanding and emotional engagement.

While the results support the value of peer-assisted learning in mathematics, not all students benefited equally. A small number experienced performance declines, underscoring the need for careful pairing and continuous teacher facilitation. The study also has limitations, including a small sample size, the lack of a control group, and the possibility of observer effects due to the teacher-researcher's presence.

Despite these constraints, the findings provide encouraging evidence for integrating the Buddy system into mathematics classrooms. It offers a culturally relevant and low-cost approach that promotes peer dialogue, confidence, and collaborative learning, particularly suited to collectivist classroom cultures like Brunei's. Future research could expand the study to include more diverse schools, extended intervention periods, and comparative control groups to validate further and refine the approach.

The study affirms that when thoughtfully designed and supported, peer-learning strategies like the Buddy system can enhance academic performance and student engagement in mathematics.

ACKNOWLEDGMENT

We express our appreciation to the school administrator, mathematics teachers, and Year 9 students who participated in this study. We also acknowledge Dr. Marlizayati Johari for her valuable academic guidance and encouragement. Special thanks are extended to Mr. Kabara Auwal Halabi (PhD student, SHBIE, UBD) for his research assistance in reviewing and reformatting the manuscript draft before its initial submission.

AUTHORS' DECLARATION

Authors' contributions	SNAJ: Conceptualisation, design of the study, classroom intervention, data collection, analysis, and manuscript writing. MS: Manuscript review, editing, and proofreading. YMS: Manuscript review and scholarly feedback. All authors have read and approved the final version of the manuscript.
Funding Statement	This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Availability of data and materials	All data are available from the corresponding author upon reasonable request.
Competing interests	The authors declare that the publishing of this paper does not involve any conflicts of interest. This work has never been published or offered for publication elsewhere, and it is completely original.

BIBLIOGRAPHY

Abdul Latif, N. H., Shahrill, M., & Hidayat, W. (2024). Mastering fractions and innovating with the station rotation model in blended learning. *Infinity Journal, 13*(2), 501–530. https://doi.org/10.22460/infinity.v13i2.p501-530

Abdul Malak, S. S. D. (2015). Cooperative learning: Buddy system in an advanced accounting subject. *International Conference on Accounting Studies (ICAS) 2015*. https://repo.uum.edu.my/id/eprint/17564/

Adams, D. (2016). The effectiveness of the buddy support system on teacher-parent collaboration and students' social interaction in special education in Malaysia (Doctoral dissertation, University of Malaya). http://studentsrepo.um.edu.my/6568/

Adeniji, O. G., & Rukayya, S. (2022). Peer tutoring and student achievement in mathematics: Evidence from a quasi-experiment. *International Journal of Educational Research Open, 3*, 100146. https://doi.org/10.1016/j.ijedro.2022.100146

Balan, H. R. (2015). Using peer mentoring-buddy system as an intervention strategy to enhance Science research skills. *Journal of Multidisciplinary Studies*, *4*(1), 168–185. https://doi.org/10.7828/jmds.v4i1.850

Bringula, R. P., & Atienza, F. A. L. (2022). Mobile computer-supported collaborative learning for mathematics: A scoping review. *Education and Information Technologies, 27*(6), 789–812. https://doi.org/10.1007/s10639-022-10845-2

Feldman, A., Altrichter, H., Posch, P., & Somekh, B. (2018). *Teachers Investigate Their Work: Introduction to action research across the professions* (3rd ed.). Routledge. https://doi.org/10.4324/9781315398822

Gan, A. L., & Shahrill, M. (2019). Why the need for private tuition in mathematics? Investigating shadow education in Brunei Darussalam. *AIP Conference Proceedings*, *2194*(1), 020031. https://doi.org/10.1063/1.5139763

Gillies, R. M. (2016). Cooperative learning: Review of research and practice. *Australian Journal of Teacher Education*, *41*(3), 39–54. https://doi.org/10.14221/ajte.2016v41n3.3

Gillies, R. M. (2020). Dialogic interactions in cooperative learning groups. *Cambridge Journal of Education, 50*(4), 377–394. https://doi.org/10.1080/0305764X.2020.1752317

Hofstede, G. (2010). *Cultures and organizations: Software of the mind* (3rd ed.). McGraw-Hill.

Hong, K. L., Ramli, I. S. M., Mazlan, N. A., Rengasamy, M., Kong, H. L., & Muniandi, K. (2020). Enhancing mathematical performance using fun teaching aids. *International Journal of Academic Research in Progressive Education and Development*, *9*(2), 405–415. https://doi.org/10.6007/ijarped/v9-i2/7486

Hossain, M. A., Tarmizi, R. A., & Ayud, A. F. M. (2012). Collaborative and cooperative learning in Malaysian Mathematics education. *Journal on Mathematics Education*, *3*(2), 103–114. https://doi.org/10.22342/JME.3.2.569.103-114

Johari, M., Ali, A. O., Musa, J., Zakir, N., & Shahrill, M. (2024). *Teacher educators' and students' perspectives in transitioning from conventional to online teaching and learning*. *Jurnal Cakrawala Pendidikan, 43*(1), 232–241. https://doi.org/10.21831/cp.v43i1.52171

Johnson, D. W., & Johnson, R. T. (2019). Cooperative learning: The foundation for active learning. In M. R. J. Guilherme (Ed.), *Active learning – Beyond the future* (pp. 59–70). IntechOpen. https://doi.org/10.5772/intechopen.81086

Johnson, D. W., Johnson, R., & Smith, K. (1991). *Active learning: Cooperation in the college classroom*. Interaction Book Company.

Kurniawan, D. A., & Saleh, C. (2023). Peer-assisted learning effects in mathematics classrooms: A classroom experiment. *Education and Information Technologies, 28*, 793–809. https://doi.org/10.1007/s10639-022-11108-0

Lestari, R., Prahmana, R. C. I., Chong, M. S. F., & Shahrill, M. (2023). Developing realistic mathematics education-based worksheets for improving students' critical thinking skills. *Infinity Journal, 12*(1), 69–84. https://doi.org/10.22460/infinity.v12i1.p69-84

Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues*, *2*(4), 34–46. https://doi.org/10.1111/J.1540-4560.1946.TB02295.X

Li, M., Wang, Y., & Huang, T. (2021). Effects of cooperative learning interventions on mathematical problem-solving and anxiety: A systematic review. *Educational Psychology Review, 33*, 569–597. https://doi.org/10.1007/s10648-020-09557-1

Mahmud, A., & Wulandari, P. (2023). Cooperative learning strategy to improve students' mathematics communication skills: A meta-analysis. *Heliyon, 9*(3), e13250. https://doi.org/10.1016/j.heliyon.2023.e13250

Mohd Zahid, A. Z., Saifullizam, N. Z., Wan Chik, W. S., Khalid, N., Kamaruddin, S. F., & Mat Zin, M. (2021). Intervention programme: The implementation of buddy system programme amongst civil engineering students. *Insight Journal*, *8*(3), 16–25. https://myjms.mohe.gov.my/index.php/insightjournal/article/view/14306

Motzo, A. (2016). Evaluating the effects of a 'student buddy' initiative on student engagement and motivation. In S. Papadima-Sophocleous, L. Bradley, & S. Thouësny (Eds.), *Innovative language teaching and learning at university: Enhancing participation and collaboration* (pp. 19–28). Research-publishing.net. https://doi.org/10.14705/rpnet.2016.000401

Pagni, D. (2004). Fractions and decimals. *The Australian Mathematics Teacher*, *60*(4), 28–30. https://search.informit.org/doi/10.3316/informit.185652646639736

Purnomo, Y. W., Pasri, Aziz, T. A., Shahrill, M., & Prananto, I. W. (2022). Students' failure to understand fraction multiplication as part of a quantity. *Journal on Mathematics Education, 13*(4), 681–702. https://doi.org/10.22342/jme.v13i4.pp681-702

Putra, Z. A., & Abdullah, A. H. (2020). The impact of structured peer-assisted learning in algebra problem-solving: A quasi-experimental study. *European Journal of Educational Research, 9*(4), 1601–1610. https://doi.org/10.12973/eu-jer.9.4.1601

Reid, P., Chau, M., & Thalluri, J. (2016). Students' experience and evaluation of peer-to-peer learning innovation. *Focus on Health Professional Education: A Multi-Professional Journal*, *17*(1), 101–104. https://doi.org/10.11157/fohpe.v17i1.125

Shahrill, M., Gan, A. L., Mohammad, H. H., & Jawawi, R. (2022). Intentions of shadow education in mathematics: Insights of secondary school students in Brunei Darussalam. *Didactica Mathematicae*, *44*, 81–105. https://doi.org/10.14708/dm.v44i1.7182

Shahrill, M., Nurhasanah, F., Ibrahim, S. A., Prahmana, R. C. I., Asamoah, D., Mohammad, H., & Gan, A. L. (2023). Exploring students' perceptions of private mathematics tutoring in three countries. *Infinity Journal*, *12*(2), 339–358. https://doi.org/10.22460/infinity.v12i2.p339-358

Slavin, R. E. (2011). Instruction based on cooperative learning. In R. E. Mayer, & P. A. Alexander (Eds.), *The nature of learning: using research to inspire practice* (pp. 161–178). OECD Publishing.

Sweeney, E. S., & Quinn, R. J. (2000). Concentration: Connecting fractions, decimals & percents. *Mathematics Teaching in the Middle School*, *5*(5), 324–328.

Trang, L. T. T., Johari, M., & Said, H. (2024). *Exploring the influences of online assessments on teaching practice at a language school in Vietnam*. *Education and Information Technologies, 29*(16), 21917–21941. https://doi.org/10.1007/s10639-024-12745-5

Ulvik, M. (2014). Student-teachers doing action research in their practicum: Why and how? *Educational Action Research*, *22*(4), 518–533. https://doi.org/10.1080/09650792.2014.918901

Vozzo, R., Johnson, S., & Tuke, J. (2024). Active Learning at Scale: Investigating the Benefits of Peer Instruction in Undergraduate Mathematics. *arXiv preprint*. https://arxiv.org/abs/2405.14151

Wahat, N. W. A. (2020). Buddy system for students with disabilities: An action research with embedded Islamic values and perspectives. *International Journal of Academic Research in Business and Social Sciences*, *10*(15), 1–12. https://doi.org/10.6007/ijarbss/v10-i15/8239