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Implementation of Cooperative Learning Among Secondary School Mathematics Teachers

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ABSTRACT

This study explores how cooperative learning is implemented by secondary school mathematics teachers. Using a quantitative survey design, data were gathered from 80 secondary school mathematics teachers across several schools. The investigation focused on comparing cooperative learning with other teaching approaches, examining its influence on classroom practices, and understanding teachers' perceptions and attitudes toward this method. A 30-item questionnaire based on a five-point Likert scale was administered, and the data were analysed using descriptive and inferential statistics. The results indicate a high level of cooperative learning implementation among teachers. Teaching experience was found to significantly influence teachers' perceptions and practices, while no significant difference was observed based on gender. The findings are consistent with the Theory of Planned Behaviour, indicating that teachers' positive attitudes and perceived readiness significantly influence their implementation of cooperative learning in mathematics classrooms. Nevertheless, some challenges were noted, particularly regarding the shift from traditional teaching to more active, student-centered approaches.

Keywords: *cooperative learning, mathematics education, teacher perception, teaching strategies, student engagement, secondary school, Theory of Planned Behaviour*

INTRODUCTION

Education in the 21st century calls for teaching approaches that emphasize collaboration, communication, and critical thinking. The *Malaysia Education Blueprint 2013–2025* highlights the importance of innovative and student-centered learning strategies to prepare students for future challenges. In line with this vision, teachers are encouraged to move away from traditional, teacher-centered methods and adopt active learning strategies that engage students more deeply in the learning process. One approach that supports this goal is cooperative learning, where students work together in small groups to share ideas, solve problems, and build understanding through discussion.

In mathematics education, cooperative learning has been shown to help students improve their understanding, motivation, and achievement. Many students perceive mathematics as a difficult and

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less interesting subject (Dimatacot & Parangat, 2022), which suggests the need for more interactive and supportive teaching approaches. Through cooperative learning, students have the chance to talk about mathematical concepts, ask questions, and explain their reasoning to peers, activities that strengthen their comprehension and retention of knowledge.

Even with its known advantages, the use of cooperative learning in Malaysian classrooms remains relatively limited. Teachers often face obstacles such as time constraints, large class sizes, and a lack of structured training on how to apply cooperative learning effectively (Gillies & Boyle, 2010). Moreover, teachers' beliefs, experiences, and understanding strongly influence whether they use such methods in practice. Therefore, exploring how mathematics teachers perceive and implement cooperative learning is important for identifying ways to make this strategy more effective in schools.

Despite extensive research highlighting the benefits of cooperative learning on students' academic achievement and engagement, much of the existing literature primarily focuses on student outcomes rather than teachers' classroom practices. In the Malaysian context, studies examining cooperative learning have largely emphasized its effectiveness on students, with limited attention given to how secondary school mathematics teachers perceive, implement, and sustain this approach in real classroom settings. Furthermore, empirical evidence exploring the influence of demographic factors, such as gender and teaching experience, on teachers' implementation of cooperative learning remains scarce. This gap highlights the need for a deeper investigation into teachers' instructional practices and perceptions to better understand the practical implementation of cooperative learning in secondary mathematics classrooms.

In response to these gaps, the present study seeks to examine the implementation of cooperative learning among secondary school mathematics teachers in Malaysia. More specifically, the study aims to:

1. Identify how often and how effectively secondary school mathematics teachers use cooperative learning strategies.
2. Analyse gender-based differences in the frequency of using cooperative learning.
3. Examine how teaching experience influences teachers' perceptions and attitudes toward cooperative learning in mathematics instruction.

By addressing these objectives, this study aims to contribute empirical evidence on teachers' instructional practices and provide insights into factors that influence the effective implementation of cooperative learning in secondary mathematics education.

Figure 1 illustrates the conceptual framework of this study. It shows the relationship between teachers' knowledge, skills, and motivation (independent variables) and the implementation of cooperative learning in mathematics classrooms (dependent variable). The framework also considers gender and teaching experience as demographic factors that may influence or moderate this relationship. The model is adapted from Ismail et al. (2020) and Alias et al. (2018), both of whom emphasize that teachers' understanding and attitudes have a strong effect on their teaching practices.

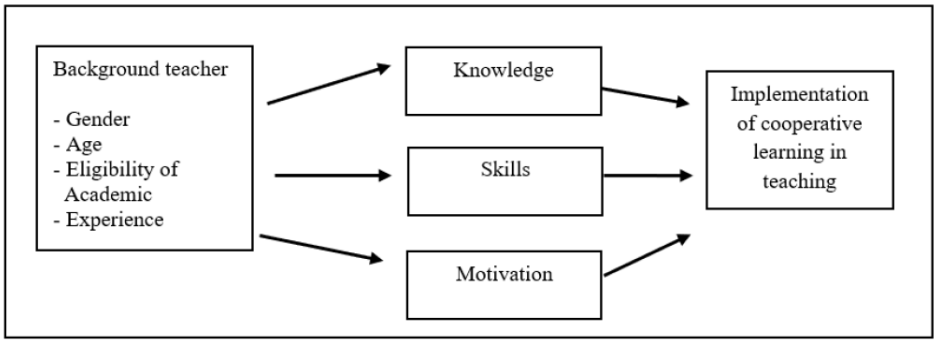

Figure 1: Conceptual Framework of the Study

The next section reviews the theoretical background and existing literature on cooperative learning, focusing on its role in mathematics education and the challenges teachers face when applying this approach.

LITERATURE REVIEW

Theoretical Foundation

This study is grounded in Lev Vygotsky's Scaffolding Theory (1978), which emphasizes that learning happens through social interaction between learners and more knowledgeable others, such as teachers or peers. Central to this theory is the concept of the Zone of Proximal Development (ZPD), the gap between what a learner can do independently and what they can achieve with guidance. Scaffolding takes place when teachers or peers provide support and gradually withdraw it as the learner becomes more competent.

In the context of cooperative learning, this theory suggests that students construct knowledge together through collaboration, discussion, and shared problem-solving. Teachers act as facilitators who design learning activities that allow students to participate actively in reasoning and exploration. In mathematics, such support helps students engage with challenging concepts and develop a deeper understanding through guided interaction.

Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB), proposed by Ajzen (1991), explains how individuals' attitudes, subjective norms, and perceived behavioural control influence their intentions and actual behaviours. In educational settings, TPB has been widely used to understand teachers' instructional decisions and classroom practices. Teachers are more likely to adopt innovative teaching strategies, such as cooperative learning, when they hold positive attitudes toward the approach, perceive institutional or peer support, and feel confident in their ability to implement it effectively.

Within the context of this study, TPB provides a relevant framework for understanding secondary school mathematics teachers' implementation of cooperative learning. Teachers' attitudes toward cooperative learning reflect their beliefs about its effectiveness, while perceived behavioural control relates to their confidence, skills, and teaching experience. Subjective norms may include curriculum demands, school culture, and expectations from school leadership. Together, these factors influence teachers' willingness and consistency in applying cooperative learning strategies in mathematics classrooms.

Cooperative Learning in Mathematics Education

Cooperative learning has long been recognized as an effective way to teach mathematics. It is generally defined as a structured approach where students work in small groups to achieve shared learning goals (Ismail et al., 2020). Through this process, learners develop not only academic understanding but also interpersonal skills such as communication, teamwork, and leadership.

Dimatacot and Parangat (2022) found that students taught with cooperative learning strategies showed higher levels of engagement, motivation, and achievement than those taught through traditional approaches. Similarly, Alias et al. (2018) reported that cooperative learning promotes essential 21st-century skills, especially communication and collaboration, that are crucial for success in modern classrooms.

In Malaysia, Jani et al. (2024) pointed out that the *Malaysia Education Blueprint (2013–2025)* encourages teachers to adopt student-centered and active learning strategies to prepare students for

future challenges. Cooperative learning fits well with this aim, as it promotes peer interaction, critical thinking, and collaborative problem-solving. Studies have also shown that mathematics teachers who apply cooperative learning often observe greater classroom participation and stronger relationships between teachers and students, marking a shift toward more interactive instruction.

Collectively, these studies suggest that cooperative learning supports both cognitive and social aspects of mathematics learning, highlighting its potential as an effective instructional approach when implemented systematically by teachers.

Benefits of Cooperative Learning

A consistent theme across research is that cooperative learning benefits both academic performance and social development. It encourages active participation, peer teaching, and higher-order thinking (Karmina et al., 2021; Cheng, 2021). When students collaborate, they share diverse viewpoints, clarify misunderstandings, and build deeper conceptual understanding.

Berta and Hoffmann (2020) found that cooperative learning helps strengthen students' motivation and social skills, while Erdogan (2019) observed that it enhances reflective thinking and mathematical reasoning. Moreover, cooperative learning creates an inclusive learning environment where students learn to respect differing opinions and share responsibility for group success. It can also build confidence in students who may otherwise remain passive in a traditional classroom, while allowing high-achieving students to reinforce their understanding by explaining ideas to peers.

Overall, prior research consistently demonstrates that cooperative learning enhances not only academic achievement but also students' motivation and interpersonal skills, reinforcing its relevance to contemporary mathematics education. These challenges indicate that the successful implementation of cooperative learning depends largely on teachers' preparedness, beliefs, and classroom management skills, underscoring the importance of examining teachers' perceptions and practices.

Challenges in Implementation

Despite its benefits, implementing cooperative learning effectively remains challenging for many teachers. Time limitations, classroom management issues, and uneven student participation are among the most frequently reported barriers (Gillies & Boyle, 2010; Veldman et al., 2020). In some cases, teachers lack training in structuring cooperative tasks or assessing group outcomes (Vollenger et al., 2018).

Others prefer teacher-centered approaches because they are more familiar and easier to manage (Atiq, 2021). Cultural expectations and exam-oriented teaching traditions in Malaysia can also discourage open discussion and collaborative work in mathematics lessons.

Teacher attitudes are another important factor. Abramczyk and Jurkowski (2020) emphasized that teachers who view cooperative learning positively are more likely to integrate it meaningfully, while those who are less confident may only use it superficially. This highlights the importance of understanding teachers' perceptions, beliefs, and readiness to apply cooperative methods effectively in mathematics education.

Overall, the literature supports cooperative learning as a powerful instructional strategy that enhances students' achievement, motivation, and social development. It aligns closely with contemporary educational goals that value collaboration and student-centered learning. However, challenges such as limited teacher preparation, time constraints, and inconsistent application still hinder its full implementation.

While much of the existing research focuses on students' outcomes, fewer studies explore teachers' perspectives and classroom practices, especially among secondary school mathematics teachers in Malaysia. Addressing this gap, the present study investigates how mathematics teachers apply cooperative learning and how demographic factors, including gender and teaching experience, influence its use in classroom settings.

In summary, existing literature strongly supports the effectiveness of cooperative learning in mathematics education, particularly in enhancing students' engagement and achievement. However, fewer studies have focused on teachers' implementation practices and the factors influencing their use of cooperative learning, especially in the Malaysian secondary school context. Guided by the Theory of Planned Behaviour, the present study addresses this gap by examining teachers' perceptions, implementation frequency, and the influence of demographic factors such as gender and teaching experience.

METHODOLOGY

Research Design

This study employed a quantitative survey design to examine the implementation of cooperative learning among secondary school mathematics teachers. The quantitative approach was selected as it enables the systematic collection and analysis of numerical data to identify teachers' perceptions, understanding, and practices of cooperative learning. Data were gathered through a structured questionnaire to obtain measurable and comparable responses from participants.

Population and Sampling

The target population of this study comprised secondary school mathematics teachers from selected schools in Perak, Johor, and Selangor. A total of 80 teachers participated in the study. Participants were selected using simple random sampling to ensure that each teacher had an equal chance of being included. The final sample size was determined based on accessibility and voluntary participation of teachers during the data collection period.

Research Instrument

Data were collected using a questionnaire consisting of 30 items, which was developed based on previous studies related to cooperative learning. The instrument comprised three sections:

- **Section A**: Demographic information (gender, qualification, teaching experience).
- **Section B**: Teachers' knowledge and skills related to cooperative learning.
- **Section C**: Teachers' perceptions and attitudes toward cooperative learning.

A *five-point Likert scale* ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) was used for most items to measure the level of agreement or frequency. Sample items include statements such as "I encourage students to work in pairs during mathematics lessons" and "I feel confident in implementing cooperative learning strategies in my classroom."

Validity and Reliability

Content validity was established through expert review by experienced mathematics educators. A pilot study was conducted to assess the reliability of the instrument. The results indicated satisfactory internal consistency, with Cronbach's alpha values of 0.86 for teachers' knowledge and skills, 0.88 for perceptions and attitudes, and an overall reliability coefficient of 0.90.

Data Collection Procedures

Data collection was conducted online using Google Forms, allowing respondents to complete the questionnaire at their convenience. Clear instructions were provided at the beginning of the survey to ensure participants understood each item. Each respondent took approximately 10–15 minutes to complete the questionnaire. The online format facilitated efficient data gathering from teachers across multiple states while maintaining accessibility and accuracy.

Data Analysis

Collected data were analysed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics (mean and standard deviation) were used to summarize the teachers' frequency, understanding, and perceptions of cooperative learning. To identify differences in implementation based on gender and teaching experience, independent samples t-tests and one-way ANOVA were employed. These analyses provided both descriptive and inferential insights aligned with the study's research objectives.

Ethical Considerations

All ethical considerations were observed throughout the study. Participation was voluntary, and informed consent was obtained from all respondents prior to data collection. Participants were assured of anonymity and confidentiality, and no identifying information was collected. The data were used solely for academic purposes.

RESULTS AND DISCUSSION

Table 1 presents the demographic characteristics of the respondents who participated in this study, including gender, academic qualification, age, and teaching experience. The information provides an overview of the background of the 80 secondary school mathematics teachers involved in this research.

Table 1: Demographic Profile

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Female	48	60.0
	Male	32	40.0
Qualification	Diploma	8	10.0
	Bachelor's Degree	60	75.0
	Master's Degree	12	15.0
Age	20–35 years	39	48.75
	36–40 years	5	6.25
	41–55 years	36	45.0
Teaching Experience	1–3 years	19	23.75
	16+ years	26	32.5

As shown in Table 1, the respondents comprised 80 secondary school mathematics teachers from selected schools in Perak, Johor, and Selangor. Most respondents were female (60.0%), while male teachers accounted for 40.0% of the sample. Most respondents held a bachelor's degree (75%), followed by those with a master's degree (15%) and diploma holders (10%). In terms of age, 48.75% of the teachers were between 20 and 35 years old, while 45% were between 41 and 55 years old. Regarding teaching experience, 32.5% of the teachers had 16 years or more of experience, and 23.75% were relatively new, with less than three years of teaching experience.

These findings indicate that the sample represents a diverse and balanced group of mathematics teachers with varying qualifications, ages, and experience levels. The predominance of female teachers reflects

the general demographic pattern of the Malaysian teaching workforce. Understanding this demographic composition provides important context for interpreting the subsequent analyses on teachers' implementation and perceptions of cooperative learning.

The following section presents findings related to the first research objective, which examines the frequency and effectiveness of cooperative learning implementation among secondary school mathematics teachers.

Frequency and Effectiveness of Cooperative Learning Implementation

The first objective of this study was to identify how frequently and effectively secondary school mathematics teachers implement cooperative learning strategies in the classroom. Descriptive analysis revealed high mean scores across all related items, ranging from M = 4.15 to M = 4.41 on a five-point Likert scale, as shown in Table 2. The highest mean was recorded for the item *"I always guide students during activities in the classroom"* (M = 4.41, SD = 0.589), followed by *"I encourage students to work in pairs during group discussions"* (M = 4.37, SD = 0.603).

These results indicate that most mathematics teachers actively apply cooperative learning principles such as peer collaboration, group discussion, and teacher facilitation. The findings align with Karmina et al. (2021) and Alias et al. (2018), who emphasize that cooperative learning encourages student engagement and enhances classroom interaction. Teachers' frequent use of these strategies demonstrates their positive acceptance of cooperative learning as an effective approach for promoting active participation and teamwork among students.

This high level of implementation may be attributed to teachers' positive attitudes toward cooperative learning and their confidence in managing group-based classroom activities. From the perspective of the Theory of Planned Behaviour, positive attitudes and strong perceived behavioural control increase the likelihood of actual classroom practice. The consistently high mean scores therefore suggest that teachers not only recognise the value of cooperative learning but also feel capable of applying it effectively in mathematics instruction.

This outcome supports Vygotsky's Scaffolding Theory, as teachers' facilitative roles and peer interactions serve as crucial elements that help students learn within their *Zone of Proximal Development*. Through guided group work and structured interaction, students become more confident in exploring mathematical concepts, which enhances comprehension and retention.

Table 2: Frequency and Effectiveness

Item	Mean	SD
I always guide students during activities in class.	4.41	0.59
I encourage students to work in pairs during group discussions.	4.37	0.60
I make active learning with student involvement.	4.36	0.56
I plan early the cooperative teaching activities.	4.35	0.58
I implement cooperative elements in all lessons.	4.30	0.58

Teachers' Understanding of Cooperative Learning Concepts

The second objective examined the level of teachers' understanding regarding the concepts and methods of cooperative learning. The findings revealed mean scores ranging from M = 4.15 to M = 4.49, as presented in Table 3, suggesting a strong understanding among teachers. The highest mean was for "I understand the concept of cooperative learning" (M = 4.49, SD = 0.551), followed by "Cooperative learning is a teaching method that encourages students to share their opinions during class" (M = 4.44, SD = 0.633).

These results demonstrate that teachers possess a solid conceptual grasp of cooperative learning and its application in classroom settings. However, the slightly lower mean for "I have attended a course related to cooperative learning" (M = 4.18, SD = 0.839) indicates that while teachers understand the concept theoretically, not all have received formal training on how to implement it effectively.

This finding corresponds with Gillies and Boyle (2010), who noted that insufficient teacher training often limits consistent and effective use of cooperative learning in classrooms. It also supports Alias et al. (2018), who highlighted the need for professional development courses to enhance teachers' pedagogical readiness for 21st-century learning. Strengthening training programs can help teachers apply cooperative learning more systematically and confidently, especially in mathematics subjects that require structured problem-solving.

Table 3: Teachers' Understanding

Item	Mean	SD
I understand the concept of cooperative learning.	4.49	0.55
I have been introduced to the concept of cooperative learning.	4.44	0.55
I can differentiate traditional and cooperative teaching methods.	4.38	0.62
I know how to implement cooperative learning.	4.33	0.59
Cooperative learning encourages students to share opinions.	4.44	0.63

Differences Based on Gender and Teaching Experience

The third objective explored whether demographic factors such as gender and teaching experience influence teachers' implementation of cooperative learning. Results from the independent samples t-test showed no significant difference between male and female teachers in their frequency of implementing cooperative learning strategies, as indicated in Table 4.

The absence of significant gender differences indicates that professional expectations, pedagogical training, and curriculum demands in Malaysian schools may play a more influential role than gender in shaping teachers' instructional practices. This finding suggests that cooperative learning is perceived as a pedagogically appropriate approach by teachers regardless of gender, likely due to standardized teacher education programs and shared instructional expectations. Similar findings have been reported in previous studies, indicating that gender is not a determining factor in teachers' adoption of student-centered teaching approaches.

Table 4: Gender & Experience Differences

Variable	Test	F/t Value	Sig. (p)	Interpretation
Gender	t-test	1.12	0.27	No significant difference
Teaching Experience	ANOVA	3.46	0.02*	Significant difference

However, results from the one-way ANOVA, also summarized in Table 4, revealed significant differences based on teaching experience. Teachers with more than 16 years of experience reported higher mean scores in perceptions and attitudes toward cooperative learning compared to those with fewer than seven years of experience. This finding implies that teaching experience contributes to greater confidence and skill in implementing cooperative strategies, possibly because experienced teachers have had more opportunities to experiment with different pedagogical methods and observe their effectiveness.

These results are consistent with Prieto-Saborit et al. (2022), who found that adequate training and years of experience are associated with higher levels of cooperative learning implementation.

Similarly, Puiggalí et al. (2023) noted that teachers' attitudes toward cooperative practices improve as they gain experience and develop stronger classroom management skills.

Overall, the results demonstrate that secondary school mathematics teachers possess positive perceptions and strong understanding of cooperative learning. Most participants frequently apply group-based methods, as summarized in Tables 2 and 3, confirming that cooperative learning is increasingly integrated into mathematics instruction. Nevertheless, challenges remain in providing structured training and support for teachers with less experience.

These findings strengthen the argument that cooperative learning aligns with the Malaysia Education Blueprint (2013–2025) goals for 21st-century learning and supports Vygotsky's Scaffolding Theory, as illustrated earlier in Figure 1. Promoting broader implementation of cooperative learning can cultivate critical thinking, communication, and collaboration skills among students, essential competencies for future-ready learners.

CONCLUSION

This study examined the implementation of cooperative learning among secondary school mathematics teachers, focusing on the frequency of its use, teachers' understanding of the concept, and differences based on gender and teaching experience. The findings revealed that teachers frequently applied cooperative learning strategies such as group discussion, peer collaboration, and guided classroom activities. Most participants demonstrated a strong conceptual understanding of cooperative learning and recognized its value in promoting student engagement and achievement.

The analysis further indicated that gender did not significantly influence the implementation of cooperative learning, while teaching experience played a notable role. Teachers with more years of experience were more confident and consistent in integrating cooperative learning methods into their mathematics instruction. These results suggest that familiarity with classroom dynamics and accumulated pedagogical experience contribute to more effective use of student-centered strategies.
Despite its contributions, this study has several limitations. The findings are based on self-reported data from a relatively small sample of secondary school mathematics teachers, which may limit the generalisability of the results. In addition, the use of a cross-sectional survey design does not allow for examination of changes in teachers' practices over time.

From a practical perspective, the findings suggest the need for continuous professional development programmes that focus on effective cooperative learning strategies, particularly for less experienced teachers. School administrators and policymakers may also consider providing structured support, adequate time allocation, and instructional resources to facilitate the consistent implementation of cooperative learning in mathematics classrooms.

Overall, the findings indicate that cooperative learning is well received and practiced among secondary school mathematics teachers in Malaysia. It supports the objectives of the Malaysia Education Blueprint (2013–2025), which advocates for active and collaborative learning environments. By fostering interaction, teamwork, and communication, cooperative learning serves as an effective approach to enhance students' mathematical understanding and to cultivate essential 21st-century learning skills.

Future research could extend this study by employing qualitative or mixed-method approaches, such as classroom observations and teacher interviews, to gain deeper insights into how cooperative learning is enacted in real classroom settings. Further studies may also explore the impact of cooperative learning on students' mathematical achievement and attitudes, as well as investigate the effectiveness of targeted professional development programs in enhancing teachers' implementation of cooperative learning across different school contexts.

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AUTHORS' CONTRIBUTION

Nordin, S. N. W. conceived the research idea, designed the study framework, and carried out the data collection and analysis. Rosly, N. S. led the writing of the manuscript, refined the interpretation of results, and structured the final version for publication. Both authors discussed the findings, contributed to the critical review, and approved the final manuscript for submission.

CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to Jurnal Intelek.

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