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The Effectiveness of Student Teams Achievement Division Cooperative Learning in Improving Mathematics Skills in VTE Engineering Students

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ABSTRACT

Student teams-achievement divisions (STAD) is a cooperative learning strategy in which small groups of learners with different abilities work together to achieve a shared goal. This study investigates the effectiveness of employing STAD amongst vocational and technical engineering (VTE) students. The objectives are to identify if using STAD in the classroom enhances students' learning and improves their performance and attitude toward cooperative learning strategies, and also to identify their learning preferences with regard to studying individually or cooperatively. The study draws from quantitative data from pre- and post-tests, student attitude questionnaires, rubric evaluation and group achievement test to assess students' performance in groups. A paired t-test was conducted, with the results demonstrating a significant difference between the students' scores in the pre- and post-tests, indicating that STAD cooperative learning improved student performance in mathematics skills and the learning outcomes.

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1. INTRODUCTION

With the increased competition related to employability, advanced technology and globalisation, there is a new urgency to develop 21st-century skills such as collaboration, critical thinking, problem-solving, communication, and digital literacy in both the learning outcomes of numeracy and support group system (Metz, 2011; Towip, Widiastuti, & Budiyanto., 2022; Wang & Wu, 2021; Abd Mokmin, Bungsu, & Shahrill, 2023; Ismail, Bungsu, & Shahrill, 2023). Collaboration through cooperative learning can be defined as the instruction which involves working together in a small group to reach a common goal to maximise one's own and each other's learning benefits (Johnson & Johnson, 1999; Johnson, Johnson, & Stanne, 2000; Johnson, Johnson, & Smith, 2014).

Cooperative learning is the main focus of this study, due first to the implementation of Brunei Darussalam's 21st Century National Education System (Sistem Pendidikan Negara Abad ke-21 or SPN21), which aspires to develop essential skills such as critical thinking, problem-solving, self-management, creativity and those related to ICT. Second, it is due to the need to prepare students for the workforce with requirements from industry and companies that employees are equipped with technical and soft skills such as leadership, teamwork and management. Third, an apparent improvement in student learning through group work experiences has been shown in several studies (Ghaith and Yaghi, 1998; Liu, 2009; Fong, 2010).

For many years, the dominant teaching approach in Brunei has been traditional. Teachers play the main role in the class environment, and students passively listen to their instructions (Shahrill & Clarke, 2014; Shahrill, 2018; Yussop et al., 2021; Hamdan et al., 2022; Ali et al., 2022). The SPN21 education system aims to promote student-centred learning that focuses on the student's needs and appreciates their perspectives on their learning. Hence, the need for students to learn actively through a cooperative approach requires more practice in VTE as this will be needed for their future employment.

The cooperative learning technique is a learner-centred paradigm in teaching and learning. It has gained popularity and is an alternative to the lecture-based approach (Rukayah et al., 2018; Listiadi, Sulistyowati, & Canda Sakti, 2019; Namaziandost et al., 2019). Due to the collaborative setting of individual learning, students tend to value competition more and continuously work hard to achieve their personal goals (Lee et al., 1997;

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Ijon, 2021).

Students should familiarise themselves with cooperative learning to improve the learning and teaching of engineering mathematics skills and to foster team learning (Towip et al., 2022). Furthermore, cooperative learning supports students' entry onto the workforce, where they are likely to work with others in a team. Previous studies have shown many positive advantages in fostering collective experiences in students, such as academic gains across different curriculum domains (Calderón et al., 1998; Fall & Webb, 2000). Other advantages include increasing students' academic achievement (Slavin, 1998; Johnson & Johnson, 1999; Johnson et al., 2000; 2014; Atiq, Saleem, & Laiqat, 2021), motivation, self-esteem, communication and interpersonal relationships. The positive attributes are developing and boosting skills such as leadership, problem-solving, critical thinking and self-management, which will be needed in the workforce and their future employment. Potentially, cooperative learning should be promoted and nurtured as a VTE approach. It offers a better alternative to learning experiences such as the traditional chalk and talk method, which is to a certain degree passive and controlled. However, it is yet to be demonstrated that the cooperative learning approach would be favourable to VTE students when they entered the workforce. Studies that have focused on cooperative learning strategies in the VTE setting include those of Ghaith and Yaghi (1998), Liu (2009), Fong (2010), Listiadi et al. (2019), Okolie et al. (2022), Abd Mokmin et al. (2023) and Ismail et al. (2023).

Collaboration with others can be achieved through cooperative learning, and STAD can measure student performance. This study therefore aims to investigate the effectiveness of employing STAD with VTE engineering students. The objectives are to identify if using the approach in class enhances students' learning and improves their performance and attitude toward cooperative learning strategies, and to establish their learning preference for studying individually or cooperatively. The two research questions are:

How does cooperative learning affect students' achievements and improvement in learning mathematics skills? and

What are students' attitudes toward cooperative learning?

2. LITERATURE REVIEW

Cooperative learning involves organising students into groups, in which they work together to achieve shared learning goals. Such learning has remained an exciting approach and has been well documented in research for the past few decades as a successful pedagogy due to its substantial theoretical foundation (Aziz & Hossain, 2010; Virgana, 2019; Atiq et al., 2021). Low-achieving students often give up easily when they encounter difficult and complex problems or questions. However, if they are grouped with high-achievers, they will be supported and motivated to find solutions. Individual learners tend to delay their work if there is little pressure from their peers. However, when working in groups, they share responsibilities. They are driven to manage their time and work to complete tasks, thus avoiding becoming a burden to their group. Cooperative learning can indirectly overcome students' shyness and lack of confidence when engaging in problem-solving or group discussions with peers, as it encourages them to communicate with each other (Takko et al., 2020).

According to Slavin (1998), STAD is a learning technique developed to give students equal opportunities to achieve their goals, and they motivate and encourage each other in the cooperative process. The principle concept of STAD is that students work and learn together by being responsible and contributing to their group to reach shared goals. In the STAD approach, each group are assigned to three members with different roles. The teams are a heterogeneous mix with the combined abilities of high and low achievers, based on their previous pre-test performance. The approach also allows peer support and tutoring in small groups. Roles are rotated after a particular lesson, so members have different tasks and opportunities to master each skill.

STAD is the best strategy when teaching modular topic with a single answer, such as mathematical computation and mechanics. Several reports have concluded that STAD applied in mathematics classes is demonstrated to have improved learning and enhanced the relationships between students with different abilities, boosted their self-esteem, and developed positive attitudes and behaviour toward mathematics (Aziz & Hossain, 2010; Virgana, 2019; Atiq et al., 2021). Some studies on the effectiveness of STAD have been conducted in relation to mathematics class. Their results show that cooperative learning positively affects student performance (Premila, 2017; Wahyuni, 2019). It is believed that such learning is more effective than the conventional approach. In a study by Nasution and Hafizah (2020) on using the STAD cooperative learning model with student worksheets, the results showed an increase in students' understanding of mathematical concepts.

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According to Ling et al. (2016), STAD acts as an active pedagogy to encourage students and teachers to be innovative and creative in improving the teaching and learning of mathematics.

3. MATERIALS AND METHODS

A quantitative, descriptive classroom-based style approach was employed. The participants comprised 12 engineering students from a Skills Certificate 2 cohort studying the 'Heavy Construction Machinery and Mechanics' course at one of the VTE institutions in Brunei. Classes are typically small for such VTE courses. The mathematics topic for the designed lesson was 'Algebraic Solutions to Simultaneous Equations'. The study took three months to complete, with lessons conducted twice a week, each ranging between 60 and 120 minutes.

The lessons comprised three stages: pre-intervention, intervention and post-intervention. A pre-test was administered to the students to determine their prior knowledge in the pre-intervention lesson stage. At this stage, students were considered to be unfamiliar with the STAD strategy and needed support from their tutor. Therefore, a presentation regarding STAD was conducted and the approach was explained to the students so that they would understand the learning process. The students took part in quizzes to practise their STAD until they were confident during the intervention stage. In the post-intervention stage, a post-test was administered to determine their achievements and to gauge the improvement made from their previous performance.

The instruments for the data collection included a student attitude questionnaire, a pre-test and post-test, rubric evaluation and a group achievement test. The attitude questionnaire was given to the students before and at the end of the STAD strategy. It contained 15 items, categorised into three parts: students' responses regarding work, the team process and skills development. There were 15 multiple-choice questions in both of the pre- and post-tests. The set of questions in both tests was similar, so the results could be easily compared in order to assess and measure the improvement in student performance in relation to the chosen strategy and intervention.

The cooperative learning rubrics assessed the students' group work criteria, with detailed evaluation criteria of the group dynamics following five principles: positive interdependence, individual accountability, face-to-face interaction, interpersonal group skills and group processing, all of which were deemed capable of improving group effectiveness in future work. Three quizzes were used as a teaching tool to identify students' achievements as a group. Quiz 1 consisted of six items created for students to develop higher-order thinking skills, while Quiz 2 comprised four items designed to help students enhance their problem-solving skills and application to engineering situations. The individual test in Quiz 3 included eight items, which were used to support students' preparation for the upcoming post-test. SPSS 20 software was used to analyse the data. The results of the pre- and post-tests were compared using a paired t-test. The quantitative data analysis was collected from the peer learning observations in the rubric assessment.

4. RESULTS

The first set of results related to to the first research question, "How does cooperative learning affect students' achievements and improvement in learning mathematics skills?" The mean score for the pre-test was 29.4, and for the post-test it was 62.2. Subsequently, the results from the paired t-test revealed that there was a significant difference between the pre-test mean score ($M = 29.4$, $SD = 7.2$, $t(11)$, $p = 0.0001$) and the post-test score ($M = 62.2$, $SD = 17.4$, $t(11)$, $p = 0.0001$). The p-value is less than 0.05, indicating a significant difference between the two mean scores. A comparison of marks between the pre- and post-tests showed that 92% of the students had improved in the post-test. These results are consistently in line with the findings of other researchers who employed cooperative learning in their studies (Yamarik, 2007; Tarim & Akdeniz, 2007; Gokkurt et al., 2012; Lim et al., 2016; Virgana, 2019; Atiq et al., 2021; Abd Mokmin et al., 2023).

For the second research question, "What are students' attitudes towards cooperative learning?", the students' attitude questionnaire was assessed according to three categories: their attitudes towards group work, the team process and skills development. Most students were attracted to group work (see Table 1). 66.7% thought that they could learn more when working in groups, and half felt that it should be used more in teaching.

These results suggest that most students had no objection to working together and were capable of participating in cooperative activities. 58.3% disagreed that collaborative activities were a waste of time, with 41.7% having no preference. A possible reason for this is that such activities are time-consuming. These responses matched well with the high positive feedback of students towards acceptance in working together, as most students (66.7%) had no preference towards the teaching methods. 16.7% enjoyed cooperative teaching,

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whereas 25% chose other teaching methods. Notably, most students (58.3%) had clear ideas about the cooperative learning approach. Therefore, educating them about the cooperative STAD method proved to be useful in helping them understand the approach and successfully undertake the activities.

Table 1. Student responses regarding group work

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Students learn more when working in groups.	0.0 % (0)	0.0% (0)	8.3 % (1)	66.7 % (8)	25.0 % (3)
Group work is a waste of students' time.	33.3 % (4)	25 % (3)	41.7 % (5)	0.0 % (0)	0.0 % (0)
I enjoy any other method of teaching over group work.	0.0 % (0)	8.3 % (1)	66.7 % (8)	25.0 % (3)	0.0 % (0)
Group work should be used more in teaching.	0 % (0)	0 % (0)	41.7 % (5)	50 % (6)	8.3 % (1)
I have a clear idea of what cooperative learning is.	0.0 % (0)	25 % (3)	16.7 % (2)	58.3 % (7)	0.0 % (0)

Students' interactions with their peers are one of the keys to successful cooperative attributes (see Table 2). The results show that 41.7% had interacted with the rest of their group. However, 16.7% said that they would have done more if working alone, 50% were neutral, and 33.3% thought that they would be able to learn more working in groups. This is because 25% strongly agreed and 25% agreed they understood their group's responsibilities. This is supported by the fact that half of the students trusted the teacher's delivery more than that of their peers. Despite this, a significant number of students, with 41.7% strongly agreeing and 41.7% agreeing, believed that that they could solve problems better as a group.

Table 2. Student responses to the team process

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There has been interaction with the rest of the group.	0.0 % (0)	8.3 % (1)	25.0 % (3)	25.0 % (3)	41.7 % (5)
Working alone, I would have done more and better.	0.0 % (0)	33.3 % (4)	50.0 % (6)	16.7 % (2)	0.0 % (0)
We were able to solve our problems as a group.	0.0 % (0)	0.0 % (0)	16.7 % (2)	41.7 % (5)	41.7 % (5)
I knew exactly my part in my team.	0.0 % (1)	16.7 % (2)	25.0 % (3)	25.0 % (3)	25.0 % (3)
I think that delivery given by the teacher is more valid than that given by my peers.	0.0 % (0)	16.7 % (2)	25.0 % (3)	50.0 % (6)	0.0 % (0)

Table 3. Student responses regarding skills development

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have developed the ability to communicate well with others.	0.0 % (0)	16.7 % (2)	16.7 % (2)	33.3 % (4)	16.7 % (2)
I have developed the capacity to think, review and reflect before making a decision.	0.0 % (0)	0.0 % (0)	41.7 % (5)	41.7 % (5)	16.7 % (2)
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Taking into account the opinion of the group has improved the results of my work.	0.0 % (0)	8.3 % (1)	50.0 % (6)	25.0 % (3)	16.7 % (2)
I have contributed to the group work by making suggestions and offering ideas.	0.0 % (0)	0.0 % (0)	25.0 % (3)	50.0 % (6)	25.0 % (3)
I have helped my classmates with their work.	0.0 % (0)	16.7 % (2)	8.3 % (1)	41.7 % (5)	33.3 % (4)

41.7% of the students agreed that through STAD they had developed their critical thinking in decision-making (see Table 3). Notably, 75% agreed that they had contributed to their group by making suggestions and offering ideas, and 75% stated that they had helped their peers in their learning activities. Half the students had

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developed the communication skills to talk to others (33.3% in agreement and 16.7% in strong agreement), while the remainder remained shy and passive in their interactions. In addition, 16.7% strongly agreed and 25% agreed that by considering their group's opinion, the results of their work had improved, although 50% of the class had no preference.

The rubric evaluation was used to observe the students' behaviour in their groups, with ratings of zero to three. The student's behaviour and performance were rated based on the five elements of cooperative learning: positive interdependence, individual accountability, face-to-face interaction, interpersonal group skills and group processing. The results of the rubric evaluation for all the groups are shown in Table 4.

Table 4. Rubric evaluation of the groups according to the five elements of cooperative learning

Group/ Student No.	Elements of Cooperative Learning					
	Positive inter-dependence	Individual accountability	Face-to-face interaction	Interpersonal group skills	Group processing	Total
A/S1	0	1	1	3	1	
A/S2	3	3	1	1	2	22
A/S3	1	1	1	1	2	
B/S4	3	3	3	2	1	
B/S5	3	3	3	2	2	33
B/S6	1	0	0	3	2	
C/S7	3	3	3	3	3	
C/S8	3	2	2	2	3	38
C/S9	2	2	2	3	2	
D/S10	3	3	2	1	3	
D/S11	2	3	2	2	2	31
D/S12	2	1	2	2	1	

Group A was the weakest group regarding positive interdependence, interaction and the processing of group skills. During class, one of the students (A/S3) was often absent from the peer-learning lesson, which made the team feel uncomfortable and demotivated because they had fewer active team members than the other groups. Despite of this, individual accountability and group processing remained evident, as they tried to complete the class exercises. Despite their efforts, the group struggled to achieve the desired cooperative learning condition because two out of the three students were reluctant to take part in the group work, tending to work individually without their peers. Moreover, they remained passive and quiet in peer discussion, perhaps because they were not confident about the learning activities. Moreover, they were possibly uncomfortable with the assigned team members. However, the group leader (A/S2) still encouraged and prompted his team members to work together.

Group B showed good group work and cooperation skills because they scored very highly in positive interdependence, interpersonal group skills and group processing. Their level of engagement was high, and they were active in peer discussion. However, towards the end, they possibly became over-confident, since B/S6 relied heavily on the other two members, showing less effort in peer activities. Nevertheless, they managed to complete all the work.

Group C performed the best out of all the teams. This group showed even better cooperation skills than Group B, scoring the highest in positive interdependence, interpersonal group skills and group processing. The leader (C/S7) played a proactive role in leading his team to success and was very active in peer teaching and guiding his team members to gain confidence as they attempted to complete the exercises and perform the group work tasks. The other members listened and followed the leader's instructions well. They were the fastest in completing their work.

Group D showed good group work and scored highly, but slightly lower than Group B and Group C in positive interdependence and group processing. Individual contribution was also high within this group, but the leader (D/S10) did not listen to his team members' opinions. Rather than helping his peers, he tended to develop solutions only with one member (D/S11), neglecting D/S12 in the process. As such, D/S12 was left with less work. This was probably because the leader was not fond of peer teaching and felt that D/S12 might have dragged their group achievements down.

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Most groups performed well on the group achievement test, particularly Group C, with the best overall mean score of 83.6%. This was attributed to the fact that they had an excellent group work process and integrated the five elements of cooperative learning. On the other hand, Group A was unable to perform well due to a lack of cooperative learning elements, which affected their overall mean group score. In comparison, Group B worked exceptionally well together but did not make use of cooperative skills as a tool to develop their understanding of the topic. Instead, they depended heavily upon the individual members when considering the problem. Group D did not perform well because of overconfidence and lack of practice before the post-test.

5. DISCUSSION

Based on the study findings, the paired t-test results from the pre- and post-tests showed a significant difference, which suggested an improvement in the students' achievement and learning. This demonstrated that the STAD strategy was potentially effective in improving the marks. In the effort to recognise and determine students' attitudes toward cooperative learning, most gave positive responses regarding the approach, with little negative feedback given. This suggests that the difference in culture or attitudes incorporated in the western STAD approach did not affect the benefits of cooperative learning. In addition, more than half of the students agreed that it improved their learning and achievements. However, some were reluctant to work with their team members during peer activities, but they still managed to perform well in the individual pre- and post-tests. This implies that cooperative learning had a significant impact on their learning.

The findings also show that the high achievers preferred to work alone, as they could not adapt to the cooperative setting as they felt comfortable learning individually in the past. One of the students (B/S6) did not see the benefits of helping his peers, as he believed that he was academically better than the others. These findings are similar to those of Kennett and Young (1999) and Yaduvanshi and Singh (2019), who found that low and medium achievers tended to obtain more benefits compared to high achievers, as they were more willing to learn to improve themselves. Overall, the main drawback of cooperative learning is the difficulty in assessing the internal group dynamics of students, which will essentially reflect the students' overall scores, as proposed by Slavin's (1998) theory on cooperative learning.

6. CONCLUSION

Cooperative learning is one of the active learning methods that can improve students' achievements and enhance their behaviour and attitudes towards group work. The findings from this study indicate that employing such learning with the STAD strategy with VTE engineering students was effective, as they performed well and showed positive attitudes and responses towards developing their skills and improving their academic achievements. Similarly, the students showed no hostility towards the approach. The effect of western culture and methodological methods on Asian educational culture had a negligible impact on the STAD method. Concerns reflected in the study, such as the difference in students' prior knowledge and their experiences or relationships with each other, may have influenced the results.

Several considerations are raised in making recommendations for future research. One issue in this study was that the sample was small and consisted solely of male students. A larger sample could be used to investigate the effect of cooperative learning based on gender differences. In addition, the investigation of students' attitudes revealed that some responded positively to cooperative learning, while others gave negative feedback regarding their attitudes towards group work. It is suggested that future studies on cooperative learning should be administered over a more extended period. This would allow the students to familiarize themselves with the strategy until they are confident enough to utilise and develop their cooperative skills. Furthermore, more data could be collected if the research were conducted for longer. This would help increase the reliability of the results on students' attitudes.

Another critical point in this research was the difficulty in assessing the groups' internal dynamics. Doing this effectively would generate more exciting and compelling findings regarding the students' thoughts, allowing in-depth understanding of STAD effectiveness . Another suggestion is to incorporate qualitative data into the research, such as analysing the complete interviews with the students who gave positive and negative responses. However, qualitative data alone would not be sufficient to assess the research. It would be best to include both quantitative and qualitative data, as the former paint an overall picture of the study, while the latter clarify, refine, and explain the quantitative data results.

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The STAD cooperative learning strategy should be used frequently by teachers when applicable to prepare students for future employment. Different cooperative learning strategies, such as Team-Game-Tournament (TGT) and Team-Accelerated Instruction (TAI) could also be used to investigate the effects on students' learning, achievements and performance.

REFERENCES

Abd Mokmin, A. U. P. A., Bungsu, J., & Shahrill, M. (2023). Improving the performance and knowledge retention of aircraft maintenance engineering students in the theory of flight through STAD cooperative learning. *ASEAN Journal of Science and Engineering Education*, *3*(2), 149-162. https://doi.org/10.17509/ajsee.v3i2.49336

Ali, H. M. H. H. M., Asamoah, D., & Shahrill, M. (2022). Flipped classroom model through multimedia technology and student performance in directed numbers. *Infinity Journal*, *11*(2), 193-210. https://doi.org/10.22460/infinity.v11i2.p193-210

Atiq, H., Saleem, K., & Laiqat, N. (2021). Cooperative learning effects on secondary level mathematics students' academic achievement: A multiple testing based comparison. *Harf-o-Sukhan*, *5*(4), 472-479. Retrieved from http://www.harf-o-sukhan.com/index.php/Harf-o-sukhan/article/view/364

Aziz, Z., & Hossain, M. A. (2010). A comparison of cooperative learning and conventional teaching on students' achievement in secondary mathematics. *Procedia-Social and Behavioral Sciences*, *9*, 53-62. https://doi.org/10.1016/j.sbspro.2010.12.115

Calderón, M., Hertz-Lazarowitz, R., & Slavin, R. (1998). Effects of bilingual cooperative integrated reading and composition on students making the transition from Spanish to English reading. *The Elementary School Journal*, *99*(2), 153-165. https://doi.org/10.1086/461920

Fall, R., Webb, N. M., & Chudowsky, N. (2000). Group discussion and large-scale language arts assessment: Effects on students' comprehension. *American Educational Research Journal*, *37*(4), 911-941. https://doi.org/10.3102/00028312037004911

Fong, P. S. (2010). Building teams that learn: Study of learning effects in engineering student teams. *Journal of Professional Issues in Engineering Education and Practice*, *136*(3), 121-127. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000017

Ghaith, G. M., & Yaghi, H. M. (1998). Effect of cooperative learning on the acquisition of second language rules and mechanics. *System*, *26*(2), 223-234. https://doi.org/10.1016/S0346-251X(98)00005-0

Gokkurt, B., Dundar, S., Soylu, Y., & Akgun, L. (2012). The effects of learning together technique which is based on cooperative learning on students' achievement in mathematics class. *Procedia-Social and Behavioral Sciences*, *46*, 3431-3434. https://doi.org/10.1016/j.sbspro.2012.06.079

Hamdan, M. K. K. H., Salleh, S. M., Shahrill, M., & Asamoah, D. (2022). Improving conceptual knowledge and soft skills among vocational students through inquiry-based learning in a flipped classroom. *International Journal of Social Learning, 2*(2), 235-249. https://www.scilit.net/journal/6084174

Ijon, I. (2021). Hasil afektif pembelajaran kooperatif IPS di kelas IX SMP Negeri Kabupaten Bengkayang, Kalimantan Barat [The affective results of social studies cooperative learning in class IX at SMP Negeri Bengkayang Regency, West Kalimantan]. *Journal of Edukasi Borneo*, *2*(2), 156-161.

Ismail, F. A., Bungsu, J., & Shahrill, M. (2023). Improving students' participation and performance in building quantities through think-pair-share cooperative learning. *Indonesian Journal of Educational Research and Technology*, *3*(3), 203-216.

Johnson, D. W., & Johnson, R. T. (1999). Making cooperative learning work. *Theory into Practice*, *38*(2), 67-73. https://doi.org/10.1080/00405849909543834

Johnson, D. W., Johnson, R. T., & Stanne, M. B. (2000). Cooperative learning methods: A meta-analysis. Minneapolis, MN: University of Minnesota Press. Retrieved from https://www.researchgate.net/publication/220040324_Cooperative_learning_methods_A_meta-analysis

Johnson, D. W., Johnson, R. T, & Smith, K. A. (2014). Cooperative learning: Improving university instruction by basing practice on validated theory. *Journal of Excellence in College Teaching, 25*, 85-118. Retrieved from https://karlsmithmn.org/wp-content/uploads/2017/08/Johnson-Johnson-Smith-Cooperative_Learning-JECT-Small_Group_Learning-draft.pdf

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v6i2.64003

Kennett, D. J., & Young, A. M. (1999). Is cooperative learning effective for high achieving entrance students? Implications for policy and teaching resources. *Journal of Research and Development in Education*, *33*(1), 27-35.

Lee, C. K. E., Lim, T. K., & Ng, M. (1997). Affective outcomes of cooperative learning in social studies. *Asia Pacific Journal of Education*, *17*(1), 67-68. https://doi.org/10.1080/02188799708547744

Lim, M. T. L., Shahrill, M., Mundia, L., Tengah, K. A., Tan, A., & Mahadi, M. A. (2016). An alternative approach to teaching: Implementing a cooperative learning strategy students team achievement division at the junior college level. *Advanced Science Letters*, *22*(5-6), 1725-1729. https://doi.org/10.1166/asl.2016.6748

Ling, W. N., Ghazali, M. I. B., & Raman, A. (2016). The effectiveness of student teams-achievement division (STAD) cooperative learning on mathematics achievement among school students in Sarikei District, Sarawak. *International Journal of Advanced Research and Development*, *1*(3), 17-21.

Listiadi, A., Sulistyowati, R., & Canda Sakti, N. (2019). Improving learning quality through NHT cooperation model in Indonesian vocational schools. *KnE Social Sciences*, *3*(11), 884-902. https://doi.org/10.18502/kss.v3i11.4057

Liu, X. (2009). Study on cooperative learning in English reading teaching. *Journal of Sichuan Vocational and Technical Education*, *10*(1), 30-34.

Metz, S. (2011). 21st century skills. The Science Teacher, *78*(7), 6-9. Retrieved from https://mydigitalpublication.com/publication/?i=81083

Namaziandost, E., Shatalebi, V., & Nasri, M. (2019). The Impact of cooperative learning on developing speaking ability and motivation toward learning English. *Journal of Language & Education*, *5*(3), 83-101. https://doi.org/10.17323/jle.2019.9809

Nasution, M. L., & Hafizah, N. (2020). Development of students' understanding of mathematical concept with STAD type cooperative learning through student worksheets. *Journal of Physics: Conference Series*, *1554*(1), 012035. https://doi.org/10.1088/1742-6596/1554/1/012035

Okolie, U. C., Oluka, B. N., Oluwayemisi, F. B., Achilike, B. A., & Ezemoyih, C. M. (2022). Overcoming obstacles to collaborative learning practices: A study of student learning in higher education-based vocational education and training. *International Journal of Training Research*, *20*(1), 73-91. https://doi.org/10.1080/14480220.2021.1965904

Premila, K. S. (2017). The effectiveness of cooperative learning (STAD approach) on the achievement in mathematics at high school level. *Shanlax International Journal of Arts, Science and Humanities*, *5*(1), 85-88. Retrieved from http://www.shanlaxjournals.in/pdf/ASH/V5N1/ASH_V5_N1_015.pdf

Rukayah, R., Slamet, Y., & Andayani, A. (2018). The implementation of cooperative learning approach with multimedia for children's literature learning at elementary school in the characters building perspective. *International Journal of Pedagogy and Teacher Education*, *2*(1), 97-106. https://doi.org/10.20961/ijpte.v2i1.15798

Shahrill, M. (2018). Teachers' devotion to review lessons: Insights to the mathematics lessons in Brunei Darussalam. *Journal of Physics: Conference Series*, *1028*(1), 012158. https://doi.org/10.1088/1742-6596/1028/1/012158

Shahrill, M., & Clarke, D. J. (2014). Brunei teachers' perspectives on questioning: Investigating the opportunities to "talk" in mathematics lessons. *International Education Studies*, *7*(7), 1-18. https://doi.org/10.5539/ies.v7n7p1

Slavin, R. E. (2013). Cooperative learning and student achievement. In R. E. Slavin (Ed.), *School and Classroom Organization* (pp. 129-156). New York, NY: Routledge. https://doi.org/10.4324/9780203056950

Takko, M., Jamaluddin, R., Kadir, S. A., Ismail, N., Abdullah, A., & Khamis, A. (2020). Enhancing higher-order thinking skills among home science students: The effect of cooperative learning student teams-achievement divisions (STAD) module. *International Journal of Learning, Teaching and Educational Research*, *19*(7), 204-224. https://doi.org/10.26803/ijlter.19.7.12

Tarim, K., & Akdeniz, F. (2008). The effects of cooperative learning on Turkish elementary students' mathematics achievement and attitude towards mathematics using TAI and STAD methods. *Educational Studies in Mathematics*, *67*(1), 77-91. https://doi.org/10.1007/s10649-007-9088-y

Towip, Widiastuti, I., & Budiyanto, C. W. (2022). Students' perceptions and experiences of online cooperative problem-based learning (CPBL) implementation: Developing 21st century skills. *International Journal of*

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v6i2.64003

Pedagogy and Teacher Education, *6*(1), 37-42. https://dx.doi.org/10.20961/ijpte.v6i1.56744

Virgana, V. (2019). Understanding of mathematical concepts through cooperative learning, and learning styles. *Journal of Education and Learning (EduLearn)*, *13*(2), 212-218. https://doi.org/10.11591/edulearn.v13i2.9917

Wahyuni, P. (2019). The effect of cooperative learning type student teams achievement division (STAD) on understanding mathematical concepts in class VIII students of MTs N Pekanbaru. *International Journal of Trends in Mathematics Education Research*, *2*(4), 168-172. https://doi.org/10.33122/ijtmer.v2i4.72

Wang, Y. P., & Wu, T. J. (2022). Effects of online cooperative learning on students' problem-solving ability and learning satisfaction. *Frontiers in Psychology*, *13, 1-7*. https://doi.org/10.3389/fpsyg.2022.817968.

Yamarik, S. (2007). Does cooperative learning improve student learning outcomes? *The Journal of Economic Education*, *38*(3), 259-277. https://doi.org/10.3200/JECE.38.3.259-277

Yaduvanshi, S., & Singh, S. (2019). Fostering achievement of low-, average-, and high-achievers students in Biology through structured cooperative learning (STAD method). *Education Research International*, *2019*, Article: ID 1462179. https://doi.org/10.1155/2019/1462179

Yussop, M. A. H., Shahrill, M., & Latif, S. N. A. (2021). Self-reliant learning strategy in vocational and technical education: Insights from group collaboration. *International Journal of Social Learning*, *1*(3), 283-303. https://doi.org/10.47134/ijsl.v1i3.73

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v6i2.64003