

The Use of the STAD Strategy to Promote Students' Achievement in Science Education

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ABSTRACT

Science is a subject that requires teachers to apply teaching strategies that encourage students to work in groups, participate in answering questions, and create an active classroom environment that enhances learning outcomes. This study examined the effects of the STAD teaching strategy on students' achievement and engagement at 2 Thnou Primary School, Battambang, Cambodia. A quantitative design with a quasi-experimental approach was employed using two Grade 5 classes, selected through simple random sampling. The experimental group, which employed the STAD strategy, consisted of 51 students, and the control group, which received instruction using conventional techniques, consisted of 51 students. The researchers compared the mean scores of the two groups and evaluated changes in academic performance by analyzing pre- and post-tests. The researchers also used an observation checklist to monitor students' participation during STAD lessons. The results showed that the experimental group scored higher on average than the control group. Furthermore, the observations revealed that STAD enhanced students' engagement in cooperative activities, group discussions, and answering questions, leading to a more vibrant learning environment. The study indicates that using the STAD strategy can significantly enhance student engagement and academic achievement in science education. In conclusion, the STAD teaching strategy effectively improves learning outcomes and promotes active participation among Grade 5 students in science.

Keywords: Cooperative Education, Enjoyment, Experiential Learning, Science Education, STAD

INTRODUCTION

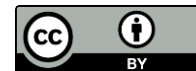
Education is the foundation of national economic growth and is essential to the development of human resources (MoEYS, 2019). According to the World Bank (1981) Primary education is considered essential foundational education that every child needs as a basis for future learning.



(MoEYS, 2010) has also focused on developing primary education to ensure that all children have equitable and inclusive learning opportunities, promoting lifelong learning for all in Cambodia (MoEYS, 2010). Furthermore, at the primary level, science teaching begins with the concrete and progresses to the abstract. Teachers present these concepts through images, real objects, definitions, symbols, observation, and experimentation to integrate STEM (Science, Technology, Engineering, and Mathematics), thereby fostering creative ideas and innovation for more effective learning at the secondary level (MoEYS, 2018).

Nevertheless, educators must develop practical teaching and learning methods that more effectively capture students' attention. Group division must also focus on skills in applying the thinking process and team management, reflecting students' responsibilities in group discussions (Tiantong & Teemuangsai, 2013). Slavin (2014) noted that cooperative learning is a method in which teachers divide students into small groups of mixed abilities to work on tasks together and help one another explain concepts. Most cooperative teaching methods require students to work in groups during the learning process, and these teaching strategies include STL, STAD, TGT, TAI, CIRC, PALS, Jigsaw, Learning Together, and Group Investigation (Slavin, 2010). Among these, the STAD teaching strategy is a cooperative strategy that can help improve students' learning outcomes (Lantajo & Tipolo, 2018; Santosa et al., 2019). Moreover, this strategy can be effectively implemented in teaching science at all grade levels, making students more engaged in learning and improving their science skills outcomes (Lantajo, 2017).

Many schools in Cambodia primarily teach applied science by relying on textbook reading, conducting some questioning and answering activities, focusing on memorization, and occasionally holding teacher-led demonstrations. However, cooperative learning is a suitable approach for student involvement in the study of applied science (USAID, 2009). According to MoEYS (2024), which focuses on the PISA test for 15-year-old children in 2022, Cambodia, one of the 81 participating countries, showed that Cambodian students' average scores in Mathematics, Reading, and Science were lower than the overall average scores of ASEAN countries and the world. Specifically, the Science score was only 10%, indicating that students can understand the content of science lessons through explanations, experimentation, interpretation, and self-organization of the experimental process. Nevertheless, even with an increase in student scores at Level 2 or higher, Cambodia's results remain below the average of ASEAN countries and the OECD, where 40% to 50% of students have an average score at Level 2. A persistent problem for students is their inability to retain lesson content in the long term, which limits their learning outcomes (Hardiansyah & Wahdian, 2023). Chophel et al. (2023) stated that several factors contribute to low student learning outcomes, including a lack of confidence, limited communication with the teacher, a lack of responsibility, inadequate cooperative skills, and a lack of questioning, among others. Research by Trygstad et al. (2013) showed that to increase student learning outcomes, over 90% of primary teachers agree that the classroom should provide opportunities for students to share their reasoning, the classroom should conclude with a summary of the key concepts that raised, the objective of the lesson should be state at the beginning of teaching and learning, and the classroom should include a review of concepts and skills learned in the previous session. To address the consensus of primary teachers above, the cooperative teaching method Student Team Achievement Division (STAD) is one of several cooperative teaching methods that help increase student engagement and learning outcomes. We can evaluate this through group discussion and an individual test application



(Rosyana, 2019). Research by Nanor et al. (2024) recommended that science teachers should use the STAD cooperative learning model in schools, as it helps increase students' learning outcomes.

The cooperative teaching method is an instructional approach that offers students opportunities to learn together in small groups (Suwardi, 2018). It includes students with diverse abilities, such as different genders, learning styles, and ethnic backgrounds, to encourage collaboration in solving various problems (Yusnani, 2018). Cooperative learning is a set of teaching methods in which students are encouraged and organized to work in groups on their studies. This process also encourages students to engage in group activities during instruction through exploration and discussion with peers in small groups. (Davidson & Major, 2014). A collaborative study also enhances students' social and professional success while fostering practical communication skills (USAID, 2009). The STAD approach is a cooperative learning system that promotes both autonomous and teamwork, making it appropriate for teaching a range of subjects (George et al., 2016). Furthermore, STAD is a flexible and straightforward collaborative teaching model that achieves diversity by dividing students into groups of 4 to 5, comprising students with diverse abilities, family backgrounds, and genders. All grade levels, from 2 to 12, can utilize this teaching strategy in subjects such as science, math, languages, and social studies. (Chim, 2015; Hayatunisa, 2014; Rosyana, 2019). Robert Slavin and his colleagues developed this method in 1980 (Alijanian, 2012). STAD, which stands for Student Team Achievement Division, refers to students' learning outcomes that depend on teamwork, a component of collaborative learning where small groups of students with mixed abilities work together to achieve shared goals and share knowledge (Deswarni, 2018). According to Li and Lam (2013) and Slavin (2006), the STAD teaching strategy involves a cycle of four instructional activities.

The learning process begins with a teacher presentation, where the teacher presents materials or images to the entire class and uses probing questions to engage students in discussions related to the lesson content. After the presentation, the students are divided into groups consisting of four to five members based on performance, ability level, gender, and transparency. In these groups, students discuss the worksheet provided by the teacher and work collaboratively to ensure that all group members understand the content by asking questions and explaining the material to one another. Following the group discussion, the teacher clarifies the answers and explanations for each group before the students return to their seats to take an individual quiz within the time limit determined by the teacher. The quiz is intended to measure each student's understanding and knowledge of the lesson, encourage students to perform well academically, and reflect the effectiveness of the group discussions. Finally, after the quizzes are completed, the teacher provides team recognition by acknowledging the groups that achieve the highest average scores and demonstrate the best cooperation during discussions. These rewards are intended to help students appreciate the importance and benefits of teamwork in the classroom.

Numerous studies have found that the STAD strategy is effective in boosting students' academic achievement and engagement across subjects and grade levels. Ina et al. (2023) found that implementing the STAD strategy increased the learning outcomes of Grade 8 Biology students on the topic of the human digestive system, raising student ability from 47.8 to 89.75. Prihatnawati et al. (2017) demonstrated that teaching with the STAD strategy positively impacted the teaching and learning process and student outcomes in science, with the average STAD score (10.41) being higher than the average score without STAD (4.2). Gukguk et al. (2023) et al. (2023) and Touwe and Lasaiba



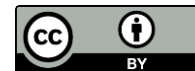
(2024) confirmed that using the STAD teaching strategy increased student achievement and enhanced Science process skills for students learning science in upper primary school. Educators also attribute the increase in student achievement to students actively participating in class, including engaging in discussions, asking questions, and maintaining attentive study habits. Hermawan et al. (2020), Nanor et al. (2024), and Tiantong and Teemuangsai (2013) indicated that the STAD model is effective in promoting students' attitudes toward learning, active participation, and motivation. Yulianto et al. (2020) stated that using the STAD teaching method, integrated with quizzes, increased students' interest in learning and motivated them to achieve good results in History. Fikri et al. (2025) researched the use of the STAD strategy for teaching Social Studies to increase the participation and learning outcomes of Grade 7 students in the Indonesian context, finding that the STAD strategy was truly effective on student achievement and engagement, helping students gain a clearer understanding of social knowledge and develop skills relevant to real-life social contexts.

A review of prior research indicates that many researchers have used the STAD strategy for teaching writing, reading, mathematics, and science. However, for the current (Cambodian) context, few studies have applied this strategy to examine changes in students' academic achievement and participation. This knowledge gap motivates the current research, which will implement the STAD strategy to examine changes in students' academic achievement and engagement in science studies.

The problems mentioned above will be addressed through the implementation of the Student Teams Achievement Division (STAD) method over 18 academic hours in the science subject. This study is aligned with two main research objectives. The first objective is to examine the effect of using the STAD strategy on students' learning outcomes in science compared to teaching using traditional methods. The second objective is to examine students' engagement activities when they are taught using the STAD strategy in science classes. To achieve these objectives, the researchers formulated several research questions. The first question investigates how the STAD strategy affects students' learning outcomes compared to traditional teaching methods in science. The second question explores whether students demonstrate engagement activities when taught using the STAD strategy in science learning. Furthermore, the researchers established the null hypothesis (H_0) with a significance level of 0.05. The null hypothesis states that, after the experiment, there is no change in students' learning outcomes in science when the STAD strategy is applied compared to traditional teaching methods. In contrast, the alternative hypothesis (H_1) states that, after the experiment, there is a change in students' learning outcomes in science when the STAD strategy is used compared to traditional teaching methods.

METHODS

This study employs a quantitative method that combines a quasi-experimental design (Drummond & Murphy-Reyes, 2017) with an observational approach. The researchers employed a pre-test and post-test to assess changes in students' learning outcomes, and observed students during STAD lessons to evaluate their engagement in activities. Specifically, the sample was selected from Grade 5 students at 2 Thnou Primary School for this research. Grade 5 "J" students were assigned to the experimental group, taught using the STAD method, and Grade 5 "K" students were assigned to the control group, taught using traditional teaching methods.



A sample of 553 Grade 5 students (260 females) from 2 Thnou Primary School was selected. The study selected only two classes using Simple Random Sampling (Noor et al., 2022): Grade 5 "J" with 50 students (31 females) and Grade 5 "K" with 51 students (33 females) in the 2024-2025 academic year. Both groups included students aged 10-14 years, from the same context and with similar knowledge levels. Teachers taught the Grade 5 "J" sample using the STAD strategy, while they taught the Grade 5 "K" sample using traditional methods. They assessed both samples using the test instruments and observation checklist described below. This study used two instruments to collect data from the sample groups: a learning outcome test and an observation checklist. For the learning outcome test, the researchers prepared a 40-minute pre-test for both the experimental and control groups to assess students' existing knowledge before teaching with the STAD method. The post-test also lasted 40 minutes and was used to evaluate students' knowledge improvement after teaching with the STAD and traditional methods. The researchers divided the test into four parts: multiple-choice, fill-in-the-blank, matching, and critical thinking questions, comprising a total of 16 questions. Three experts reviewed and evaluated the test to assess its accuracy and score it. To ensure the content's reliability, the researchers conducted a pilot test with 41 students. The results, analyzed through the SPSS program, yielded a Cronbach's Alpha of 0.847, confirming good reliability for the evaluation (Kennedy, 2022). Moreover, the researchers prepared an observation checklist to examine students' activities during the STAD lessons, adapting a 15-item checklist from the format used by student interns to observe student engagement. (Cassar & Jang, 2010). The observation checklist was reviewed and evaluated by three experts to assess the clarity of each item and its accuracy before use in actual observation.

The research, focused on "The Use of the STAD Teaching Strategy to Promote Students' Achievement in Science," aims to examine the change in learning outcomes and student engagement after teaching with STAD. Data was collected using the learning outcome test and the observation checklist. The researchers administered the pre-test for 40 minutes before teaching with the STAD and traditional methods. After completing 18 academic hours of instruction using both methods, they administered the post-test, also for 40 minutes, to evaluate changes in students' learning outcomes. To enhance data reliability, this study employed an observation checklist to assess students' engagement during STAD lessons, as observed by student interns. They also verified the accuracy and reliability of the data collection instruments. Based on the research objectives, the collected data were analyzed using Microsoft Excel, divided into two parts:

- a. The researchers analyzed the learning outcome test data (pre-test and post-test) from both groups using inferential statistics, including the Paired Sample T-test and Independent Sample T-test, to compare the mean scores between the experimental and control groups. They interpreted the analyzed data using the mean (M), standard deviation (SD), t-value, and p-value as further evidence to support the research.
- b. The researchers also analyzed the observation checklist using descriptive statistics and interpreted the data in terms of percentages and frequencies.

RESULTS

To answer research question 1 and the hypothesis above, the results of the Independent Sample T-test analysis between the experimental and control groups and the Paired Sample T-test



between the pre-test and post-test scores of the experimental and control groups are presented in the following tables:

1. Pre-Test Results of the Experimental and Control Groups

Table 1. Comparison of Mean Pre-test Scores Between the Experimental and Control Groups

Group	N	M	SD	d	t(99)	p-value	Cohen's d
Experiment group	50	3.26	1.06	0.75	2.83	0.01	0.56
Control group	51	4.01	1.57				

Table 1 presents a comparison of the existing knowledge in the experimental and control groups before learning using the STAD strategy. The pre-test results show that the control group had a mean score of $M = 4.01$ ($SD = 1.57$), while the experimental group had a mean score of $M = 3.26$ ($SD = 1.06$), yielding a mean difference of $d = 0.75$. The independent-samples t-test, $t(97) = 2.83$, $P = 0.01$, indicates that the mean scores of the experimental and control groups were similar at the 0.05 level, with a Cohen's d effect size of 0.56, indicating a medium effect. Thus, before the experiment, students in both groups had similar levels of existing science knowledge. This result suggests that teachers can conduct science experiments using the STAD strategy without introducing significant bias in the knowledge levels of the two groups.

2. Pre-test and Post-test Results of the Control Group

Table 2. Comparison of Pre-test and Post-test Results of Control Group Students

Result	N	M	SD	d	t (50)	p-value
Pre-test	51	4.01	1.57	1.18	6.66	0.00
Post-test	51	5.19	1.48			

*Note***p<.001*

Table 2 presents the pre-test and post-test results in science for the control group. Before the experiment, the control group had a mean score of $M = 4.01$ ($SD = 1.57$), and after learning, they had a mean score of $M = 5.19$ ($SD = 1.48$), yielding a mean difference of $d = 1.18$. The statistical test ($t = 6.66$, $p\text{-value} = 0.00$) indicates that the students' scores in the control group differed before and after learning science; specifically, the post-test score was higher than the pre-test score at the 0.001 level of significance. This result shows that students also gained knowledge through traditional methods.

3. Pre-test and Post-test Results of the Experimental Group

Table 3. Comparison of Pre-test and Post-test Results of Experimental Group Students

Result	N	M	SD	d	t (49)	p-value
Pre-test	50	3.26	1.06	3.77	19.54	0.00
Post-test	50	7.03	1.51			

****p<.001*



Table 3 shows that the pre-test in science had a mean score of $M = 3.26$ ($SD = 1.06$), while the post-test had a mean score of $M = 7.03$ ($SD = 1.51$), resulting in a mean difference of $d = 3.77$. The statistical test ($t = 19.54$, p -value = 0.00) indicates that the Grade 5 students' scores before and after learning science were significantly different; specifically, the post-test score was much higher than the pre-test score at the 0.001 level. Thus, this data suggests that students experienced significant improvement after learning science using the STAD strategy.

4. Post-test Results of the Experimental and Control Groups

Table 4. Comparison of Mean Post-test Scores Between the Experimental and Control Groups

Group	n	M	SD	d	t	p	Cohen's d
Experiment group	50	7.03	1.51	1.84	6.18	0.003	1.23
Control group	51	5.19	1.48				

Note: *** $p < .001$

Table 4 presents a comparison of the knowledge gained by the experimental and control groups after learning science using the STAD strategy. The post-test results show that the control group had a mean score of $M = 5.19$ ($SD = 1.48$), whereas the experimental group had a mean score of $M = 7.03$ ($SD = 1.51$), yielding a mean difference of $d = 1.84$. The independent-samples t -test, $t(99) = 6.18$, $p < 0.001$, indicates that the mean scores of the experimental and control groups differed significantly at the 0.001 level, with a Cohen's d effect size of 1.23, indicating a strong effect. Thus, after the experiment, students' knowledge of the science lesson changed in both groups, with the experimental group achieving a higher overall mean score than the control group.

To answer Research Question 2, quantitative data from the observation checklist were collected from three student interns after observing the experimental group's level of engagement during the STAD lessons over four sessions, as shown in Table 5 below.

Table 5. Observation Checklist on the Engagement Level of the Experimental Group During STAD Lessons

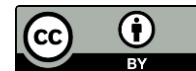
No	Statement	Frequency and percentage				
		1	2	3	4	5
E = Effort						
1	Students pay attention in science class	0 (0.00%)	0 (0.00%)	4 (33.33%)	3 (25.00%)	5 (41.67%)
5	Students join the groups assigned by the teacher	0 (0.00%)	0 (0.00%)	1 (8.33%)	5 (41.67%)	6 (50.00%)
10	Students try to finish their tasks even if they are difficult	0 (0.00%)	0 (0.00%)	0 (0.00%)	7 (58.33%)	5 (41.67%)
12	Students are responsible for their work, both group and individual.	0 (0.00%)	0 (0.00%)	0 (0.00%)	7 (58.33%)	5 (41.67%)



14	Students participate in the test at the end of every period with satisfaction.	0 (0.00%)	0 (0.00%)	0 (0.00%)	7 (58.33%)	5 (41.67%)
I = Initiative						
3	Students perform the tasks diligently during the test	0 (0.00%)	0 (0.00%)	2 (16.67%)	6 (50.00%)	4 (33.33%)
4	Students actively participate in group discussions	0 (0.00%)	0 (0.00%)	1 (8.33%)	6 (50.00%)	5 (41.67%)
8	Students ask questions when they are confused	4 (33.33%)	3 (25.00%)	1 (8.33%)	1 (8.33%)	3 (25.00%)
11	Students raise their hands to answer the question when the teacher asks	0 (0.00%)	0 (0.00%)	1 (8.33%)	5 (41.67%)	6 (50.00%)
13	Students shared knowledge during the group discussion.	0 (0.00%)	0 (0.00%)	2 (16.67%)	5 (41.67%)	5 (41.67%)
D = Disruptive Behavior						
2	Students argue with other students in the class	4 (33.33%)	8 (66.67%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
6	Students disrupt other friends/peers while working on group tasks/work	7 (58.33%)	4 (33.33%)	1 (8.33%)	0 (0.00%)	0 (0.00%)
9	Students discuss non-lesson-related topics with their peers in class	1 (8.33%)	10 (83.33%)	1 (8.33%)	0 (0.00%)	0 (0.00%)
N = Inattentive Behavior						
7	Students do not pay attention to all the activities in the class	8 (66.67%)	3 (25.00%)	1 (8.33%)	0 (0.00%)	0 (0.00%)
15	Students need support from the teacher when doing the tasks	1 (8.33%)	2 (16.67%)	1 (8.33%)	8 (66.67%)	0 (0.00%)

Table 5 shows the engagement activities of the experimental group students when learning with the STAD strategy, focusing on four primary indicators: Effort, Initiative, Disruptive behavior, and Inattentive behavior, with 15 items and a 5-point scale (1. Never, 2. Rarely, 3. Occasionally, 4. Frequently, and 5. Always).

The Effort (E) indicator demonstrated a high level of student engagement during the implementation of the STAD strategy in science learning. Item 10, namely “Students try to finish their tasks even if difficult,” obtained the highest frequency and percentage, with 7 students (58.33%) categorized at the frequent level. This finding indicates that students showed persistence and seriousness in completing the assigned tasks. The observers’ field notes further supported this result, stating that “students tried hard to answer the group discussion questions even though only a few students initially contributed” and that “students continuously encouraged one another and collaborated in thinking to complete the tasks more quickly.” Similarly, Item 12, “Students are



responsible for their work, both group work and individual work,” also recorded a frequency and percentage of 7 (58.33%) at the frequent level. This result reflects students’ sense of responsibility and active participation throughout the STAD-based science learning activities. The observers noted that “students actively attempted to write answers and collaboratively supported one another in generating ideas and searching for solutions, while also showing strong attention and effort to obtain motivational rewards.” Furthermore, Item 14, “Students willingly participate in the test at the end of every session,” achieved the same frequency and percentage of 7 (58.33%) at the frequent level, indicating that students positively responded to the assessment component integrated within the STAD strategy.

In addition, Item 5, “Students join the groups assigned by the teacher,” obtained the next-highest percentage, with a frequency of 6 (50.00%) at the always level. The observers’ notes indicated that “students formed groups according to the grouping determined by the teacher.” This finding suggests that students were receptive to cooperative learning arrangements and demonstrated adaptability toward collaborative learning environments, which are considered essential in 21st-century learning contexts. Group-based learning activities appear to provide students with opportunities to interact, exchange ideas, and support one another during the learning process. Moreover, Item 1, “Students pay attention to the teacher’s explanation during the science session,” also demonstrated a high frequency, with 5 students (41.67%) categorized at the always level. This result indicates active student involvement and attentiveness during classroom instruction. The observers’ field notes revealed that “students raised their hands to respond to the teacher’s questions and made efforts to listen attentively to the teacher’s explanations.” These findings imply that the instructional approach implemented by the teacher was interactive and engaging, thereby encouraging students to remain focused and actively participate in the learning process. Consequently, such classroom interactions may contribute positively to the improvement of students’ learning outcomes in science.

The Initiative (I) indicator demonstrated that students showed active involvement and participation during the implementation of the STAD strategy in science learning. Item 11, namely “Students raise their hands to answer when the teacher asks,” obtained the highest frequency and percentage, with 6 students (50.00%) categorized at the always level. This finding indicates that half of the students consistently demonstrated confidence and initiative in expressing their ideas during classroom activities. The observers’ field notes further supported this result, stating that “students actively participated in the lesson, with all students attempting to answer questions effectively.” In addition, the subsequent highest frequency and percentage for this item were recorded at 5 (41.67%), which falls under the frequently category. These findings suggest that all students participated in classroom activities according to their respective levels of understanding and confidence.

Similarly, Item 4, “Students actively participate in group discussions,” also recorded a frequency and percentage of 6 (50.00%) at the frequently level. This result confirms that students were actively involved in collaborative learning activities by supporting one another in generating ideas, discussing concepts, and solving problems collectively. The observers noted that “students attempted to think through the answers during group discussions with the participation of all group members.” Furthermore, the subsequent highest frequency and percentage for this item were 5 (41.67%) at the always level, further indicating strong student engagement during group



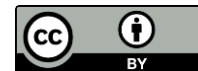
discussions. These findings imply that the STAD strategy successfully encouraged cooperative interaction and active participation among students during the learning process.

Item 3, “Students carefully focus on the task when taking a test,” obtained a frequency and percentage of 6 (50.00%) at the frequently level. This finding indicates that students demonstrated considerable concentration and seriousness when completing individual tests or assignments administered by the teacher. The observation checklist also revealed that “students made diligent efforts to complete their tasks thoroughly,” suggesting that students showed responsibility and attentiveness during assessment activities.

In addition, Item 13, “Students share knowledge during group discussion,” achieved a frequency and percentage of 5 (41.67%) at the always level. This result highlights students’ ability to exchange ideas, provide explanations, and communicate their understanding effectively within their groups. The observers noted that “students actively participated in thinking and sharing ideas,” which reflects effective collaboration among group members according to their respective roles. Moreover, the same frequency and percentage of 5 (41.67%) were also recorded at the frequently level, indicating that students consistently shared knowledge and contributed during discussions. Additional observer notes stated that “students participated in presentations and provided clear explanations after reaching conclusions through discussion.” These findings suggest that students developed not only collaborative skills but also the confidence and communication abilities required to present their ideas effectively based on the outcomes of group discussions.

Meanwhile, Item 8, “Students ask questions when they have doubts,” obtained a frequency and percentage of 4 (33.33%) at the rarely level. This result indicates that students tended to ask questions primarily when the teacher introduced scientific phenomena or during experimental activities. The observers’ notes supported this finding, stating that “students asked questions when the teacher presented phenomena and during experiments.” Overall, these findings suggest that students generally listened attentively to the teacher’s explanations, actively participated in collaborative group activities, and shared ideas effectively with their peers. However, students’ questioning behavior was more likely to emerge in situations involving direct observation, experimentation, or unfamiliar phenomena, indicating that inquiry-based activities may stimulate greater curiosity and interaction during science learning.

The Disruptive Behavior (D) indicator demonstrated that students showed relatively low levels of disruptive behavior during the implementation of the STAD strategy in science learning. Item 9, namely “Students chat outside of lesson content with friends in class,” obtained the highest frequency and percentage, with 10 students (83.33%) categorized at the rarely level. This finding indicates that most students generally remained focused on the learning process and only occasionally engaged in conversations unrelated to the lesson content. The observers’ field notes revealed that “one or two students lost their focus at the end of the lesson, which led them to discuss topics unrelated to the lesson content.” This condition may have been influenced by the learning schedule, particularly during the fourth period, where students experienced fatigue and hunger after participating in previous lessons. Consequently, students’ concentration levels slightly decreased, resulting in occasional off-topic conversations during instructional activities. Nevertheless, the data from Item 9 overall indicate that the majority of students remained attentive to the teacher’s explanations and actively participated throughout the learning sessions.



Furthermore, Item 2, “Students argue with other students in class,” obtained the next-highest frequency and percentage, with 8 students (66.67%) categorized at the rarely level. This result suggests that negative interpersonal behaviors among students occurred infrequently during classroom activities. Most students consistently participated positively in learning activities and interacted cooperatively with both the teacher and their peers. The observers noted that “most students participated in all activities, and only two students occasionally argued with each other.” In addition, the subsequent highest frequency and percentage for this item were 4 (33.33%) at the never level, indicating that a considerable number of students did not engage in quarrels or conflicts during the lesson. Instead, students tended to focus on the teacher’s explanations and actively participated in group discussions according to the teacher’s instructions.

Similarly, Item 6, “Students disrupt other friends or peers while working on group tasks,” obtained the highest frequency and percentage of 7 (58.33%) at the never level. This finding indicates that students generally demonstrated respectful and cooperative behavior during collaborative learning activities. During the learning process, students concentrated on listening to the teacher’s explanations, participated in answering questions, and completed assessments without disturbing their classmates. These findings suggest that the STAD strategy effectively promoted positive classroom interactions and minimized disruptive behaviors during cooperative learning activities.

Regarding the Inattentive Behavior (N) indicator, Item 7, “Students are inattentive to all activities in class,” obtained the highest frequency and percentage of 8 (66.67%) at the never level. This result indicates that students generally maintained attention and engagement throughout the learning process and rarely demonstrated inattentive or careless behavior. The subsequent highest frequency and percentage for this item were 3 (25.00%) at the rarely level. The observer noted that “students occasionally chatted with their tablemates without contributing to the group work, which may have been influenced by the warm classroom environment.” Although minor inattentive behaviors were occasionally observed, these incidents were limited and did not significantly interfere with the overall learning activities.

Moreover, Item 15, “Students require assistance from the teacher while completing tasks,” obtained the highest frequency and percentage of 8 (66.67%). This finding indicates that, although students actively participated in the learning process, they still required guidance and facilitation from the teacher when completing tasks or addressing difficulties encountered during learning activities. The observers noted that “students needed assistance from the teacher because some questions required additional explanations before they could complete the tasks.” Another observation further revealed that “because the lesson involved experiments that students could not perform independently, the teacher needed to provide minimal facilitation.” These findings demonstrate that teacher support remained essential in helping students understand scientific concepts, perform experiments, participate in discussions, and complete both practical and written assessments effectively.

Overall, the findings indicate that the implementation of the STAD strategy was highly effective in science learning for Grade 5 students. The strategy not only improved students’ learning outcomes but also enhanced active participation, collaboration, responsibility, and engagement during both group and individual activities. In addition, students demonstrated positive interaction skills, confidence in expressing ideas, and cooperative behavior in solving problems collectively during the learning process.



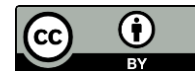
DISCUSSION

The objective of this research was to examine improvements in students' learning outcomes and engagement when using the STAD strategy in science teaching, comparing results between the control and experimental groups. The results showed that the experimental group, which learned using the STAD strategy, achieved a post-test mean score of $M = 7.03$ ($SD = 1.51$), higher than that of the control group taught through traditional teaching methods ($M = 5.19$, $SD = 1.48$). Since $p < 0.05$, the H_0 was rejected.

The increase in the experimental group's post-test scores is a positive effect on students' learning outcomes through cooperative learning using the STAD strategy for Grade 5 Science. This research result is similar to that of Samarth and Lalitha (2025), which showed that the STAD strategy is indeed effective in improving students' learning outcomes and recommends its inclusion in Science teaching to further enhance them. Dewi et al. (2020) found that teaching using the STAD strategy has a significant impact on students' learning outcomes through a student-centered approach, enabling students to understand the lesson content, express their ideas, and take responsibility for themselves and the group. Rorimpandey et al. (2022), who conducted research at the Grade 4 primary level on science, found that students taught using the STAD strategy achieved higher scores than those taught through traditional methods, thereby strengthening teacher-student and student-to-student interactions in the learning process. Furthermore, research by Yaduvanshi and Singh (2019) investigating the use of the STAD strategy for teaching Biology at the secondary level found that the experimental group's scores were higher than those of the control group, concluding that the STAD strategy promotes improved student learning outcomes in the Indian context.

Touwe and Lasaiba (2024) showed that the learning outcomes of both the experimental and traditional groups increased after learning the Science lesson. However, the experimental group's post-learning score was higher than that of the traditional group, indicating that the STAD strategy is indeed effective for teaching science. Specifically, the STAD strategy not only increases learning outcomes but also enhances Science process skills. Chophel et al. (2023) experimented with the STAD strategy in Grade 9 Biology using a single sample group, showing a significant change from the pre-test mean of $M = 6.67$ ($SD = 2.79$) to the post-test mean of $M = 10.98$ ($SD = 2.53$), indicating the effectiveness of the STAD strategy on students' learning outcomes.

Based on the observation results of the experimental group's engagement activities, students demonstrated active learning behaviors, including participating in group discussions, collaborating, and assisting one another in finding answers. The positive behavior indicators, 'Effort' and 'Initiative', showed high frequency and percentage in the frequently (4) and always (5) scales, while the negative behavior indicators, 'Disruptive behavior' and 'Inattentive behavior', had low frequency and percentage in the frequently (4) and always (5) scales. This research result aligns with the theory of Connell and Wellborn (1991), who posited that close student interaction in the classroom characterizes Emotional and Cognitive Engagement. This theory illustrates how emotions (such as happiness, boredom, and anxiety) and students' cognitive abilities in completing tasks and engaging in flexible discussions contribute to achieving better learning outcomes. Fahmi Syuhada et al. (2025) confirmed that the STAD strategy not only helps increase students' learning outcomes but also increases classroom engagement. Students have more opportunities to participate in group discussions, express ideas, and prepare to present and share with the whole class. The use of the



STAD strategy for science rarely leads researchers to focus on both learning outcomes and engagement. Most researchers only examine the effectiveness of this strategy on students' learning outcomes. Other research that utilized the STAD strategy for various subjects, such as Nurhuda (2020), demonstrated that the STAD strategy enhanced students' engagement in reading sessions, with students actively participating in activities such as presentations, group discussions, questioning, and sharing ideas with peers.

Based on the discussion above, the STAD strategy is indeed effective on students' learning outcomes and engagement in science. The research results, focusing on engagement, reveal a new finding: the STAD strategy not only affects students' learning outcomes but also increases their engagement in science activities.

CONCLUSIONS

Based on the discussion of the topic "Use of the STAD Teaching Strategy to Enhance Students' Achievement in Science Grade 5," the conclusion is that the teaching strategy is essential in the Cambodian education context, particularly in primary science, where it has not been previously used. The current study presents a new finding, demonstrating the effectiveness of the teaching strategy in enhancing students' activities. Post-test results indicated that the experimental group learned significantly more than did the control group.

During STAD learning, observers noted students' engagement, including participating in group discussions, asking questions, and collaborating to solve problems. This observation demonstrated the teacher-student and student-to-student interactions, making teaching and learning more engaging and active. Based on the experiment's results and observations, the STAD strategy is efficacious in improving students' learning outcomes, increasing the experimental group's post-learning scores, and enhancing student engagement during class. Given the positive results of this strategy, this research still has limitations: the experiment was short, and it compared the STAD strategy only with traditional methods. Therefore, further research should study key areas such as: Comparing the STAD strategy with other cooperative learning strategies like Think Pair Share, Team-Games-Tournament, and Jigsaw to determine which strategy is more effective for teaching.

Examining students' Science Process Skills in addition to learning outcomes and engagement. The researchers conducted this study by developing another test, the Test of Integrated Process Skills (TIPS), to evaluate students' abilities in observation, classification, measurement, inference, prediction, and communication in science.

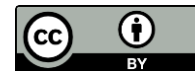
Applying the STAD strategy to teach other subjects such as Mathematics, Khmer Language, and Social Studies.

REFERENCES

- Alijanian, E. (2012). The effect of Student Teams Achievement Division technique on English achievement of Iranian EFL learners. *Theory and Practice in Language Studies*, 2(9). <https://doi.org/10.4304/tpis.2.9.1971-1975>
- Cassar, A. G., & Jang, E. E. (2010). Investigating the effects of a game-based approach in teaching word recognition and spelling to students with reading disabilities and attention deficits. *Australian Journal of Learning Difficulties*, 15(2). <https://doi.org/10.1080/19404151003796516>



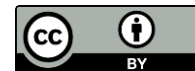
- Chim, H. (2015). Literature review of the cooperative learning strategy – Student Team Achievement Division (STAD). *International Journal of Education*, 7(1). <https://doi.org/10.5296/ije.v7i1.6629>
- Chophel, S., Tshewang, P., Wangdi, P., Wangdi, U., & Jamtsho, S. (2023). Implementing Student Teams Achievement Divisions (STAD) learning model in grade 9 Biology and its impact on learning achievement. *International Research Journal of Science, Technology, Education, and Management*, 3(2). <https://doi.org/10.5281/zenodo.8139804>
- Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness: A motivational analysis of self-system process. In *Minnesota Symposia on Child Psychology* (Vol. 23). Harold B. Lee Library. https://jewishcamp.org/wp-content/uploads/2020/05/ConnellWellborn1991CompetenceAutonomyandRelatedness_A_MotivationalAnalysisofSelf-EsteemProcesses.pdf
- Davidson, N., & Major, C. H. (2014). Boundary crossing: Cooperative learning, collaborative learning, and problem-based learning. *Journal on Excellence in College Teaching*. http://colab.eun.org/c/document_library/get_file?uuid=0a205030-a9f7-4bdb-9678-e31dd8bc5d45&groupId=5897016
- Deswarni, D. (2018). The effect of using STAD strategy toward students' reading comprehension. *AL-ISHLAH: Jurnal Pendidikan*, 10(1). <http://www.journal.staihubbulwathan.id/index.php/alishlah/article/view/72>
- Dewi, L. M. S., Wibawa, I. M. C., & Agustiana, I. G. A. T. (2020). Improving science learning outcomes through Student Team Achievement Division (STAD). *International Journal of Elementary Education*, 4(3). <https://doi.org/10.23887/ijee.v4i3.25917>
- Fahmi Syuhada, M., Tobroni, T., Rasilah, R., & Hadiansah, D. (2025). Application of the STAD-type cooperative learning model in improving natural science learning outcomes. *Journal of General Education and Humanities*, 4(1), 129–140. <https://doi.org/10.58421/gehu.v4i1.329>
- Fikri, A., Saputra, C., Boty, M., Rico, M., Ilmiawan, I., Assidiqi, M., & Setiawan, J. (2025). The effectiveness of the student teams' achievement divisions in social studies learning on activeness and learning outcomes. *Journal of Education and Learning (EduLearn)*, 19(2), 954–962. <https://doi.org/10.11591/edulearn.v19i2.21526>
- George, G. M., Ra, R., & Mohamed, B. B. (2016). The impact of STAD (Student Teams-Achievement Division) strategy on Primary 6 pupils' continuous writing. *ELIS Classroom inquiry*. <https://elis.moe.edu.sg/files/greenwood-primary-report.pdf>
- Gukguk, I. N. P. R., Lumbantobing, M. T., & Sitio, H. (2023). The influence of the Student Teams Achievement Division (STAD) learning model on the learning outcomes of class V students Subhema 1: How the body processes food. *International Journal of Integrated Science and Technology (IJIST)*, 1(3). <https://doi.org/10.59890/ijist.v1i3.535>
- Hardiansyah, F., & Wahdian, A. (2023). Improving science learning outcomes through the development of the Magic Card Box Learning Media. *AL-ISHLAH: Jurnal Pendidikan*, 15(1), 823–833. <https://doi.org/10.35445/alishlah.v15i1.2711>
- Hayatunisa, L. (2014). Student Teams Achievement Divisions (STAD) technique in teaching writing narrative text. *Journal of English and Education*. <https://ejournal.upi.edu/index.php/L-E/article/view/743>



- Hermawan, C. M., Rosfiani, O., Suheti, & Susanti, S. F. (2020). STAD type cooperative-learning-model: An action in learning mathematics. *International journal of science & technology research*, 9(4). <http://www.ijstr.org/final-print/apr2020/Stad-Type-Cooperative-Learning-Model-An-Action-In-Learning-Mathematics.pdf>
- Ina, E. T., Makaborang, Y., & Enda, R. R. H. (2023). Implementation of STAD-based learning model in improving students' learning outcomes. *Jurnal Pena Sains*, 10(2), 88–94. <https://doi.org/10.21107/jps.v10i2.19999>
- Kennedy, I. (2022). Sample size determination in test-retest and cronbach alpha reliability estimates. *British Journal of Contemporary Education*, 2(1), 17–29. <https://doi.org/10.52589/bjce-fy266hk9>
- Lantajo, J. (2017). *The use of STAD model in teaching chemistry: Its effect to students' academic performance* Multi-Disciplinary Manila (Philippines) Conferences Jan. 26–27, 2017 Cebu (Philippines),
- Lantajo, J. T., & Tipolo, R. L. (2018). Student-Team Achievement Division (STAD) and its effect on the academic performance of grade 8 students. *Journal of Physics: Conference Series*. <https://doi.org/10.1088/1742-6596/1254/1/012014>
- Li, M., & Lam, B. H. (2013). *Cooperative learning*. H. K. I. o. Education. https://www.eduhk.hk/aclass/Theories/cooperativelearningcoursewriting_LBH%2024June.pdf
- MoEYS. (2010). *Cambodia education strategic plan 2009–2013*. https://planipolis.iiep.unesco.org/sites/default/files/ressources/cambodia_education_strategic_plan_2009-2013.pdf
- MoEYS. (2018). *Detailed science curriculum for primary education [in Khmer]*. <https://moeys.gov.kh/jp/primary-education/document-2690>
- MoEYS. (2019). *National policy on lifelong learning*. https://www.uil.unesco.org/sites/default/files/medias/fichiers/2023/05/cambodia_policy_on_lil_04-10-18_eng_1.pdf
- MoEYS. (2024). *A country report: PISA 2022 results for Cambodia*. <https://api.weteka.org/public/orgs/63fc7c5751508ff62e6ce857/pdf/d380d8ab-06be-48fb-971d-cb8dc117b004.pdf>
- Nanor, E., Mahama, A., & Hanson, R. (2024). Effect of STAD model of cooperative learning on students' learning outcome on nomenclature of hydrocarbon. *International Journal of Scientific Research and Management (IJSRM)*, 12(03), 3264–3274. <https://doi.org/10.18535/ijstrm/v12i03.el03>
- Nurhuda. (2020). Improving students' engagement in reading class by using Student Teams Achievement Division (STAD). *Journal of English Education and Literature*, 1(2). <https://scispace.com/pdf/improving-students-engagement-in-reading-class-by-using-lxmz35rnd1.pdf>
- Prihatnawati, Y., Amin, M., & Muhdhar, M. H. I. A. (2017). *The effect of module implementation with STAD cooperative learning on process skills in science and cognitive achievement of 8th-grade students*. Proceedings of the International Conference on Learning Innovation (ICLI 2017), <https://www.atlantis-press.com/proceedings/icli-17/25891041>
- Rorimpandey, W. H. F., Maaluas, F., Mangangantung, J., & Suryanto, H. (2022). The Student Teams Achievement Divisions learning model in its influence on the motivation and science



- learning outcomes of elementary school students. *Journal of Innovation in Educational and Cultural Research*, 3(3), 345–354. <https://doi.org/10.46843/jiecr.v3i3.72>
- Rosyana. (2019). CHAPTER II Student Team Achievement Division (STAD). <http://repository.unpas.ac.id/46223/4/CHAPTER%20II.pdf>
- Samarthy, P. M., & Lalitha, D. J. (2025). A study on the impact of STAD cooperative learning strategy on academic achievement in biology among secondary school students. *International Journal of Creative Research Thoughts*, 13(3). <https://www.ijcrt.org/papers/IJCRT2503668.pdf>
- Santosa, S., Furda, M., Nurtaela, S., & Sarsono. (2019). STAD learning model to improvement of activity and student learning outcomes. *American International Journal of Business Management (AIJBM)*, 2(10). <https://www.aijbm.com/wp-content/uploads/2019/10/C2102229.pdf>
- Slavin, R. E. (2006). *Educational psychology: Theory and practice* (8th ed.). Pearson Education. https://lms.pdesas.org/content/courses/General_PD/ESLAOL/media/1D_reading_02.pdf
- Slavin, R. E. (2010). Co-operative learning: What makes group-work work? In H. Dumont, D. Istance, & F. Benavides (Eds.), *The Nature of Learning Using Research Practice to Inspire*. OECD. https://www.oecd-ilibrary.org/co-operative-learning-what-makes-group-work-work_5km98jtk716d.pdf?itemId=%2Fcontent%2Fcomponent%2F9789264086487-9-en&mimeType=pdf
- Slavin, R. E. (2014). Instruction based on cooperative learning in R. E. Mayer & P. A. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 358–374). Routledge. https://www.researchgate.net/publication/267247317_Instruction_Based_on_Cooperative_Learning
- Suwardi, H. (2018). Experimentation of cooperative learning model STAD-TGT. *Journal of Physics: Conference Series*, 2. <https://doi.org/10.1088/1742-6596/1028/1/012090>
- Tiantong, M., & Teemuangsai, S. (2013). Student Team Achievement Divisions (STAD) technique through the moodle to enhance learning achievement. *International Education Studies*, 6(4). <https://doi.org/10.5539/ies.v6n4p85>
- Touwe, S., & Lasaiba, M. A. (2024). Enhancing science education through the Student Teams Achievement Division (STAD) learning model: An experimental study on process skills and learning outcomes at middle school. *AL-ISHLAH: Jurnal Pendidikan*, 16(2), 1178–1192. <https://doi.org/10.35445/alishlah.v16i2.5372>
- Trygstad, P. J., Smith, P. S., Banilower, E. R., & Nelson, M. M. (2013). *The status of elementary science education: Are we ready for the next generation science standards?* I. Horizon Research. <https://www.horizon-research.com/NSSME/2012-nssme-reports-articles/the-status-of-elementary-science-education-are-we-ready-for-the-next-generation-science-standards>
- USAID. (2009). *Cooperative Learning: Theory and Practice [in Khmer]*. https://www.kapekh.org/files/report_file/101-en.pdf
- World Bank. (1981). *Education and basic human needs*. World Bank. <https://documents1.worldbank.org/curated/ar/771641467980462310/pdf/SWP450000Education0and0basic0human0needs.pdf>
- 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, 1–10. <https://doi.org/10.1155/2019/1462179>



- Yulianto, I., Warsono, W., Nasution, N., & Rendy A.P, D. B. (2020). The effect of learning model STAD (Student Team Achievement Division) assisted by media Quizizz on motivation and learning outcomes in class XI Indonesian History subjects at SMA Trimurti Surabaya. *International Journal for Educational and Vocational Studies*, 2(11). <https://doi.org/10.29103/ijevs.v2i11.2746>
- Yusnani. (2018). Theoretical perspectives on cooperative learning. *KnE Social Sciences*, 3(4). <https://doi.org/10.18502/kss.v3i4.2005>