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Utilization of Student Teams-Achievement Division (STAD) Cooperative Learning Model in Improving Conceptual Learning on Intermolecular Forces of Senior High School Students

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ABSTRACT

Student Teams-Achievement Division (STAD) is one of the strategies under the cooperative learning model where students in heterogenous grouping learn together, are assessed individually, and scores are added together, contributing to the team's performance. This study determined its effectiveness in improving the conceptual learning of Grade 12 Accountancy, Business and Management (ABM) students of Agusan del Sur National High School on intermolecular forces (IMFs). This action research followed a quasi-experimental mixed-methods design where 93 students in two sections were assigned as experimental and control groups. Pretest and posttest scores and students' perceptions were obtained. The results show that students taught using STAD have significantly higher posttest scores than those in the lecture method ($p<0.05$). Students also conveyed that the strategy helped them learn the topic by interacting with their groupmates and becoming more motivated to learn throughout the activity. On the other hand, some challenges identified by the participants include groupmates learning at a different pace, time restrictions, and negative feelings towards group activities. It is concluded that STAD can effectively aid in learning the IMFs. It is recommended that the strategy be utilized in other topics and disciplines and tested further for effectiveness.

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I. Context and Rationale

The 21st century, characterized by a rapidly changing society, calls for the educational landscape to respond in order to produce individuals that are knowledge- and skills-ready and are also adaptive to such changes. To be more specific, it is crucial for the shift from teacher-centered to learner-centered teaching approaches to happen to fit this information age (Carter, 2020). Learner-centered learning is an educational approach designed to individually cater to the needs of the learners (Green & Harrington, 2020). In the present world, it is indeed a crucial thing for learners to be equipped with 21st century skills – critical thinking, creativity, collaboration, and communication – for them to be ready as they continue their education or enter the workforce.

One way for teachers to become facilitators of a learner-centered classroom is to utilize cooperative learning structures where students explore a certain topic hands-on while at the same time actively engage with their classmates (Long, 2020). Cooperative learning occurs when small groups of students work together to enhance their own and all the other members' learning which makes it the foundation of most active learning strategies (Johnson & Johnson, 2019). Its success in improving learner achievement has been explored and proven by numerous researches in various subjects.

Cooperative learning is based on two theories (Johnson & Johnson, 2019). First, the Structure-Process-Outcome theory, which states that a learning situation should be designed in a way that the desired process of interaction among learners is achieved and consequently, the desired outcome will automatically come along. Second, the Social Interdependence theory, describes how the goal of an individual is affected by other people surrounding them and how it encompasses cooperative, competitive, and individualistic processes in a group.

In the Department of Education, through its DepEd Order 42, s. 2016 where it established policy guidelines in the preparation of daily lessons, different instructional strategies were suggested. Among this is the interactive instruction in which teachers address the needs of the learners to be active towards learning and at the same time to be interactive with other people around them. One of the mentioned methods is cooperative learning.

Under the cooperative learning model are several teaching strategies (Slavin, 2006). The list includes Teacher Presentation Students Revision (TPSR), Team Games Tournament, Group Investigation, Group Project Work, Jigsaw, the Student Teams-Achievement Division (STAD).

STAD, is a cooperative teaching strategy that is characterized by a regular teaching cycle wherein mixed-ability student teams are created, and recognitions are awarded to those who excel (Slavin, 2006). This is done by creating small heterogenous groups working together towards a common goal (Julina et al., 2022). This allows learners to interact with each other within the group, sharing ideas about the topic.

The strategy is composed of the following activities: (a) Teach, where the teacher presents the lesson; (b) Team study, where student groups are provided with learning materials; (c) Test, where students are given individual assessment; and (d) Team recognition, where individual scores are added to determine the group's total score.

Meanwhile, the topic on intermolecular forces (IMFs) is one of the competencies that were retained in the Most Essential Learning Competencies (MELCS) in the First Quarter Physical Science, a core subject in the Senior High School. This is discussed in two competencies, namely: describe the general types of intermolecular forces (S11/12PS-IIIc-d-17) and explain the effect of intermolecular forces on the properties of substances (S11/12PS-IIId-e-19). These topics deal with concepts that are on the molecular level which could be difficult to grasp for students. Moreover, this becomes more challenging since there are multiple terms that confuse students, it is difficult to observe these forces, and the topic itself is heavy (Hamjad, 2022).

Currently, this is offered to the Grade 12 students of Agusan del Sur National High School in the Division of Agusan del Sur. Based on the diagnostic test conducted by the researcher before the semester began, this topic garnered the lowest number of correct responses during the item analysis with an average of 23%. Moreover, as per observation of the teacher during the teaching of molecular polarity, the topic that precedes the topic of IMFs, learners still find it quite difficult to correctly determine the polarity of a molecule despite the long number of hours spent in conducting lectures and individual activities. Polarity is an essential topic and is crucial in learning the IMFs.

For this study, STAD teaching strategy was incorporated in the teaching of Intermolecular Forces (IMFs) which covers two competencies in the Physical Science. The strategy is considered to be the most appropriate for teaching a wide range of subjects, especially those that focus on facts and concepts (Slavin, 2006). The researcher conducted this study to determine whether a cooperative learning model, specifically STAD strategy, can improve student academic performance of the topic. Furthermore, the study also sought the suitability of the strategy through the experiences of the students.

II. Action Research Questions

This study was aimed at determining the effectiveness of the Student Teams-Achievement Division (STAD) teaching strategy in improving the learning of Grade 12 Accountancy, Business and Management (ABM) students on intermolecular forces.

Specifically, this research answered the following questions:

1. What is the academic performance of students in intermolecular forces before and after exposure to STAD strategy and to lecture method?
2. Is there a significant difference in the academic performance of students in intermolecular forces exposed to STAD strategy and to lecture method?
3. How do students perceive STAD as a strategy in learning the topic?

III. Action Research Methods

A. Participants and/or Other Sources of Data and Information

The participants of the study were the 93 Grade 12 Accountancy, Business and Management (ABM) students, divided into two sections, namely: one as the experimental group (n=46), and the other section in the control group (n=47). Both sections are the only ABM sections and are handled by the researchers in Agusan del Sur National High School for SY 2022-2023.

Information was obtained quantitatively and qualitatively. Numerical data were from the 15-item pretest and post-test adopted from the Department of Education Caraga Region Standardized Assessments in SHS Science. The said assessment was in accordance with a table of specifications. Moreover, qualitative data were from an open-ended questionnaire given to all students to collect their perceptions on the strategy.

B. Data Gathering Methods

Before the actual conduct of the research, the researcher submitted a research proposal to the School Research Committee. A letter of permission from the Office of the Principal to conduct the study was also secured. Upon approval, lesson plans were then prepared that covers the four sessions allotted for the topic. Two sets of lesson plans were created by the researcher – one for the experimental group with STAD teaching strategy and another for the control group with lecture method. Once approved, the teacher then proceeded with developing corresponding instructional materials and assessment tools and were also submitted for approval.

This study followed a quasi-experimental mixed-methods design. On Session 1, the students in both groups were oriented of the research objectives first and the teaching strategy to be implemented to them. Both classes were then given 15-item pretest. The experimental group was then divided into 12 groups, comprised of four to five members. The groupings were created based on their pretest scores, ensuring that the class was fairly distributed to all the groups.

On Sessions 2 and 3, the first competency was delivered with a 10-item teacher-made test at the end of the lesson. Individual scores of the members were added to comprise the team average score which will be added to the second competency results. The class was then allowed to share their comments on the strategy which was used in the improvement of the current lesson plan and for the next lesson plan.

On Sessions 4 and 5, the second competency was delivered and another 10-item teacher-made test was also given at the end. The quiz results were added to the results of the previous quiz then average scores are calculated. The class was asked again for points of improvement of the second lesson.

On Session 6, the researcher distributed open-ended questions about their over-all experience with the teaching strategy. They were also asked about what they liked about it and what needs to be improved. The team who obtained the highest average score was then announced and was given school supplies as awards. The announcement was made at the end of all the lessons to avoid bias on their responses. Lastly, the same 15-item assessment was given as posttest.

Pretest and posttest scores were then analyzed using mean and standard deviation while independent samples t-test was used to determine if there is a significant difference in the learners' scores in the experimental group. Furthermore, a qualitative data analysis was also done to extract emerging themes from the learners' responses.

IV. Discussion of Results and Reflection

A. Performance of Students in IMFs Before and After Exposure to STAD Strategy

Table 1 presents the test scores of the Grade 12 ABM students in the experimental and control groups before and after the implementation of the STAD strategy in the experimental group.

	Section	N	Mean	SD	Description
Pretest	Experimental	46	7.76	1.61	Did Not Meet Expectations
	Control	47	7.89	1.62	Did Not Meet Expectations
Posttest	Experimental	46	13.26	1.56	Very Satisfactory
	Control	47	12.47	1.80	Satisfactory

Table 1 Pretest and posttest scores of the students

The table shows that during the pretest, the mean score of the experimental group (M=7.76, SD=1.61) and that of the control group (M=7.89, SD=1.62) are similar with qualitative descriptions of "Did Not Meet Expectations" which suggests that both sections have the same level of performance before an intervention was implemented in the experimental group. On the other hand, during the posttest, the mean score of the experimental group (M=13.26, SD=1.56) or "Very Satisfactory" was higher than those in the control group (M=12.47, SD=1.80) or "Satisfactory". This demonstrates that the students exposed to STAD strategy have better performance in intermolecular forces topic than those who learned using lecture method.

Furthermore, pretest scores were analyzed using independent samples t-test shown in Table 2.

	Mean score	P-value	Remark
Experimental group	7.76	.692	Not Significant
Control group	7.89		

Table 2 Independent samples t-test results of the pretest results of both groups

The results of the independent samples t-test shows that there is no significant difference between the mean score for both sections; t(91)= -0.397, p=0.692. It simply means that both sections have the same level of understanding to the questions prior to teaching the lesson.

B. Significant Difference between the Posttest Scores of Learners Exposed to the Two Strategies

An independent-samples t-test was also conducted to compare the test scores of students before and after being taught using STAD strategy and lecture method as shown in Table 3.

	Mean score	P-value	Remark
Experimental group	13.26	.026	Significant
Control group	12.47		

Table 3 Independent samples t-test results of the posttest results of both groups

The results shows that there is a significant difference between the mean score of students exposed to the STAD strategy and to those with the lecture method; t(91)=2.268, p=0.26. This suggests that the said cooperative learning model significantly increased the performance of the students on intermolecular forces than those who were taught using the conventional method.

Similar results are also consistent in other studies. STAD strategy significantly improved the performances of Grade 9 in their Science class (Jony, 2020), junior high school students (Ginanjar et al., 2019), and Grade 11 TVET students' performance in the theory of flight (Mokmin et al., 2023). These means that STAD strategy is indeed effective in improving the academic performances of the students as they are more engaged with the lesson and with their groupmates.

C. Perceptions of the Learners towards the STAD Strategy

The learners expressed their experiences from the teaching strategy through their responses in the open-ended questions. These include their over-all experiences and the opportunities and challenges they found from the strategy.

C.1. Experiences on Learning the IMFs through the STAD Strategy

It was found that most of the participants (93%) expressed that they have learned a lot about the topic through the STAD strategy. They saw that the strategy allowed them to be able to understand the topic independently, since they have to read by themselves, and at the same time, cooperatively, since they are encouraged to discuss to the group what they understood from the reading materials. Some of the participants responded:

It helps to enhance my understanding and reading skills since we are challenged to understand everything on our own (Student 42).

It helped me because I read it carefully and repeated it so that I can understand IMF by myself (Student 6).

The strategy assisted me in comprehending how IMF operates and takes several form, as well as how to use it in practical situations (Student 13).

Moreover, two students conveyed:

The strategy helped us to self-understand the text itself and share it to our group mates. This strategy helps us to understand and comprehend the topic (Student 35).

I get to know what my group members thinks and understanding about a particular topic and understand more about the IMF (Student 7).

Accordingly, cooperative learning strategies posits that team effort towards a goal is better that solo effort (Gull & Shehzad, 2015). Being able to immerse in the topic with the group assisted the students in learning the topic rather than just learning alone and keeping it to themselves. This means that cooperative learning fit the students in promoting the conceptual learning of the topic.

C.2. Opportunities and Challenges in the STAD Strategy

While learning about IMFs, the students also mentioned about certain opportunities and challenges they experienced through the strategy.

Most students (n=34) liked the strategy since one member's understanding and idea can be shared to all the group members, which helped them learn more about IMFs. They also see it as an opportunity to be able to interact with the group. Some students revealed:

I like it because it is a group activity, although individual in answering the quiz but by group in discussing the lesson. By this activity, I get to bond with my classmates while learning and listening to their ideas (Student 7).

I like the strategy because it is not that hard, and we can even share our learnings to our groupmates about what we read (Student 27).

I like it because we can share our own idea. We can get idea from another person. Also, I like it because I can ask questions with my groupmates, and they help me understand the specific topic (Student 23).

In addition, some students (n=17) also stated that they liked learning with a group:

It was easier learning the topic because our leader assigned one to each of us and later, we discussed it to our other groupmates (Student 32).

What I like is how we helped each other learn the given topic (Student 36).

The students (n=11) also found the strategy to be motivating, challenging and fun as they learned IMF together:

We enjoyed doing the activities with my groupmates and also we share ideas and understanding about the topic (Student 9).

I like the strategy because I am motivated to learn, and also, I am excited learning and discussing in my group (Student 22).

Though STAD requires working with the team, students have also indicated that the strategy also led to them being a responsible member of the team. Some students (n=6) revealed that they are encouraged to also learn on their own while in the group. The responses include the following:

The strategy motivates the students to participate in every discussion and activities. It also taught us not to rely on other members even though it is a group activity (Student 15).

What I like about the strategy is about how to understand the topic as a group, it also taught us to understand on our own (Student 14).

In general, the statements showed the learners' positive response towards learning as a group and the individual positive attitudes they develop while doing the activities. Cooperative learning such STAD strategy are effective ways to expose the learners in collaborating with others, especially that it is needed for success in the 21st century (Palmer et al., 2017).

On the other hand, the students also expressed some challenges during the lessons. Some students (n=13) felt that they needed more time to discuss well with the group. Some students conveyed the following:

It takes too much time since its new to us and not everyone can get it easily (Student 11).

The time we have to discuss is not enough and knowing that we have to process the lessons in the reading materials. Also, sometimes it's overwhelming to see some familiar or confusing images (Student 25).

Others (n=11) have also felt the shyness and pressure in participating in the STAD strategy.

I get anxious and thoughts like, "What if they get angry and blame me for not winning," crossed my mind often (Student 7).

It creates hurdles like reluctance in communication because not everyone feels comfortable around each other (Student 12).

Moreover, some (n=8) expressed that not all of their groupmates can understand easily, and some facts about the lesson can become confusing.

I had a hard time understanding the topic because I forgot the teacher's explanation, but thanks to my groupmates I understood it eventually (Student 3).

The challenges mentioned above are in agreement to a study on university students wherein identified issues with cooperative learning include the time constraint, difficulty in establishing teamwork, catering to individual differences, and fostering positive relationships (Keramati & Gillies, 2022). Thus, these experiences within the classroom are common but the teacher can still minimize the negative impacts of such challenges.

V. Conclusion

In totality, this research showed that the use of STAD strategy have a significant positive impact on the students' learning of IMFs. Aside from being able to understand the topic, the students have also provided positive feedback about the strategy – the fun in working and learning as a group, the motivation to be able to share what they learned to the group, and the challenge to contribute the group's score at the end. There can also be more aspects to be improved like taking into consideration the different pace by which students learn from a topic and the negative feelings that they may experience in groups activities like this.

Teachers have a crucial role in cooperative learning. Though more interaction takes place between students, they need to be skillful in creating learning groups, setting individual and group responsibilities, and monitoring all that takes place during the lesson (Palmer et al., 2017). Sufficient amount of time is also needed to prepare and completely execute the lesson (Jony, 2020).

The researcher recommends that the STAD strategy be utilized in other topics in Science and in other subjects. Cooperative learning strategies create good avenue for learner interaction, enhancing them with conceptual understanding and social skills.

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