Available on: https://jsshrs.ep-journals.org/ E-ISSN: 3051-3561, P-ISSN: 3051-3553

Journal of Social Science and Human Research Studies

Volume : 02 Issue : 07 July-2026

Cooperative Learning and Biology Students' Acquisition of Higher Order Thinking Skills in Secondary Schools in Buea, Cameroon

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Published Date: July 10, 2026 **Article DOI: 10.65150/EP-jsshrs/V2E7/2026-12**

ABSTRACT: This study aimed at investigating cooperative learning and biology students' acquisition of higher order thinking skills (HOTS) in secondary schools in Buea, Cameroon. Two specific objectives were formulated: to find out the effect of teacher's use of think-pair-share on biology students' acquisition of higher order thinking skills in secondary schools in Buea and to find out the effect of teacher's use of group Investigations on biology students' acquisition of higher order thinking skill in secondary schools in Buea. Both objectives were transformed into research questions and then into research hypotheses to be tested. The Study made use of a quasi-experimental research design. An observation checklist was used as the instrument for data collection. The study targeted 2,510 students in 10 high schools in Buea. 160 form four students of Government High School (GHS) Bokwango and GHS Great Soppo were sampled. The independent T-test statistic was used to test all the two null hypotheses stated at $p \leq 0.05$ level of significance. Findings from the analysis of the quasi-experiment revealed a significant difference between the academic performance of students taught biology using the cooperative learning method and those taught using traditional lecture method. Findings obtained from the observation checklist revealed that think-pair-share and group investigation have a significant positive effect on the development of biology students' HOTS in secondary schools in Buea. Based on these findings, it was recommended that teachers should adopt the cooperating learning method in enhancing biology students' HOTS development in secondary school in Buea.

KEYWORDS: Cooperative learning, think-pair-share, group investigation, Higher order thinking skills

INTRODUCTION

High Order Thinking Skill (HOTS) is the ability for students to develop, stimulate, and engage complex thinking processes (Alkhatib, 2019). According to Alkhatib (2019), HOTS consists of four subthinking skills; problem-solving, critical thinking, creative thinking, and decision-making. According to McLoughlin and Luca (2000), HOTS encompass the capacity to exceed the provided information and involve critical thinking, application, metacognitive awareness, and problem-solving. Anderson and Karthwohl (2001) state that the ability to engage in high-level thinking entails analyzing, evaluating, and creating. Rofiah et al. (2013) argue that HOTS constitutes a complex, reflective, and creative cognitive process carried out consciously to attain goals by acquiring knowledge of analytical, synthetic, and evaluative thinking levels.

Cooperative learning is a student-centered, instructor-facilitated instructional strategy in which a small group of students is responsible for its own learning and the learning of all group members (Li & Lam, 2013). According to Felder and Brent (2007), cooperative learning refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied. The spirit of the team is positive interdependence as each student is responsible for his/her own understanding and the other students' understanding. Johnson and Johnson (2018) defined cooperative learning as students working together to maximize their own and each other's learning. They also outlined five essential elements for effective cooperative learning: positive interdependence, individual accountability, promotive interaction, social skills, and group processing. Deutsch (1962) theory of cooperation and competition laid the foundation for understanding social interdependence, which is central to cooperative learning. He defined cooperation as positive goal interdependence, where the success of one member depends on the success of others.

Think-pair-share (TPS) is one of the cooperative learning strategies that promote students' involvement in the classroom (Apriyanti & Ayu, 2020). Think-pair-share involves three stages: think, pair, and share (Cooper et al. 2021). TPS is often used to build fluency with learners across subject areas, through asking the learners to provide or elaborate on examples and processes (Westheimer & Kahne, 2004). TPS is used to help students form individual ideas, discuss and share with the others in-group. TPS can be used to help students form individual ideas, discuss and share with the others in-group. It can be used before reading or teaching a concept and works better with smaller groups. TPS is often used to build fluency with learners across subject areas, through asking the learners to provide or elaborate on examples and processes (Westheimer & Kahne, 2004).

TPS is an instructional strategy commonly used in education to promote active student engagement and collaborative learning. It involves three stages: think, pair, and share (Cooper et al. 2021). During the "think" stage, students are given a question, problem, or prompt to think about

independently. They are encouraged to reflect on the topic and generate their own ideas, solutions, or responses. This stage allows students to process information, organize their thoughts, and develop their individual understanding. Teachers begin by asking a specific higher-level question about the text or topic that students will be discussing. Students "think" about what they know or have learned about the topic for a given amount of time (usually 1-3 minutes).

In the "pair" stage, students are paired up with a classmate or a small group. They share their thoughts, ideas, or answers with each other. This step promotes peer interaction, discussion, and the exchange of perspectives. Students can compare and contrast their individual responses, clarify their understanding, and learn from each other's insights. According to Johnson and Johnson (2018), each student should be paired with another student. Teachers may choose whether to assign pairs or let students pick their own partner. Remember to be sensitive to learners' needs (reading skills, attention skills, language skills) when creating pairs. Students share their thinking with their partner, discuss ideas, and ask questions to their partner about their thoughts on the topic (2-5 minutes).

Finally, in the "share" stage, pairs or groups of students are given the opportunity to share their discussions, findings, or conclusions with the larger class. This can be done through whole-class discussions, presentations, or other forms of sharing. The purpose of this stage is to foster a collaborative learning environment, encourage active participation, and provide students with a platform to articulate and communicate their ideas to the wider group (Cooper et al. 2021).

Think-pair-share (TPS) is an effective strategy because it allows students to engage in higher order thinking, such as analysis, evaluation, and synthesis, as they process information, discuss it with their peers, and articulate their thoughts. It also gives students time to think and respond, and help each other thereby improving students' ability to respond to questions (Sumarni, 2016). By engaging in dialogue and sharing ideas, students can deepen their understanding, gain new perspectives, and develop their critical thinking skills. In think-pair-share strategy the teacher acts as a facilitator, and poses a question or a problem to the students. The students are given sufficient time to think and gather their thoughts, after which the teacher asks them to pair themselves and share their thoughts with each other.

As the students begin to share their thoughts and views, each learns to see the different perspectives of thinking among their peers. By doing so the students' learning is enhanced by the formation and articulation of an idea. This also enables the students to have clarity of thought and have the ability to communicate their thoughts and ideas to another student (Healy et al., 2011). If time permits, the paired students can share their thoughts with other paired students, and teachers can ask one or two pairs to share their ideas with the entire class. The process is easy to prepare and takes only a small amount of time to perform in class. The interaction with students at a personal level is intended to motivate those students who may not be generally interested in the topic. Different kinds and levels of questions can be asked from lower order to higher order thinking questions. The teacher can understand the different thought processes of the students while listening to the pairs and when the students share their view at the end. The use of TPS is time consuming since the teacher has to assist the students in making the groups. The classroom can be very noisy because the students work in group, discussing with one another as they share ideas.

According to Kemp (2010), group investigation (GI) is an approach that actively involves students in the learning process, promotes teamwork, critical thinking skills, and encourages a deeper understanding of the subject matter. Bahri et al. (2021) state that group investigation (GI) involves students in planning the topics to be studied and how to run the investigation. Operationally, GI is an instructional strategy where students work collaboratively in small groups to investigate a topic or problem, conduct research, analyze data, and present their findings. GI is a method for classroom instruction in which students work collaboratively in small groups to examine, experience, and understand their topic of study (Sharan, 2015). So, GI is a teaching method that is able to make the students interactive in the classroom because they need to have positive interdependence and individual responsibility. They also need to have great interaction with their friends because they have to work in groups. Bahri et al. (2021) state that there are six-step approach to GI, as follows:

Topic Selection: Students choose a specific sub-topic within the field of certain common problems, which are usually explained by the teacher. Then, students are organized into small groups consisting of task-oriented two to six people. The composition of the needs to be both academically and ethnically.

Cooperative Learning: Students and teachers plan procedures, tasks, and specific learning objective in accordance with sub-topics selected. Implementation: Students implement the plan formulated. Learning should involve a variety of activities and skills and should lead students to a variety of a sources inside and outside of the school. The teacher follows closely the development of each group and offers help when needed.

Analysis and Synthesis: Students analyze and evaluate information obtained and plan on how this information can be summarized; by drawing to be displayed or presented to classmates.

Presentation of the final product: Some or all groups in the class give an interesting presentation on topics to make each other involved in his work and achieve a broader perspective about a topic. Presentation group coordinated by the teacher.

Evaluation: In some cases, the groups follow up the different aspects of the same topic. The students and the teacher evaluate the contribution of the whole work in each group. The evaluation included individual and group assessment or both of them.

Primahesa et al. (2023), posited that GI can have a positive impact on the development of higher order thinking skills among biology students in secondary schools. Here are some ways in which group investigation influences higher order thinking skills: Critical Thinking: Group investigation encourages students to think critically about biological concepts and problems. By working collaboratively in groups, students engage in discussions, analyze information, evaluate evidence, and generate reasoned arguments. They are exposed to diverse perspectives and are challenged to think deeply and critically about the subject matter, leading to the development of critical thinking skills.

Problem-Solving: Group investigation involves students in solving complex problems related to biology. They apply their knowledge, conduct research, analyze data, and work together to find solutions. This process requires students to engage in higher order thinking skills such as problem identification, analysis, synthesis, and evaluation. Komala et al. (2020) are of the opinion that group investigation has an influence in students' higher order thinking skills as it makes them more active to exercise their ability.

Inquiry and Research Skills: Group investigation promotes inquiry-based learning and research skills among biology students. Students engage in the process of asking questions, formulating hypotheses, designing investigations, and collecting data. They learn how to conduct research, analyze scientific literature, and draw evidence-based conclusions. These research skills foster higher order thinking as students critically evaluate information, draw connections, and make informed judgments. Analysis and Synthesis: According to Schwichow and Zimmerman (2016), during group investigation, students gather and analyze data, information, and evidence related to the biology topic they are investigating. They learn to critically examine and interpret data, identify patterns, and draw meaningful conclusions. Through this process, students develop analytical and synthetic thinking skills, enabling them to integrate information, draw connections between concepts, and develop a deeper understanding of biological phenomena.

Communication and Collaboration: Group investigation involves communication and collaboration among students. They discuss ideas, share information, present findings, and engage in dialogue. Through these interactions, students develop communication and collaboration skills, including active listening, articulating thoughts clearly, and respectfully exchanging ideas. Effective communication and collaboration are essential components of higher order thinking skills. By engaging in group investigation, biology students in secondary schools have the opportunity to develop and strengthen their higher order thinking skills, including critical thinking, problem-solving, inquiry, analysis, synthesis, metacognition, and communication. These skills are not only valuable for understanding biological concepts but also for their future academic and professional endeavors.

However, when working with others, it is natural that disagreement will arise due to differences in opinions. Some students find it difficult to accept criticism from their peers and struggle to get on board with ideas that are not theirs. Moreover, students who are quiet often have difficulty expressing their ideas in a group and may feel uncomfortable working with people they do not normally speak to. As a result, they may be seen as lazy, thereby creating conflict.

In group work, one will often observe a large discrepancy in participation between the different group members. With a lot of group projects, it is common to find 1-2 students taking the bulk of the workload, whilst other members essentially freeload. This can lead to conflict and breed bitterness amongst the different group members especially if the student feels others are being rewarded for their hard work. When working in a group, it is quite common for students to go off-topic, especially if the task involves discussion. Some students may use that time to gossip, do other tasks, or loaf around. This results in the group work session being less effective and productive. Working in a team can be extremely time-consuming as a student. Not only do meetings have to be scheduled outside of class hours but they have to co-ordinate with everyone's schedule.

Statement of the Problem

Cooperative learning can enhance higher order thinking skills by fostering active engagement and collaboration which improves critical thinking, problem- solving skills and decision making. Using cooperative learning brings about a culture of inquiry thereby empowering students to think independently. Cooperative learning also fosters communication, builds the students' self -esteem and motivation.

If biology teachers do not use cooperative learning; think-pair-share and group investigation appropriately, students may not perform well in biology. As a consequence, they may not write and pass entrance examination into professional institutions that require the knowledge of biology, choose career in biology related professions, and solve real life individual and societal problems that involve biology. It may also cause the students to have poor academic performance as well as inadequate qualified skills and aptitude. It is in this light that the study seeks to investigate the effect of cooperative learning (think-pair-share and group investigation) on biology students' acquisition of higher order thinking skills in secondary schools in Buea.

METHODOLOGY

The Study made use of a quasi-experimental design and an observation checklist. The study targeted 1,993 students in 20 high schools in Buea. 160 form four students of Government High School (GHS) Bokwango and GHS Great Soppo were sampled. Purposive sampling technique was used to select Buea, as well as to select the form four class. Simple random sampling was used to arrive at the two secondary schools used for the research. The independent T-test statistic was used to test all the two null hypotheses stated at $p \leq 0.05$ level of significance.

Findings

The findings of the study were based on two research questions

Research Question One: What is the effect of teacher's use of think-pair-share on biology students' acquisition of higher order thinking skills in secondary schools in Buea?

The table below presents the observation on think-pair-share.

Table 1: Observation on think-pair-share

Activity	Excellent	Very good	Good	Poor	Very poor	Decision
Students communicate freely with one another	10 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**Excellent**
Take into consideration the opinion of their classmates	0 (0.0%)	4 (40.0%)	3 (30.0%)	0 (0.0%)	3 (30.0%)	**Very good**
Share materials with one another	5 (50.0%)	0 (0.0%)	3 (30.0%)	0 (0.0%)	2 (20.0%)	**Excellent**
Checking to make sure everyone understands	0 (0.0%)	0 (0.0%)	3 (30.0%)	2 (20.0%)	5 (50.0%)	**Good**
Mean	**3.75**	**1**	**2.25**	**0.5**	**2.5**	

The table above shows how students communicate freely with one another, take into consideration the opinion of their classmates, share materials with one another while checking to make sure everyone understands. From the observation it can be concluded that biology students' use of think-pair-share can be excellent and it positively affects their acquisition of higher order thinking skills in secondary schools in Buea.

Table 2: Descriptive statistics for objective one

	Mean	N	Std. Deviation	Std. Error Mean
Pretest	9.7	160	5.25	0.48
Post-test	10.73	160	5.31	0.49

From the above, the mean score of students for pretest was 9.7 with a standard deviation of 5.25 (9.7±5.25). On the other hand, the mean score for post-test was 10.73 with a standard deviation of 5.31 (10.73±5.31). From the statistics, it is seen that the post-test mean of the students' scores was higher than that for the pretest.

Research Hypothesis

Ho_1: Teacher's use of think-pair-share has no significant effect on biology students' acquisition of higher order thinking skills in secondary schools in Buea.

Ha_1: Teacher's use of think-pair-share has a significant effect on biology students' acquisition of higher order thinking skills in secondary schools in Buea.

Table 3: Paired Samples Test for pretest and post-test for objective one

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest-posttest	-1.03333	6.85005	.62532	-2.27253	.2049	-1.652	119	.101

Paired-sample t-test was used to separate the means between pre-test and post test at α=0.05 (95% confidence interval)

From the table above, it is seen that there was a significant difference between pretest and post-test (t=-1.652, p=0.101; 95%: -2.27153 0.20487). This therefore means that there is evidence to support the claim that teacher's use of think-pair-share on biology students' has a significant effect on their acquisition of higher order thinking skills in secondary schools in Fako Division.

Research Question Two: What is the effect of teacher's use of group investigations on biology students' acquisition of higher order thinking skill in secondary schools in Buea?

The table below presents the observation on group investigations.

Table 4: Observation on group investigations

Activity	Excellent	Very good	Good	Poor	Very poor	Decision
Students brainstorm and carryout Investigations	0 (0.0%)	4 (40.0%)	2 (20.0%)	0 (0.0%)	4 (40.0%)	**Very good**
Students bring feedback after investigation	0 (0.0%)	8 (80.0%)	0 (0.0%)	0 (0.0%)	2 (20.0%)	**Very good**
Reports difficulties	5 (50.0%)	0 (0.0%)	4 (40.0%)	0 (0.0%)	1 (10.0%)	**Excellent**
Appreciate each other's success	0 (0.0%)	4 (40.0%)	3 (30.0%)	0 (0.0%)	3 (30.0%)	**Very good**
Mean	1.25	4	1.75	0.5	2.5	

The table above shows the observations on how students brainstorm and carryout Investigations, students bring feedback after investigation, reports difficulties and appreciate each other's success. From the observation, it can be concluded that teacher's use of group investigations is excellent and it positively affects Biology students' acquisition of higher order thinking skills in secondary schools in Buea.

Table 5: Descriptive statistics for objective two

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Pre-test	160	.00	20.00	10.383	.403	4.412
Post-test	160	.00	20.00	13.667	.525	5.752
Valid N (listwise)	160					

From the above, the mean score of students for pretest was 10.38 with a standard deviation of 1.41 (10.38±4.41). On the other hand, the mean score for post-test was 13.67 with a standard deviation of 0.49 (13.67±5.75). From the statistics, it is seen that the post-test mean of the students' scores was higher than that for the pretest for this objective.

Ho_2: Teacher's use of group investigation has no significant effect on biology students' acquisition of higher order thinking skills in secondary schools in Buea.

Ha_2: Teacher's use of group investigation has no significant effect on biology students' acquisition of higher order thinking skills in secondary schools in Buea.

Table 6: Paired Samples Test for pretest and post-test for objective two

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test - Post-test	-3.283	6.397	.584	-4.439	-2.13	-5.63	119	.000

Paired-sample t-test was used to separate the means between pre-test and post-test at α=0.05 (95% confidence interval)

From the table above, it is seen that there was a significant difference in pretest and post-test (t=-5.622, p=0.00; 95%: -4.43972, -2.12694). This therefore means that teacher's use of group investigation on biology students has a significant effect on their acquisition of higher order thinking skills in secondary schools in Buea.

CONCLUSION

Findings from research question one revealed that, teacher's use of think-pair-share has a significant positive effect on biology students' acquisition of higher order thinking skills in secondary schools in Buea. Again, findings from research question two showed that, teacher's use of group investigations has a significant positive effect on biology students' acquisition of higher order thinking skills in secondary schools in Buea. Therefore, from the findings it was concluded that teachers' use of cooperative learning positively affects Biology students' acquisition of higher-order-thinking skills in secondary schools in Buea.

It was recommended that, biology teachers should incorporate think-pair-share techniques as part of cooperative learning strategies in Biology classrooms to foster students' higher order thinking skills. Also, teachers should regularly assess students' progress in developing higher-order thinking skills and adjust the group investigation approach accordingly.

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