Cooperative Learning Can Promote Active Engagement and Critical Thinking: An Undergraduate Zoology Case Study at a Government College of Bangladesh

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ABSTRACT

Introduction. Cooperative learning can enhance students' motivation, active engagement, deep understanding, and critical thinking by stimulating their inquisitiveness and analytical capacities in learning process. This requires systematically operated explorative and complex problem-solving activities that apparently remain under explored in Bangladesh college education perspective.

Methodology. A single qualitative method case study in one government college of Bangladesh was aimed to investigate the perceptions of undergraduate zoology students and teachers about the effect of cooperative learning on learners' active engagement and critical thinking. Questionnaires containing a mixture of Likert scales and open-ended questions were used to investigate 3rd and 4th year undergraduate zoology students' (n=36) perspectives, while semi-structured interviews were conducted simultaneously to understand teachers' (n=8) experience and opinions of using cooperative learning pedagogies and their effects. All but three respondent students were female so that gender issue was not considered in data analysis. The study data- both qualitative and quantitative were analyzed statistically on MS-Excel-2016.

Findings. The study revealed a clear positive consensus of the respondent students and teachers on the ability of small group work based cooperative learning to promote students' active engagement and critical thinking. Both responding groups perceived students' active engagement, better critical thinking and peer sharing, and alternative ways of solution as the benefits, whilst ensuring adequate learning resources, active peer engagement, and equal access to learning resources as the challenges of the learning tool. Most students (83%) viewed the new learning settings to help them engage equally and 86% assessed their performance to be promoted to very good or excellent ranks. Moreover, 83% either agreed or strongly agreed that their participation in cooperative learning classes could enhance their critical thinking ability whilst, teachers' instructional design for students' equal access to adequate learning resources and motivation for new and alternative ways of learning appeared the mostly viewed pedagogical elements for promoting students' active engagement and critical thinking respectively. There was a clear agreement between the perceptions of the students and their teachers in many instances of the positive roles of the learning method for better student outcomes.

Conclusion. Cooperative pedagogies not only promote students' active engagement but their critical thinking abilities also. Forming small- groups of students to the beginning of a marking session and assigning them with research projects as part of their course works seemingly helped bring better learning achievement in the study. This has strengthened the call for adopting cooperative learning as a regular alternative instructional method in under graduate zoology classes of Bangladesh.

Keywords: Cooperative learning, Active engagement, Critical thinking, under graduate zoology case study

INTRODUCTION

Over the last century, lecture centered instructions dominated the technique of transmitting information to the students of all grades spanning through primary to higher education (Felder & Brent, 2005). Yet, a strong

consensus has already been built that students should not be allowed to remain passive but active participants in learning that in many instances gets missed in lecture based classes (Biggs & Tang, 2011; Ramsden, 2010). Here is the point for a call for cooperative learning (CL) as an alternative instructional method to promote students' better learning outcomes. Cooperative learning is a teaching approach that uses varied methods to facilitate students' learning in small groups so that they need to engage actively in solving learning problems given by their teachers (Sharan, 2010). Students in CL need to work together and take their own learning responsibilities while the teachers help them maintain and control the learning environment. This cause the teachers to become the facilitators of learning not the only source of transmitting information in classes. Every student needs to participate in the team on shared and mutually cooperative approach to bring learning collaboration in the whole class leading to better understanding of subject matter and win a team goal (McKeachie, 1988; Slavin, 1995). This helps them engage in deep learning, not rote learning of most lecture dominated classes. The theory of constructivism (Bandura, 1995; Vygotsky, 1978) gives us an idea about the very process involved in cooperative learning through social contact in peer interactions in team works (McLeod, 2023). Such team work in CL classes turns more significant and beneficial for the generation Z, also termed as 'Gen 1' or' Gen Next' being born between the early 1990s and the early 2000s who including the present study subjects, are seemingly more self-directed, smarter, and able in processing information better than the previous generations though may not be showing similar performance as team players (Igel & Urquhart, 2012). Therefore, cooperative learning for this youth force turns better in a critically designed series of steps for achieving a specific learning goal in group works. Hence, this work took cooperative learning for understanding its role to promote student outcomes in the following context.

The study students were mostly found to be instructed in traditional lecture oriented methods. Only a few theory classes and some practical or laboratory classes are instructed in cooperative method in small group works, like in-group filed works, group assignments, and group projects in a marking period. But to cover exam syllabus and allow the students prepare for both internal formative assessment and public examinations of the terminal summative assessment, they need to attend more in lecture based classes. They considered such classes to help them prepare better in a relatively short time for upcoming exam days no matter how far they could learn actively and critically with developing necessary life-skills.

But higher education in zoology should aim at building students' proper knowledge of understanding, observing, analyzing, explaining, evaluating, comparing and reasoning of the structural and functional features that students come across in their real life settings. Any inappropriate teaching method in biological science can turn learning facilities unproductive and makes the concepts difficult to understand by the students. Many influential reports and articles have stressed on bringing changes in the traditional teacher-centered instructions for undergraduates to promote better meaning, enhanced problem solving ability, and critical thinking of not for the advanced or more privileged segment of the class but the whole class in any situation (Armbruster, Patel, Johnson, & Weiss, 2009). Different cooperative strategies of teaching-learning in such case help both teachers and the students to overcome the underuse and improper use of learning resources both intrinsic and extrinsic. Conversely, the success of today's undergraduates as future work force heavily depends on their critical thinking skills and ability to work as a team member in the complex and complicated social settings. This has been weighed and acknowledged through the call of many researchers for including the issues of critical thinking, problem solving, collaboration, and communication skills as the core curricular elements in higher education (Aronowitz, 2010). With this end in view, promoting student participation and critical thinking obviously requires students to engage themselves actively and critically in solving suitable learning problems (Biggs & Tang, 2011; Ramsden, 2010). Hence, lecture dominated undergraduate zoology classes in Bangladesh college education was assumed to fall in many instances below the expectation levels of students' active engagement and critical thinking for a better learning outcome. In a view to ensuring proper instruction and guidance in learning zoology towards maintaining equal and active student engagement and critical thinking, the views of both the students and their teachers were attempted to understand in this study.

Interestingly, on theoretical notes, students' active engagement was considered one of the two main constructs that examined whether student active engagement could be promoted through cooperative learning. Fritschner (2000) and Rocca (2010) showed strong association between student engagement and learning performance while Race (2005) metaphorically used 'doing' for active engagement in bringing learning success. By the way, not all student-centred instructional methods are of cooperative type. When students are motivated to

perceive that their learning goals are common and can only be achieved best from mutual cooperation and sharing, they can really reach the culmination of meaningful learning (Johnson and Johnson, 1989). It means that students in shared learning becomes actively engaged for winning their targets in cooperative learning that include observing, asking, explaining, exploring, challenging, open-minded acknowledgement of answers to debating issues, and communicating with others to solve the learning problems (Johnson *et al*., 2000). These all peer-interactions can turn cooperative if individual accountability and positive interdependence among the learners could be maintained through the whole learning period (Millis & Cottel, 1998; Slavin, 1996). Hence, individual accountability should be encouraged by keeping the provision of assessing students in part for their personal learning outcomes that will also help prevent social loafing (do nothing) during in-group activities (Johnson & Johnson, 2009). This allows a student to pursue individual goals in group works. Again, Trowler (2010) found student engagement as an ambiguous idea that Biggs and Tang (2011) grouped into two forms: 'approaches to learning' that infers the qualitative accounts of students' attitude, motives, perceptions, and strategies towards their ongoing learning for high quality learning outcomes, and 'in-class participation' to account for students' eagerness to engage in discussion along with sharing self-comments and understanding with others. Anyway, the attributes of students' active engagement in many cases are well aligned with that of their 'critical thinking' so that one complements the other.

Consequently, critical thinking (CT) was the 2nd and final construct in the present study. It refers to have a deep root in interwoven thinking of scientific, mathematical, anthropological, philosophical, historical, economic, and moral contexts in a wide range of subject matters, purposes and issues provided in a learning setting. The development and application of critical thinking skills in one's life becomes a lifelong endeavor (Lord, 2001). Such skills comprise analytical thinking, conceptualization, synthesizing, applying, evaluating information, good communication, creative thinking, open-mindedness, ability to solve problems, asking thoughtful questions, mindful observation, experience, reflection, reasoning, clarity, consistency, accuracy, relevance, precision, sound evidence, proper reasons, fairness, and depth as well as breadth that transcend subjects or course matters, and guide the critical thinkers to belief and action (Scriven & Paul, 1987; "6 Examples of Critical Thinking Skills | Indeed.com," n.d.). Thus, critical thinking in any setting becomes an essential condition for learning success.

So, the research argument in this work reads that the aforementioned students' active engagement and critical thinking can be promoted through cooperative learning. The argument has been established through understanding and explaining the perceptions and experiences of the students and their teachers accordingly. At this point, the research purpose became evident through addressing the following research questions:

1. What are the perceptions of students and teachers with regard to their experiences of a cooperative teaching-learning approach?

1.1 What are students' and teachers' perceptions in relation to benefits and challenges of co-operative learning?

1.2 To what extent do students and teachers perceive that all students are equally and actively engaged in co-operative learning?

2. To what extent, if any, does co-operative learning enhance student outcomes?

2.1 To what extent, if any, does co-operative learning enhance students' learning performance?

2.2 To what extent, if any, does co-operative learning promote students' critical thinking?

3. What specific pedagogical approaches within the framework of cooperative learning enhance students' active engagement and critical thinking in undergraduate zoology classes?

3.1 What elements of the co-operative learning pedagogy are particularly beneficial for students' motivation and active engagement?

3.2 What elements of the co-operative learning pedagogy are particularly beneficial to the development of students' critical thinking?

METHODOLOGY

Accelerating learning outcomes in the form of students' active engagement and critical thinking in cooperative learning requires both student and teacher experiences to adapt into the contextual learning settings. Accordingly, under a single case study, a college and its undergraduates, majoring zoology was chosen being accessible for collecting data in proper contexts and instruments (semi structured questionnaire for students and structured interview for teachers). That learning could be constructed through in-group social interactions so that students can actively participate by following systematic logical pathways in a critical way was the main theoretical basis of various learning experiences in the study. Anyway, the learning participants need inquisitive and investigative efforts for understanding and reaching a predefined goal with the problems and their solutions. This has been the focus of the study that gave the students some more cooperative learning classes with various group works, quizzes, and projects on animal physiology. The respondent students shared their perceptions and experiences on various cooperative learning classes that they experienced before and within prevailing Covid-19 pandemic situation respectively in in-person and virtual classes. As such, the research questions included an inquiry for the students' and teachers' perceptions on the benefits and challenges with cooperative learning, the extent that respondents find cooperative learning to allow active student participation, the extent that cooperative learning can promote students' critical thinking and learning performance and finally the pedagogical approaches that the teachers find with cooperative teaching-learning to facilitate students' better learning outcomes through better active engagement and critical thinking. Hence, the study investigated both students and teachers' experiences by adopting a well cited research methodology from March 2020 to February 2021.

Research Methodology

Shifting students from mostly practiced traditional lecture centered passive learning to small-group work based cooperative learning settings needed first to redesign instructional approaches. The virtual class settings were considered also during setting as well as fine tuning the data collection instruments towards addressing the research questions, aims, and objectives. In such case, the study was considered as a single case study on the undergraduates of honour's 3rd and 4th year students at the department of Zoology of the college where the author used to teach (Yin, 2009; Cited in Cohen, Manion, and Morrison, 2011). Considering various research paradigms, like the ideas of positivist versus post positivist (anti positivism), quantitative versus qualitative, or mixed method, the study based its design on a qualitative approach to offer the best attributes of consolidating the required data. This helped availing a generalized end to investigating into the research problem (Cohen, Manion, and Morrison, 2017). That the research-probe in the work should go beneath the surface of the learning participants' perceptions and experiences with the intervening learning strategy (cooperative learning, which is intangible otherwise), and that it needed to examine two learning constructs (active learning engagement and critical thinking), an experience and performance based methodology was deemed to give the best result in the given situation (Cohen, Manion, and Morrison, 2011). To gain overall picture of the learning intervention through fine grained analysis of data, the questionnaire and interview schedule were designed by focusing on the participants' attitudes, behavior, and the artifacts developed in the whole process of the study. In addition, before deciding on adopting qualitative method single case study, surveys, experimental studies, and action research were considered. But the research context: undergraduate zoology teaching-learning in Bangladesh college education, and constructs: student active engagement and critical thinking apparently suited best into a case study design with questionnaire and interview for the students and teachers respectively (Yin, 2009; cited in Cohen, Manion, and Morrison, 2011). The threat of researcher biasness in a qualitative research from its needs of suitable theoretical or paradigmal basis was also checked by refining the asking statement (Gorard & Smith, 2006, Maxwell, 2005; cited in Cohen, Manion, and Morrison, 2017). This was another point for qualitative method to be decided for the study so that confirmatory and exploratory research on the constructs could be combined against the research questions (Onwuegbuzie & Leech, 2005). The method included some basic qualitative questions (What, How, Why, etc.) to cover both implicit and explicit causal factors behind an outcome and a lot of useful light could be shed on a simple statistics (Cohen, Manion, & Morrison, 2011). The study purposed to portray, analyze, and interpret the uniqueness of the students and the study setting (situation) through in-depth, detailed, and accessible data

being subjective and objective to some extent. Thus, the data were analyzed descriptively, not inferentially to contribute to action and intervention, to grasp the complexity of behavior with a sense of being in reality in a single institutional instance, un-researched otherwise to date (Cohen, Manion, and Morrison, 2011; Yin, 2009). Hence, the style of study in this work turned a case study that investigated a case in a single context with a unique example of real people in real situations with many potential variables operating in a way encompassing extensively qualitative data that obviously has given it a prototypical instance of an ideal qualitative method research.

Research population and method of sampling

The department of Zoology of the study college comprised 160 undergraduate (Honour's) students in a 4 year course. Enrolled sample student number in 3rd year and 4th year was 30 apiece. For understanding the cooperative teaching learning experience, students of the 1st and 2nd year were considered to lack investigative and critical mood of their learning practices as they are taught mostly the descriptive courses then. But in the upper two years (3rd and 4th year), students need to embark on various analytical and critical thinking learning topics. So, the sampling of the students has been of non-probability purposive type (Cohen, Manion, and Morrison, 2011). All of the students in the two classes (3rd year and 4th year) were invited to join the virtual cooperative classes irrespective of age, gender, or any other socio-demographic identities that they had experiences on many occasions of doing in-person cooperative classes, both theory and laboratory ones before the prevailing Covid pandemic situation. The sampling for the total 60 senior undergraduates turned simple random type (Cohen, Manion, and Morrison, 2011) as only those who joined the on-line classes willingly were administered the questionnaires. Anyway, the concern of students' poor participation with an obviously new learning experience apparently got resolved whilst the participating students were given regular on-line classes in the pandemic situation. Besides, the cooperative learning setting was in action just by replacing the traditional lecture-centered classes. Initial motivation and encouragement along with small group formation in structured and heterogeneous form with necessary instructions were maintained before assigning the learning groups with problems. Moreover, teacher input and interference during the ongoing group works was maintained so that all the participants could make their best efforts in group works and fill the questionnaires as a part of their own learning responsibility. For interview schedule, the respondent teachers were selected in a non-probability convenient style. They all were the colleagues of the author (the researcher) of this essay and had experience of instructing cooperative learning classes in zoology at the college in different periods of their teaching profession.

Instructional approach

A time bound and unit wise instruction was given to guide in-group problem solving and implement student–centered pedagogy (Tadesse & Gillies, 2015). The 5-7 minute instruction in each setting was followed by assigning each group with predefined learning problems. The questionnaires required words, opinion, facts, and illumination on some specific issues of cooperative teaching-learning that was addressed by direct communication with the respondents (Cohen, Manion, and Morrison, 2011). Given this, the virtual classes were made student-centered through adopting a number of measures: enumerating unit wise learning topic with learning objective and goals, forming student groups of four in the first class, and instructing for small-group assignments along the whole data collection period (November 2020 to May 2021) of the study (Tadesse & Gillies, 2015). Every group was asked to choose one assignment topic from a list of titles as their group assignment (project). Every group needed to engage into the problem based group works and present that in the next scheduled classes with defending their works in a question-answer sub-session. The presentations in most cases were supported with power point slides while inter group quiz and critical inquiries into one group's performance by other groups went on. The teacher input in such cases was limited to designing critical learning problems, facilitating students' access to learning resources, and probing, correcting, and motivating the students for their increased attention and active engagement.

Method of data collection

The research questions were operationalized in a way to facilitate data collation through a semi-structured questionnaire for the respondent students, and a semi-structured interview schedule for the respondent

teachers. All the students got seven common virtual classes on animal physiology in cooperative group works before being asked to fill the interview questionnaires individually that they got online through e-mail, and returned the filled copy as their reply mails (Lodico, Spaulding, & Voegtle, 2010). Students were allowed to write the open-ended question-answers in their mother tongue, Bangla that was then translated into English by the researcher. Besides, interview schedule for the selected teachers was maintained on mutual agreement. The teacher-interview session was over phone and/or on video call through messenger and WhatsApp in Bangla that was then transcribed into English by the researcher.

Data organization, analysis, and presentation

The data analysis required a sequence of steps to be followed. Firstly, collating the questionnaire data in a simple grid from a simple categorizing and/or thematizing being designed carefully underpinning the research questions. The responses to a particular close ended question were tallied against the concerned level (point or grade) on the ranking and rating scales (Likert scale). Then all the responses were summarized through translating the tallies into the numbers and then tabulated in a proper sequence and order for descriptive data analysis through measuring frequency mean, standard deviation (SD), and coefficient of variance (CV) of the frequency distributions. Moreover, the data were summarized and directed towards a question-answer fashion through content analysis followed by the approaches for classifying, categorizing or extracting themes of the thoroughly reviewed open-ended question-answers into a succinct set of broad categories. Such broad categories then were ordered, counted for frequency, and tabulated under specific title or hook for a specific research question. At this point, the findings were tabulated showing the frequencies of the categorized themes and the classified responses as well. To say, all the data from the two instruments were organized, analyzed, and presented in tabulated forms along with relevant graphs followed after the required summary reporting in texts (Cohen, Manion, and Morrison, 2011). Data analysis was based on non-parametric data, i.e. nominal (categorical) and ordinal data, and the qualitative data. MS-Excel was used to arrange and analyze the data and to count and construct the required tables and graphs. The analytical statistics were not inferential but descriptive so that frequencies, percentages, cross tabulations, mean, minimum and maximum scores, and SD, and CV were computed for better interpretation and clear decision on the findings.

FINDINGS

Student view on benefits of cooperative learning

All participating students shared their perceptions and experiences on the benefits of cooperative learning. Of the eight benefits, better learning performance, e.g. *"I understood animal physiology better through hearing explanation to my questions several times in group discussion"* appeared with the highest frequency (27%) followed by active learning engagement (22%), better motivation (12%), better confidence (10%), better critical thinking (8%), peer sharing (8%), alternative ways of solution (8%), and better peer teaching (6%) (Figure-1)

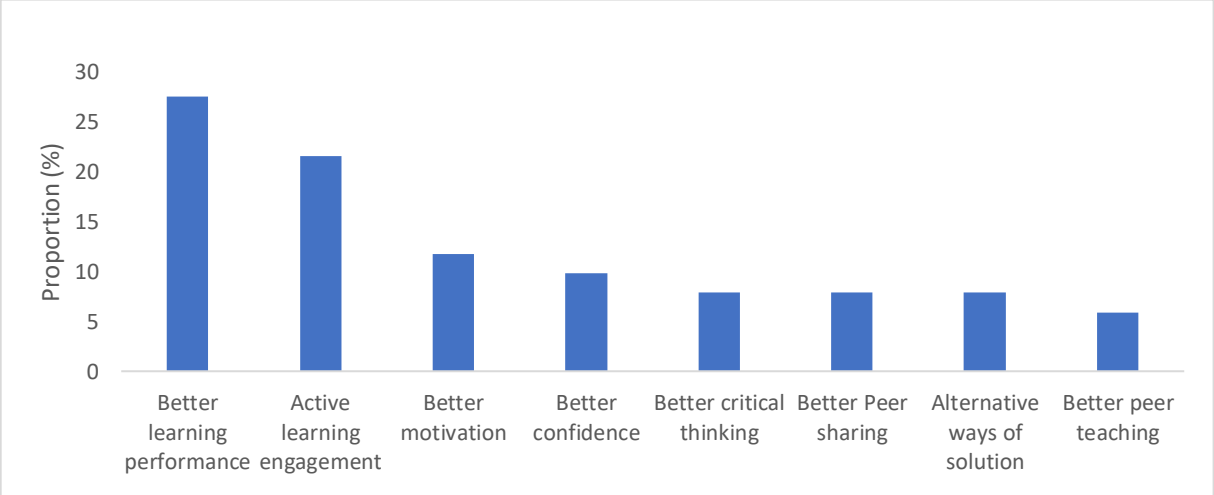

Figure-1. Student perceptions on benefits of cooperative learning

Teacher view on benefits of cooperative learning

All the respondent teachers shared their perceptions on the benefits of cooperative learning. Of the seven benefits, group work based active learning, e.g. *"Students find their group works to fit for their active engagement as they enjoy more freedom"* was with the highest frequency (25%) followed by better critical thinking (17%), less teacher input (12.50%), shared learning responsibilities (12.50%), alternative ways of solution (12.50%), Better communication skills (12.50), and teachers' enough time for designing learning problem (8%) (Figure-2)

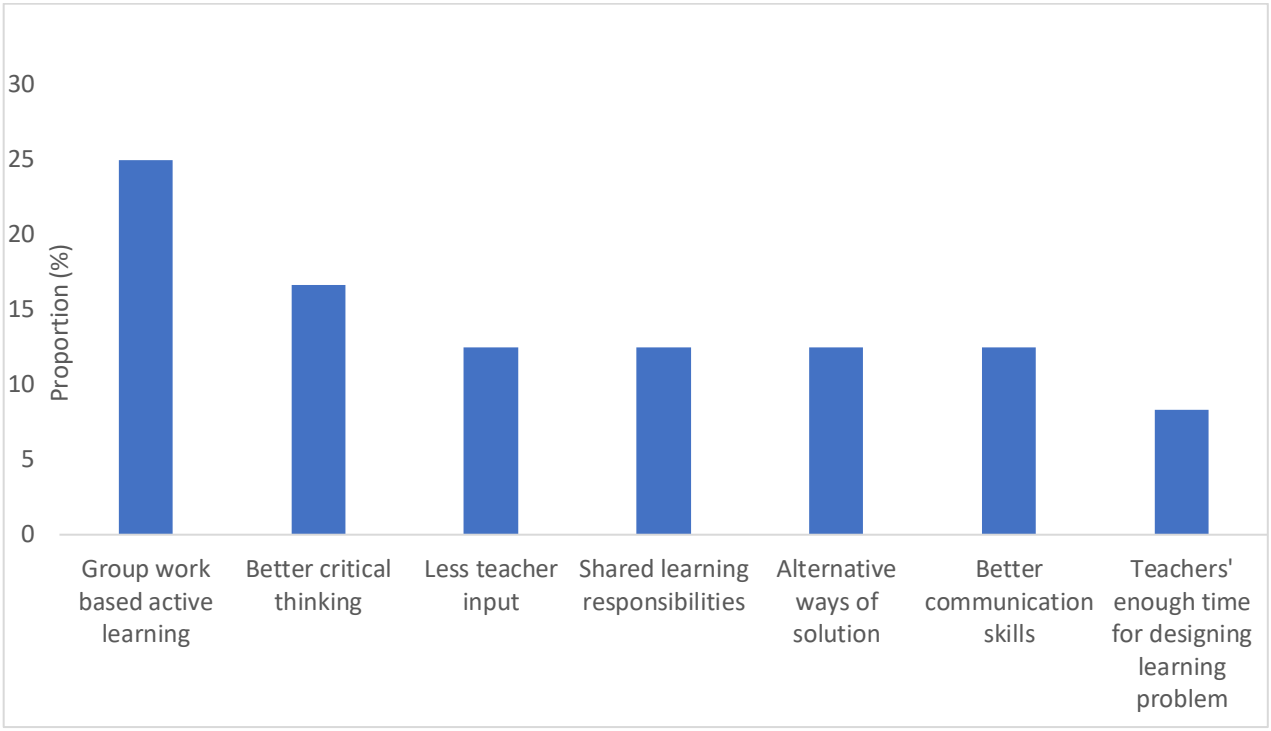

Figure-2. Teacher perceptions on benefits of cooperative learning

Student view on challenges of cooperative learning

All the respondent students shared their views on the challenges of cooperative learning. Of the eleven challenges, ensuring equal and active peer engagement and cooperation was with the highest frequency (17%), e.g. *"In many instances I did not get frank and equal cooperation from some of my team mates"* followed jointly by 'ensuring sound virtual meeting'(15%) and 'individual learning responsibility'(15%), ensuring 'critical thinking based problems'(13%), 'group learning responsibility'(11%), 'equal access to learning resources'(9%), 'overcoming inter-personal and cultural distance'(6%), 'managing teamwork'(6%), 'proper access to teacher input'(4%), 'proper time management'(4%), and 'maintaining self-motivation in adverse situation' (2%) (Table-1)

Table-1 Student perceptions on challenges of cooperative learning

SL. No	Theme	Frequency (n)	Proportion (%)
1	Ensuring active engagement and cooperation	9	17
2	Ensuring sound virtual class	8	15
3	Ensuring individual learning responsibility	8	15
4	Ensuring critical thinking based problems	7	13
5	Ensuring group learning responsibility	6	11
6	Ensuring equal access to learning resources	5	9
7	Overcoming inter-personal and cultural distance	3	6
8	Managing team work	3	6
9	Ensuring proper access to teacher input	2	4

10	Ensuring proper time management	2	4
11	Maintaining self-motivation in adverse situation	1	2
	Total idea	11	100
	Total response/answers	54	100
	Total respondent	36	100

Teacher view on challenges of cooperative learning

All the respondent teachers shared their views on the challenges of cooperative learning. Of the five challenges, 'ensuring adequate learning resources' was with the highest frequency (25%), e.g. *"Our departmental library is not rich enough and students do not get necessary books, papers, etc. on many occasions"* followed jointly by ensuring 'teachers' training and skills'(21%), and 'active peer engagement'(21%), 'students' equal access to learning resources'(18%), and 'adapting cooperative learning into curriculum/coursework'(14%) (Table-2).

Table-2. Teacher perceptions on challenges of cooperative learning

SL. No	Theme	Frequency (n)	Proportion (%)
1	Ensuring adequate resources	7	25
2	Ensuring training and skills	6	21
3	Ensuring active peer engagement	6	21
4	Ensuring equal student access to learning resources	5	18
5	Adapting cooperative learning into curriculum	4	14
	Total response	28	100
	Total idea	5	100
	Total respondent	8	100

Student view on their equal and active engagement in cooperative learning

On the five points Likert scale (ranking scale-1, Table-3), 30 (83%) respondents were on agree or strongly agree views with regard to their cooperative learning setting's roles to help them engage actively while only one (3%) opted for disagree and 5 (14%) picked neutral position to the relevant statement-1 (SD, 24.64, CV, 1.23). In response to statement-2 on the same scale, no one disagreed but 2 (6%), 18 (50%), and 16 (44%) students opted respectively for neutral, agree, and strongly agree (SD, 25.03, CV, 1.25). Again, on rating scale-1 (Table-3), 18 (50%) respondents rated 4 or 5, and 10 (27%) marked 3 i.e. the mean point with regard to the learning setting's capability to engage them equally and actively (SD, 14.88; CV, 1.26) while 23 (63%) rated their extent of active engagement in the cooperative learning situation as 4 or 5 with SD, 8.00 and CV, 0.80 of the frequency distribution on the scale.

In open-ended question-answer, 30 (83%) answered Yes, e.g. *"Our group project won the best assignment status as each member in my group took it seriously for giving her best to the project"* while 3(8%) answered No, e.g. *"I could not participate in the group activities properly as I missed clear answer to some of my questions and some members in my group did not attend scheduled classes also"*, and 3 (8.33%) did not respond to the asking of whether the learning setting helped them engage equally and actively in problem solving (Figure-3.1). Among Yes answers, peer sharing (27%) and group discussion (24%) dominated while peer non-cooperation (6%) dominated the instances for 'No answers (Figure-3.2).

Table-3. Summary of student perceptions in relation to their equal and active engagement in cooperative learning from close-ended questions

Ranking Scale-1	Statement	Strongly disagree, n/%	Disagree, n/%	Neutral, n/%	Agree, n/%	Strongly agree, n/%	Total agree and strongly agree, N/%	Mean (%)	Standard Deviation (SD)	Coefficient of variance (CV)
1	Group work based learning settings helped me participate with my peers in problem solving equally and actively	0/0	1/ 3	5/14	22/61	8/22	30/83	20	25	1.23
2	Group presentation of the task helped us to engage actively in the learning activities	0/0.0	0/0.0	2/6	18/50	16/44	34/94	20	25	1.25
Rating scale-1	Statement	1 (Lowest), n/ (%)	2, n/ (%)	3, n/ (%)	4, n/ (%)	5 (Highest), n/ (%)	Total rating on 4 and 5, N/ (%)	Mean (%)	Standard Deviation	Coefficient of variance
1	The learning setting‘s capability to engage us equally and actively in learning process was..	2/6	6/17	10/28	15/42	3/8	18/50	12	15	1.26
2	The extent to which I could engage myself actively in the new learning situation was?	1/ 3	4/11	8/22	19/53	4/11	23/64	10	8.00	0.80

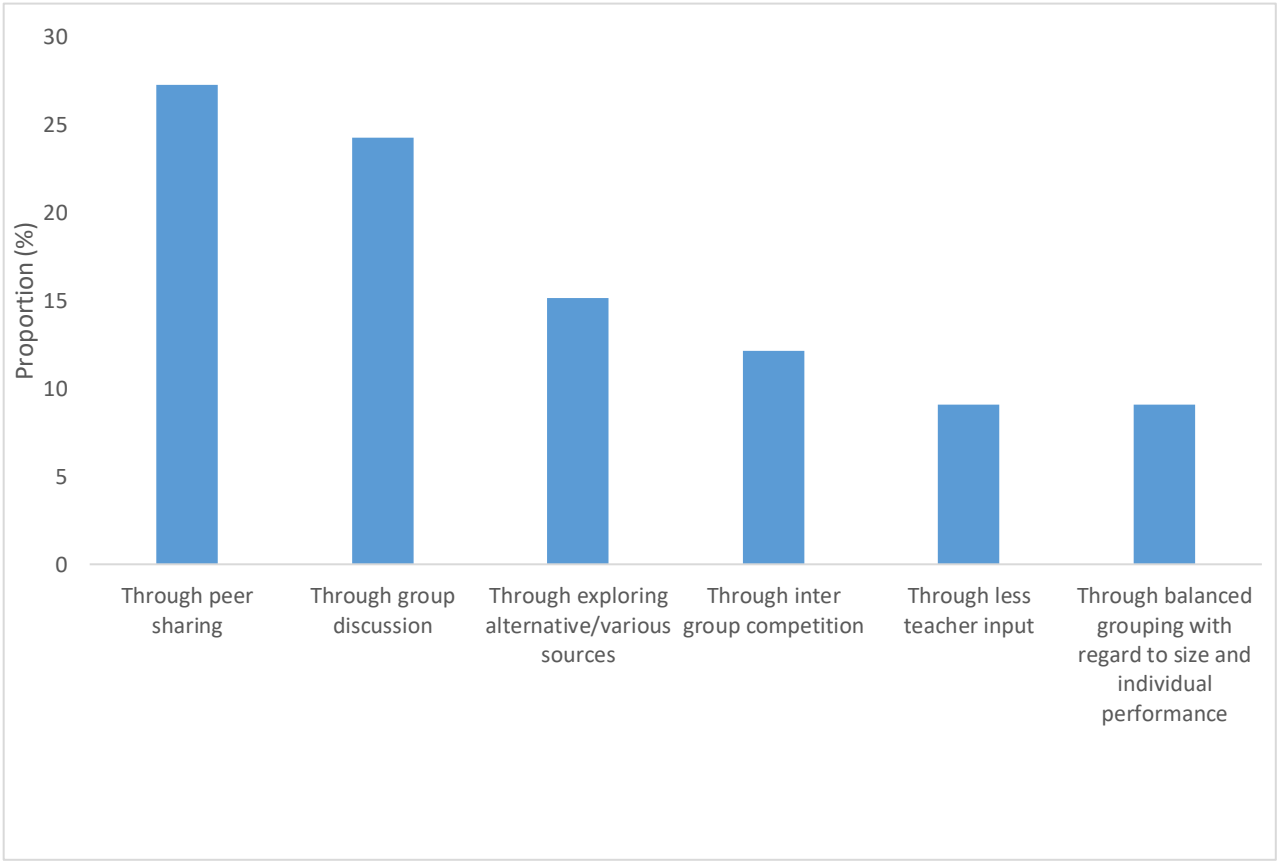

Figure-3.1 Summary of student perceptions from open ended questions on the ways that the cooperative learning setting helped them engage equally and actively

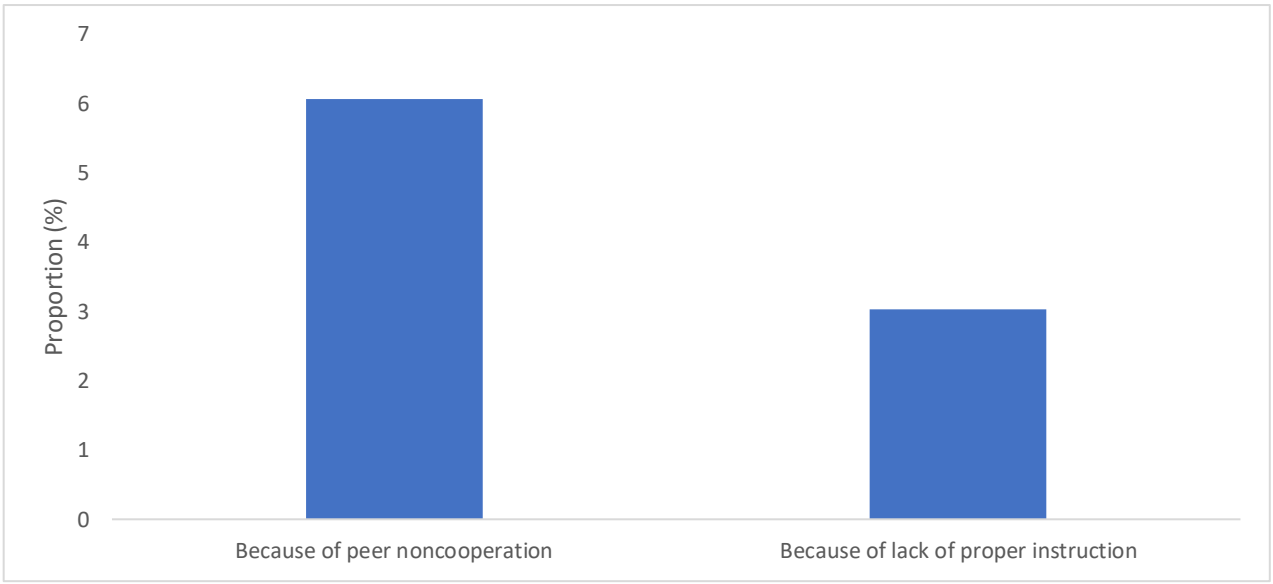

Figure-3.2. Summary of student perceptions from open ended questions on the causes that the cooperative learning setting did not allow them engage equally and actively

Teacher view on students' equal and active engagement in cooperative learning

Teachers' positive perceptions of cooperative learning with regard to students' equal and active engagement included five ideas of how cooperative learning could help students maintain equal and active engagement. Among the ideas, the provision of 'announcing project works and assignment at the beginning of a session dominated' (27.50%) followed jointly by 'learning problems inviting alternative ways of solution', 'split assignment questions for individual roles', 'linking group assessment with individual performance', and 'forming heterogeneous groups including 'poor', 'medium' and 'strong' performing students' with 18% frequency each (Table-4).

Table-4 Summary of teacher perceptions in relation to students' equal and active engagement in cooperative learning

SL. No	Theme	N	Proportion (%)
1	Inclusion of small-group projects, assignment into curriculum/coursework and announcing to the beginning of session	3	27.50
2	Learning problems inviting multiple thoughts and alternatives forms of solution	2	18
3	Assignment with splitted questions helps group members to decide on individual roles	2	18
4	Linking group assessment with individual performance motivates peer interactions and sharing	2	18
5	Forming groups by accommodating 'poor', 'medium', and 'strong' performing students leads to active engagement	2	18
	Total response	11	100
	Total idea	5	

Student views on the enhancement of their learning performance in cooperative learning

On the five points ranking scale-1 (Table-5.1), 5 (14%) respondents ranked their pre-existing level of knowledge or skills as very good or excellent at start of cooperative learning class (SD, 18.15; CV, 0.91) while at the end of the classes, 31 (86%) respondents ranked their level of knowledge or skill to rise to 'very good' or 'excellent' marks (SD, 23.52; CV, 1.18) so that 20 (56%) respondents ranked contribution of the group works to be either very good or excellent (SD, 19.19; CV, 0.96). Moreover, in an attempt to rate the role of small group based learning problems for engaging students actively in exploring alternative solutions in their course,

15 (42%) respondents answered very good, 5 (14%) answered excellent, 14 (38.89%) answered satisfactory, and 2 (5.56%) picked fair with nil in poor option (SD, 19.19; CV, 0.96). In another Likert scale (Ranking scale-2, Table- 5), 32 (89%) respondents strongly agreed or agreed on the better roles of cooperative learning on promoting their learning ability compared **to** the traditional lecture method (SD, 23.11; CV, 1.16) whereas 29 (80.50%) respondents were found under the ranks of agree or strongly agree that the group work based learning experience provided them better learning performance (SD, 22.86; CV, 1.14). To add, 97% agreed or strongly agreed that they enjoyed group work based classes more than the lecture classes so that 94% fell under agreed and strongly agreed levels with regard to their enhanced interest to attend the cooperative classes (SD, 25.26; CV, 1.25). The 5 points rating scale-1 on the same table unveiled 18 (50%) and 3 (8%) respondents to rate 4 and 5 (highest) respectively to the ability of problem solving approaches in cooperative learning to enhance their motivation for better learning performance (SD, 19.19; CV, 0.96) whilst the enhancement of learning performance and learning enjoyment were rated with 21 (58%) and 33 (92%) respectively to the highest level of the scale- 4 and 5 marks.

In open-ended question-answer 28 students replied 'Yes' to the asking of whether their learning performance enhanced in the cooperative setting while 8 students did not reply. Of the 28 respondents a total of 7 ideas came out: 'enhanced active engagement'(29%), e.g. *"I could solve many problems myself after an open group discussion first in my class",* 'enhanced understanding'(25%), 'critical thinking'(14%), e.g. "*I could label and explain different endocrine glands and how do they work after investigating a number of labeled diagrams on vertebrate endocrine systems in groups"*, 'peer sharing'(11%), 'oral communication'(7%), and 'better performance with less teacher input'(4%) (Figure-4).

Table-5. Summary of the students' perceptions on the enhancement of their learning performance in cooperative learning from close-ended questions

	Close ended question-answers									
Ranking Scale-1	Statement	Poor, n/ (%)	Fair, n/ (%)	Satisfactory, n/ (%)	Very good, n/ (%)	Excellent, n/ (%)	Total very good and Excellent, N/	Mean (%)	Standard Deviation	Coefficient of variance
1	Level of my skill/knowledge at start of class	4/11	17/47	10/28	5/14	0/0	5/14	20	18	0.91
2	Level of my skill/knowledge at end of class	0/0	0/0	5/14	20/56	11/31	31/86	20	24	1.18
3	Contribution of group works to my skill/knowledge	0/0	2/6	14/39	15/42	5/14	20/56	20	19	0.96
4	The small-group learning setting of small problems helped me explore beyond class room with many alternative solution paths.	0/0	2/6	14/39	15/42	5/14	20/56	20	19	0.96
Ranking Scale-2	Statement	Strongly disagree, n/(%)	Disagree, n/(%)	Neutral, n/(%)	Agree, n/(%)	Strongly agree, n/(%)	Total agree and strongly agree, N/(%)	Mean (%)	Standard Deviation	Coefficient of variance
1	The learning setting enhanced my learning ability better than the traditional lecture classes	0/0	0/0	4/11	18/50	14/39	32/89	20	23.11	1.16
2	My learning performance enhanced during the group works	0/0	0/0	7/19	20/56	9/25	29/81	20	23	1.14
3	I enjoyed the group work based cooperative classes better than the lecture centered traditional classes	0/0	0/0	1/3	20/56	15/42	35/97	20	26.61	1.33
4	The study setting enhanced my interest to attend the cooperative type classes	0/0	0/0	2/6	19/53	15/42	34/94	20	25	1.26

Rating scale-1	Statement	1 (Lowest), n /%	2, n/(%)	3, n/(%)	4, n/(%)	5 (Highest), n/%	Total rating on 4 and 5, N/ (%)	Mean (%)	Standard Deviation	Coefficient of variance
1	The problem solving approaches in group works enhanced my motivation for better learning performance	1/3	4/11	10/28	18/50	3/8	21/58	20	19	0.96
2	My learning performance enhanced during group activities?	1/3	4/11	10/28	16/44	5/14	21/58	20	16	0.82
3	My learning enjoyment increased with peer teaching-learning	0/0	0/0	3/8	18/50	15/42	33/92	20	24	1.20

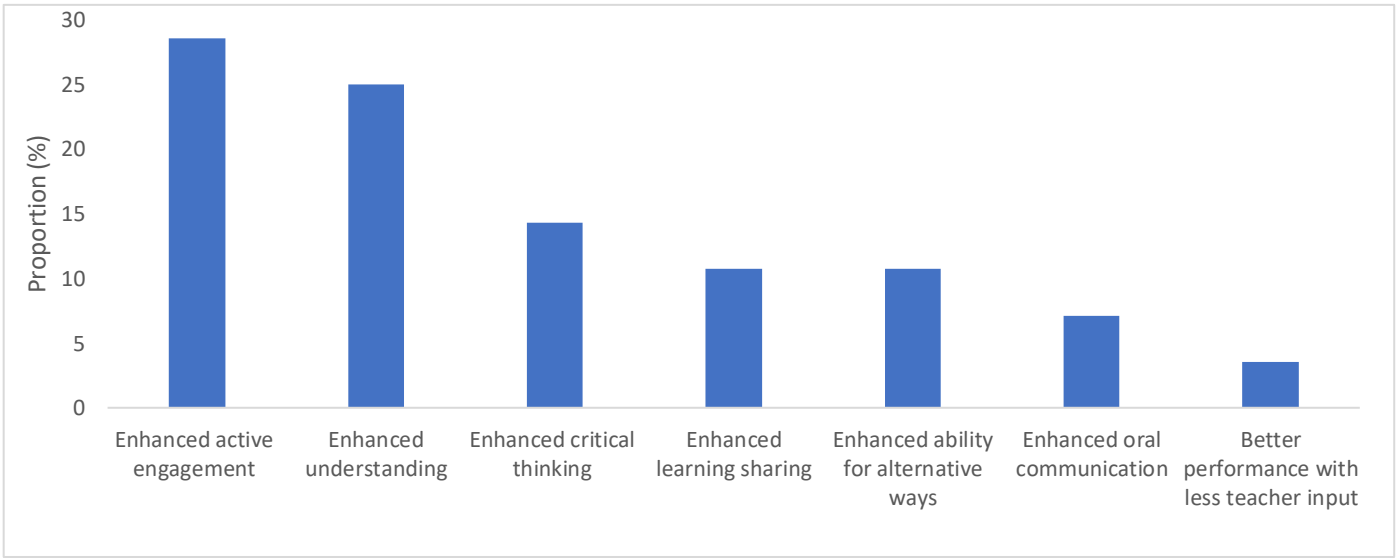

Figure-4. Students' positive perceptions on their learning performance in cooperative learning

Teacher view on the enhancement of students' learning performance in cooperative learning

All of the 8 respondent teachers (100%) opined positive for increased student learning performance in cooperative learning. The teachers' perceptions included 6 ideas: 'motivation for active engagement' (36%), 'motivation for in-group performance' (21%), 'self-confidence and sense of independence' (14%), 'learning with less teacher input' (14%), 'developing leadership quality' (7%), and 'motivation for peer sharing' (7%) (Figure-5).

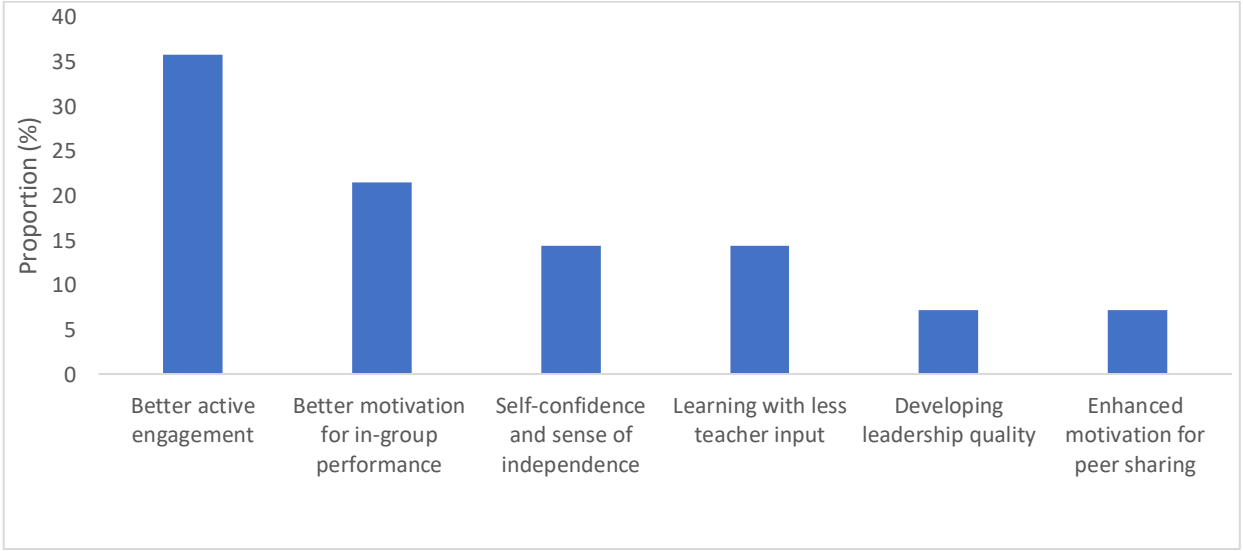

Figure-5. Teachers' positive perceptions on students' learning performance in cooperative learning

Student view on the promotion of their critical thinking in cooperative learning

All the participant students responded to the statements in Table-6. On the five points ranking scale-1, 2 (6%) respondents kept neutral on whether they could develop critical thinking in cooperative learning while total 34 (94%) either agreed or strongly agreed that they could think critically in the given cooperative learning setting (SD, 25.03; CV, 1.25). Again the ability in-group works to promote students' better explaining and understanding was either agreed or strongly agreed by 30 (83%) out of 36 respondents (SD, 21.28; CV, 1.06) along with their enhanced ability to follow inquisitive pathways in group works through the use of 'why', 'how', etc. (N, 86%. CV-1.26), Moreover, 22 (61%) respondents ranked their promotion of inquisitive and analytical thoughts from participating in the cooperative learning on agree and/or strongly agree levels while only 1(3%) and 4 (11%) perceived strongly disagree and disagree levels respectively (SD, 18.57; CV, 0.93). In the same table in response to the open ended question-1, 22 (61%) students opined positively that the cooperative learning has promoted their critical thinking. To support their answer the respondents mentioned 5 instances: enhanced abilities to 'compare and contrast' (32%), 'better self-explanation' (23%), 'analyze and synthesize' (18%), 'defend group works' (18%), and 'criticizing individual role' (9%) (Figure-6).

Table-6 Summary of the students' perceptions on promotion of their critical thinking in cooperative learning from close-ended questions

Close ended question-answers										
Ranking Scale-1	Statement	Strongly disagree, n/(%)	Disagree, n/(%)	Neutral, n/(%)	Agree, n/(%)	Strongly agree, n/(%)	Agree and strongly agree, N/(%)	Mean (%)	Standard Deviation	Coefficient of variance
1	I could think critically in the learning setting	0/0	0/0	2/56	16/44	18/50	34/94	20	25	1.25
2	In-group works could promote my ability to explain and elaborate my understanding	0/0	0/0	6/17	13/36	17/47	30/83	20	21	1.06
3	I could better use 'which', 'why', 'how', 'so what' type asking in group discussion	0/0	0/0	5/14	22/61	09/25	31/86	20	25	1.26
4	Participation in the new learning setting promoted my inquisitive and analytical thoughts	1/3	4/11	9/25	18/50	4/11	22/61	20	19	0.93

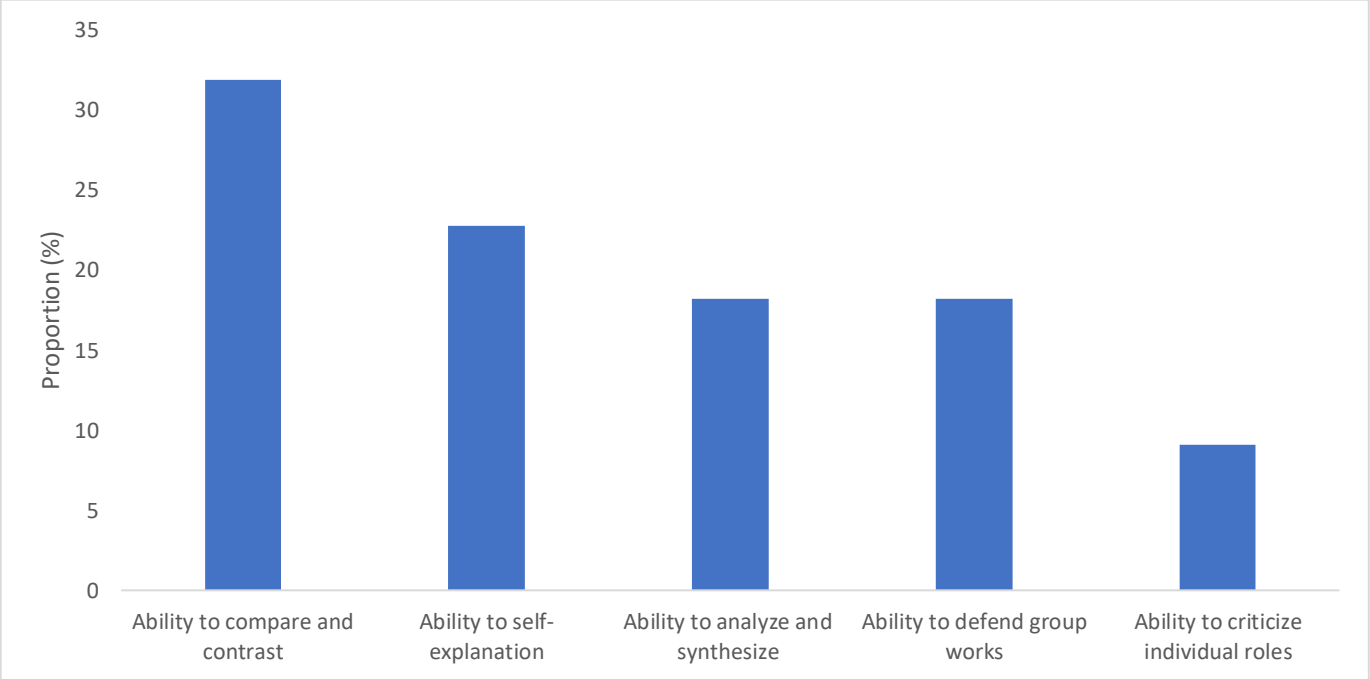

Figure-6 Students' positive perceptions on enhancement of their critical thinking in cooperative learning

Student view on teachers' instructional roles in promoting their equal and active engagement, and critical thinking in cooperative learning

On the five points ranking scale-1 (Table-7), 12 (33%) respondents ranked their teachers' instructional inputs, like probes, prompts, and quizzes on promoting their equal and active engagement in cooperative learning very good or excellent while 2 (56%), 10 (28%), and 12 (33%) students ranked that poor, fair, and satisfactory respectively (SD, 12.33, and CV, 0.62) indicating that the perceptions centered around the average or satisfactory rank, and the difference between the frequencies of the positive and negative views potentially stood little. In addition to weighing teachers' instructional roles on their active engagement, all students (100%) also ranked the teachers' instructional roles that helped them develop critical thinking in group works (Figure-7). Accordingly, total 8 (22%) students marked it as either very good or excellent while 11 (31%), 13 (36%), and 4 (11%) fell under satisfactory, fair, and poor ranks respectively (SD, 12.94; CV, 0.65). This also indicated maximum views to lie centered round the mean with potentially even proportions on both sides (upper and lower) of the frequency distribution.

Table-7 Summary of the students' perceptions from close ended questions on teachers' instructional roles in promoting their equal and active engagement and critical thinking in cooperative learning

Ranking Scale	Statement	Poor, n/ (%)	Fair, n/ (%)	Satisfactory, n/ (%)	Very good, n/ (%)	Excellent, n/ (%)	Very good and Excellent,	Mean (%)	Standard Deviation	Coefficient of variance
1	The role of teachers' instructions (e.g. probes, prompts, and quizzes) for enhancing my equal and active engagement in group works	2/6	10/28	12/33	9/25	3/8	12/33	20	12	0.62
2	Teacher's instructional interference and inputs that helped me think critically during group works	4/11	13/36	11/31	6/17	2/6	8/22	20	13	0.65

Teacher view on the promotion of students' critical thinking in cooperative learning

All of the 8 respondent teachers (100%) opined positive for students' increased critical thinking in cooperative learning. The teachers' perceptions led jointly by 'enhanced ability to analyze and synthesis, and explain (n, 4; 31% apiece) were followed by better abilities for comparing and contrasting and criticizing individual roles (frequency, 15% apiece), and ability to explain in students' own words (8%) (Figure-7)

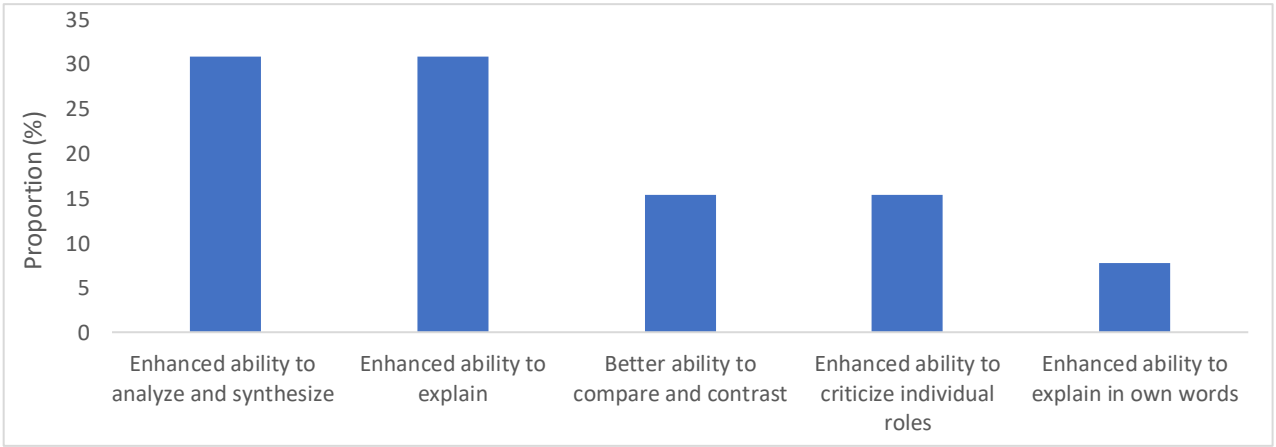

Figure-7. Teachers' positive perceptions on enhancement of students' critical thinking

The pedagogical elements that are beneficial for students' motivation and active engagement in cooperative learning

All respondent teachers shared their views of pedagogical elements that they think to benefit students' motivation and active engagement in cooperative learning. The teachers' perceptions to this end gave eight

pedagogical ideas: 'ensuring equal access to adequate learning resources' (22%), 'ice breaking with informing the class learning goals and done and to be done'(17%), 'group performance based assessment' (17%), 'linking group performance to final assessment', 'continuous motivation through assertion', 'instructions and linking individual performance with group performance' (11%, each), 'student-student and student-teacher interactions' (6%), and 'flexibility into learning tasks and schedules' (5.56%) (Table-8)

Table-8 Summary of the pedagogical elements that are beneficial for students' motivation and active engagement in cooperative learning

Themes of the pedagogical elements for student motivation and active engagement	Frequency (n)	Proportion (%)
Equal access to adequate learning resources	4	22
Ice breaking with informing the class about learning goals, done and to be done, etc.	3	17
Group performance based assessment	3	17
Links of the group learning problems to final assessment	2	11
Continuous motivation for cooperative tasks through assertion and instructions	2	11
Linking individual performance with group performance	2	11
Face to face S-S and S-T interactions for active engagement	1	6
Flexibility into learning tasks and schedules for better engagement	1	6
Total responses/answers	18	100
Total respondents	8	
Total idea	9	

The pedagogical elements that are beneficial to the development of students' critical thinking in cooperative learning

All respondent teachers (100%) shared their views of pedagogical elements that could benefit the development of students' critical thinking in cooperative learning. The teachers' perceptions included nine ideas: 'motivating students for new and alternative ways of learning' (19%), 'asking for students' informal exploring'(12.50%), 'using probes and prompts', 'asking student for group presentation and defense', 'presenting learning goals and key terms and process' (12.50 %, each), asking for 'students' critical inquiry' (6%), 'formulating hypothesis in comparative studies' (6%), and 'inter group question-answer' (6%) (Table-9)

Table-9 Summary of the pedagogical elements that are beneficial to the development of students' critical thinking in cooperative learning

Transcribed themes of the pedagogical elements for student critical thinking	Frequency(n)	Proportion (%)
Motivation for new and alternative ways of learning	3	19
Asking for students' informal exploring during learning	2	12.50
Asking through probes and prompts	2	12.50
Asking students for a pause and think approach towards critical thinking	2	12.50
Asking students for group presentation and defense	2	12.50
Presenting learning objectives and key terms and process for students' group	2	12.50
Asking students to try their ideas in a critical way	1	6
Asking students to formulate hypothesis in comparative studies	1	6
Asking for intergroup question answers	1	6
Total responses/answers	16	100
Total respondents	8	100
Total idea	9	100

Thus, all of the research questions and their answers were explored before describing them critically in a broader context of relevant studies, implications, and the inferences.

DISCUSSION

Perceptions on benefits and challenges of cooperative learning in undergraduate zoology

A bunch of benefits and challenges of cooperative learning was shared by the students and teachers in this study. Students' comments centered on the idea of learning and understanding more in an easier way being summarized as 'better learning performance' followed by 'active learning engagement', e.g. *"Many times I started to share my views first before my peers in resolving a puzzle"*, 'better motivation', 'having more confidence', 'better critical thinking', e.g. *"I could label the blood circulation pathways with more accuracy in explaining cardiac cycle compared to lecture centered classes"*, 'ability to follow alternative ways of solutions', and friendly 'peer teaching', e.g. *"Many of my classmates shared their ideas with me which I missed before in group discussion"*. The relative percentages of the benefits (Figure-1) have made it clear that the small group-work based learning settings succeeded to create a number of basic positive outcomes of cooperative learning supporting many relevant studies (Donham *et al*., 2001; Johnson and Johnson, 2000; Shipman & Duch, 2001; Slavin, 2012). Teachers' perceptions to this context went along a similar path of common experiences. They provided seven ideas in which 'students' group work based active learning' became the most frequent followed by students' enhanced critical thinking and others including 'more time for instructional design by the teachers'. Teachers' view in this respect could be attributed to that of their students that small group works engage students engage actively with more enthusiasm as one respondent teacher opined, *"I find it very effective when my students get freedom to think with less concern but more interest in their group works that they take not as obligation but a good social interactions on some common goals and targets, which are not strictly time bound rather flexible relying on their choice and ways"*. This is reflected in Gillies (2016) that emphasized cognitive development through exchanging information for analysis and synthesis in cooperative group works. Therefore, teachers' perceptions in this work aligned with that of students' perceptions regarding the benefits of better active engagement, critical thinking, and peer sharing, alternative ways of solution, and positive attitudes to learning in groups. Apart from this, the challenges with cooperative learning as viewed by the respondents overlapped between the students and teachers in many instances and are well cited also (Eisen, 1996; Lord, 1998; Tanner, Chatman, & Allen, 2003). Accordingly, the challenge of maintaining active peer engagement (Colak, 2015; Prosser & Trigwell, 2014; Tanner, Chatman, & Allen, 2003; Johnson & Johnson, 2009) arguably elicited the weakness to the overall learning settings in this study since managing students' equal access to learning resources is crucial to facilitate effective and participatory group works. Again, 'maintaining sound virtual meeting' is built on the very fact of the extra ordinary adverse situation of Covid pandemic that the study's data collection went through and hence, could be considered rather a partial experience while students shared their experience in context to not the pre-pandemic situation but within its adversities. This clearly corresponds with Tanner, Chatman, & Allen (2003) who emphasized on the provision of a pro-student, friendly, and well equipped classroom setting for cooperative learning in any case. Besides, the challenges from teacher points of view, like ensuring teachers' training and skills (Chalmers & Gariner, 2015; Eisen, 1996; Tanner, Chatman, & Allen, 2003; Umar, 2011), motivating teachers and students for a positive attitude (Biggs & Tang, 2011), students access to learning resources, and adapting the learning method into curriculum (Nolinske & Millis, 1999) stood mutually complementary between the students and teachers as well grounded in relevant literature also (Loh & Ang, 2020). What can be corroborated is that both the teachers and students in the present work shared and expressed some common generic issues of benefits and challenge in cooperative learning reflecting mutually inclusive and complementary learning experience relation of the two stakeholders of learning in a functional learning environment (Slavin, 1995). In such case, teachers play the role of the facilitator or service provider and students, constructors of learning (Tan, Sharan & Lee, 2006). Moreover, all the benefits and challenges as mentioned underpinned students' motivation for active engagement and self-dependence that definitely can operate in a critical approach to problem solution in group works (Tanner, Chatman, & Allen, 2003). Therefore, the mutually agreeing common benefits and challenges of cooperative learning in the present work stand for a cohesive and coherent active learning engagement of the students in context to institution, subject, and the inquisitive learning settings that can contribute to enhancing the overall student learning outcomes as explored further in the following section.

Cooperative learning promotes student outcomes in under graduate zoology classes

Student outcomes in this study comprised students' performance with their active engagement and critical thinking constructs that were expected to be operated through proper instructional guidance and student motivation. The implications with the two constructs were also considered as the basic elements in the cooperative learning experience that the respondent students and teachers shared in questionnaire and interview schedule respectively. All the respondent students ranked and rated the measures (statements) on the ranking and rating scales. Most students either agreed or strongly agreed with the common theme of the two statements on the Likert scale that they could engage equally and actively in the given cooperative learning settings while the SDs stood 18.15 and 23.52 respectively with the CV > 1 for one of the two frequency distributions indicating a relatively high variance towards right tail (positive) for the agreement. Again, the scores (%) of students for 4 and 5 points on the rating scale for the common theme of rating the learning setting's capability to let them engage equally and actively came out respectively 50% (statement-1; SD, 15, CV, 1.26) and 63% (statement-2; SD, 8.0, CV, 0.80) on the rating scale (Table-3) showing greater proportions of the perceptions standing above the neutral (3) position and with a relatively high range of variance to the positive (right tail) direction of the scores. In a separate instance of open ended question-1 (Figure-3.1), all but three students (9%) agreed that they could engage equally and actively in the given cooperative settings supporting Tan, Sharan, & Lee (2006). Noticeably, the respondents who picked disagree along with lower scores of 1 or 2 in the previous scales belonged to the group of 3 who answered 'No' to the open ended question (Figure-3.2) by showing two reasons, viz. peer non-cooperation and poor teacher input- a common criticism with nonperforming cooperative learning in any setting (Tanner, Chatman, & Allen, 2003; Umar, 2011). Nevertheless, there remains a high consensus among students on the positive role of cooperative learning settings with regard to equal and active engagement of the students in the present work. Besides, the reasons (Figure-3.1) that they mentioned as instances for the positive role of the CL for active engagement is also well acknowledged (Bhandari, Mehta, Mavai, Singh, & Singhal, 2017; Herrmann, 2013; Slavin, 2012). All the views and agreements of the students on their equal and active engagement guarantee for their critical understanding on the relevant issues and queries with the construct that obviously acknowledges the settings' success in engaging them equally and actively. Conversely, teachers positive views on the question of students' equal and active engagement in cooperative learning (Table-4) were reflected through five instances: 'incorporating group projects into course works and informing students early to the beginning of session' (Nolinske & Mills, 1999), 'alternative ways of solution', 'group problems with splitted questions for helping individual role play', 'associating individual performance with group assessment' (Herrmann, 2013; Johnson & Johnson, 2009), and 'heterogeneous group formation including 'poor',' medium', and 'strong' students (Tanner, Chatman, & Allen, 2003). All these go along with the student views and could be mutually inclusive ideas on the potentials of cooperative learning's ability to engage students equally and actively for better outcomes (Loh & Ang, 2020). Therefore, an argument that active learning engagement of students to constitute the base of their learning performance is meant for better interest and positive change to learning, better way of learning from alternative sources, interest for learning activities, better learning achievement, better retention of learning materials, sharing and presenting ability, ability to explain, and better oral and written communication as attested by the respondents' perceptions, and many studies including Herrmann (2013), Lord, (1997), and Lord (2001). On the other hand, students' assessment in two ranking scales and one rating scale in Table-5 clearly attests for their enhanced learning performance with regard to the concerned four statements of each of the two ranking scales, in which 'Ranking scale-1' has given the highest score for the levels of 'very good' or 'excellent' (statement-2, score, 86%; statement-3 and 4 score, 56% apiece) exceeding either 'satisfactory' or 'neutral' while on the 'Ranking scale-2' the scores were highest for 'agree' or 'strongly agree' for all of the four statements, giving the scores of 89%, 81%, 97%, and 94% respectively that together again complements the measures on Rating scale-1 which marked highest scores for higher or highest rates of 4 or 5 exceeding the medium score of '3' with scores, 58%, 58%, and 92% for the three numerically ordered statements respectively. Thus, a well consistent perceptions among the responding students could be measured and documented through all of the scale readings. Moreover, the open ended question in the same table was answered by 28 (78%) while 8 (22%) students did not answer willingly. Here seven ideas came out acknowledging the attributes of the enhancement of active participation that implies students' positive attitude of enhancing learning performance in cooperative group works being extrapolated also in a significant number of research findings (Cavanagh, 2011; Du, 2016; Loh & Ang, 2020; Seng, 2014; Webb, 2009). In addition, the

self-assessed learning performance in Table-5 clearly aligns with Springer *et al* (1999) that ensured students' positive attitude and achievement beside reducing their attrition from class works in. Moreover, similar positive attitudes were found in Felder & Brent (2007) that were deemed as the outcomes of students' individual as well as social cognitive engagement in learning that otherwise does not work in teacher centered instructional methods. Again, to strengthen students' appreciations of cooperative learning in enhancing learning performance, all of the teachers (Figure-5) echoed nearly same aspects of its promoting roles that not only attested for students experience and measurement but reflected their positive instructional implications with the promoted indices of student learning performance. Additionally, the ideas that they perceived cooperative learning can offer the students indicates positive interdependence among peers for learning in groups (Lord, 2001). Therefore, a consistency is built between the views of teachers and their students in the context to promoting learning performance in cooperative learning in this study (Johnson, Johnson, and Stanne, 2000). However, in higher education, students' learning performance cannot fit their cognitive maturity and the metacognitive implications until and unless they can think critically and embark on investigative learning approaches in various social interactions during learning. Here is the point to visit some way towards exploring student critical thinking construct so that the learning outcomes gets a complete touch.

As inferred, student critical thinking in this work has been meant for reasoning, questioning, illustrating, explaining, data analysis, synthesis, and evaluation in a systematic and scientific pathway during dealing with learning problems and activities in various group works (Chatil & Al Husseiny, 2017; Glaser, 1941). Accordingly, to operationalize these attributes in students' cooperative group works it has been focused, especially whether the respondent students could create or follow new ideas and alternative sources of information, how much they could explain and defend their accomplishment as meant for a group project work, to what extent they could raise questions to a class during a demonstration or project presentation, whether they could elaborate, compare, or contrast their understanding, and could criticize their group performance. To this end, both the students' and teachers' responses were examined and the data were analyzed that confirmed the promotion of students' critical thinking in many settings (Davis, Maher & Noddings, 1990; Slavin, 2012). For instance, statements, 1, 2, and 3 in the ranking scale-1 in Table-6 were acknowledged highly positive by the students with frequency, 94%, 83%, and 86% respectively in agree or strongly agree groups while only 1 (3%) ranked strongly disagree and 4 (11%) ranked disagree leaving a positive score of 61% against the statement, 4, seemingly because of their irregular and incoherent experiences being engrafted into individual perceptions on the overall learning settings. It is because, these five negative assessors belonged, otherwise to the positive ranks for the preceding three statements of close ended part and responded 'Yes' in the relevant open ended question.

On shifting to the open ended responses, all students opined positive that the given learning setting could promote their critical thinking. Consequently, five ideas emerged, including enhanced abilities to compare, self-explain, analyze, synthesize and defend group works (Lord, 2001; Slavin, 1995), and criticize individual role (Devi, Musthafa, & Gustine, 2016). Similar views were reflected from the respondent teachers who provided five instances of how the cooperative learning can promote students' critical thinking. This is very interesting that nearly all the themes of the positive explanations of the teachers corresponded to those of students' views. This once again highly indicates the close association and understanding that prevailed between a teacher and his/her students in the learning settings even within the Covid adversities, and authenticates mutually agreed and well synchronized cooperative learning settings in the present and other studies (Light, 1990; Loh & Ang, 2020; Shipman & Duch, 2001).

Therefore, both students and teachers perceptions acknowledged the high prospects of positive roles of cooperative learning to promote students outcomes with regard to active learning engagement and critical thinking. The cooperative learning success thus seemed to depend heavily on the instructional approaches of the teachers who need to shift from teacher centered rigorous lecturing to planning, setting, and guiding students' learning activities in groups in a critical way. Notwithstanding, this should lie upon proper understanding and maneuvering the specific pedagogical elements for promoting students' effective roles towards better learning experience.

Pedagogical elements in cooperative learning that can promote students' active engagement and critical thinking in undergraduate zoology classes

The method and practice of teaching in cooperative learning in higher education, especially in undergraduate zoology differs with that in the traditional lecture method classes in many contexts in this work. It appears challenging for many higher education teachers to create instructional conditions for promoting students engagement and credit in better learning outcomes (Haggis, 2006) while most are dependent on lecturing in most of the class time (Janes, 2013). This study situation is compounded that belongs to one of the low income economies where higher education is expanding rapidly. This entails difficulties with accessing learning resources, and the constraints with local needs and institutional culture with its internal capabilities that obviously matters a lot for managing better learning settings for better outcomes (Schweisfurth, 2011; Teferra & Altbach, 2003). Given this, eight pedagogical elements of promoting student motivation and active engagement in CL were recorded that teachers perceived based on their teaching practices in cooperative learning method. Accordingly, cent percent respondent teachers considered CL to be effective in promoting students' motivation and active engagement that seemingly supports the idea of cooperative learning's positive role in students' critical thinking (Ebert-May *et al.*, 1997; Johnson, Johnson, & Holubec, 2013). On enumeration, ''giving students equal access to adequate learning resources' stood the most frequent element for active engagement. Besides, 'Ice breaking with informing students on learning goals, and providing done and to be done clues' and 'Introducing group performance based assessment' appeared jointly the 2nd most shared views while 'Linking group problems to final assessment test, continuous motivation through assertion and instruction for cooperative group tasks', and 'Linking individual performance to group performance' emerged each as the 3rd most frequent pedagogical element. Interestingly, 'facilities for student-student and student-teacher face to face interactions' and 'maintaining flexibility in group learning tasks and schedules' are well grounded many other studies (Cavanagh, 2011; Du, 2016, Felder & Brent, 2007; Johnson, Johnson, & Holubec, 2013; Lord, 1997, 2001; Sharan & Sharan, 1992; Slavin, 1990).

On moving to students' critical thinking, the Table-8 has presented nine pedagogical elements that can help students develop their critical thinking in cooperative learning works. The general ideas accrued from these summarized elements in promoting students' critical thinking went hands in hands through a number of studies (Loh & Ang, 2020; Millis & Cottell, 1998). The 1st element, 'motivation for new and alternative ways of learning' was with the highest frequency (19%) being supported by Lord (2001) & Davis, and Maher & Noddings (1990). The studies emphasized on motivation from teachers to work as ice breaking or brain warming for students so that their attention can be focused on the nearby world of exploring the learning topic. Noticeably, a transcribed teacher-notion, *"I find it to work good for critical thinking when I divert students' attention to some recent events in biological sciences that occupy a certain topic in their course, I ask them to explain or comment on the issues of interest, I do this to the beginning of my instruction for their cooperative learning"* emphasized on the theme of 'teacher motivated alternative ways of learning' to cause students think in a different way of critical pathways. Then five elements, namely asking for informal exploring, using probes and prompts, asking students for a pause and think approach, encouraging group presentation and defence, and presenting learning goals and key terms and processes, each became the 2nd most frequent idea with some overlapping explanations seemingly because of the teachers' similar levels and settings of theoretical and instructional viewpoints. Accordingly, splitting the classes into small groups and assigning each group with specific learning problems was found to be a common view of all but two respondent teachers while they shared their views in response to ensuring student active engagement and critical thinking without drawing clear demarcation between the two constructs otherwise. This was reflected in one teacher's comment, "*My students need to explore outside their classroom to seek answers to their questions; I allow them enjoy additional time on finding them hassle in class period to finish when they fail to bring a meaning to learning; nay, I intervene them with alternative questions when I find anything wrong or not going on right way"*. Another respondent observed that he likes to use probes and prompts intermittently for cross checking and expanding the field of thoughts of his students while others stressed on informing students on the key terms and processes first and to go for formulating hypothesis if needed and try their ideas through intergroup discussion and bring a better meaning to their learning in a critical way reflecting the effective instructional approach of extracting students' reasoning in cooperative learning in some studies (Johnson, Johnson, & Stanne, 2000). It is worth to note that the shared pedagogical elements were well adapted into the relevant

views of the students reinforcing the teachers' views again. Thus, many of the student-viewed challenges were acknowledged well with the issues in the teachers' pedagogical convictions. This further indicates a good tie between the teacher and the students on cooperative learning experiences in a critical way.

CONCLUSION

This single case study aimed to explore the issues and implications with promoting undergraduate zoology students' active engagement and critical thinking through cooperative learning in a government college of Bangladesh. The experience and perceptions of the students and their teachers on cooperative learning were the data source. The most obvious finding in the study was that both students and teachers perceived in-group learning to promote students' equal and active engagement and critical thinking (Harman, 2013). The second major finding is that most students enjoyed cooperative group works through peer sharing and exploring alternative ways of learning (Armbruster, Patel, Johnson, & Weiss, 2009; Lord, 2001). Ensuring all members' equal participation, sound virtual class settings, and individual learning responsibilities in group works revealed highly viewed challenges of cooperative learning (Colak, 2015; Tanner, Chatman, & Allen, 2003). Besides, majority students perceived that they could think critically in the given cooperative learning settings (Devi, Musthafa, & Gustine, 2016; Gokhale, 1995). These happened to be the outcomes of students' active participation in facing the challenges in their cooperative learning settings. In addition, majority of the students were motivated better to share their ideas and information with peers to solve the learning problems in exploratory and alternative ways. Consequently, the teachers were found to facilitate their students' various in-group learning activities through intervening with necessary probes, prompts, and some relevant instructional guidance (Johnson, Johnson, and Stanne, 2000).

With such view, the positive perceptions of the respondents on the role of cooperative teaching-learning in enhancing students' active engagement and critical thinking experiences have been uncovered in this study, first ever of its type. Like many other beneficial roles, cooperative learning allowed the students to collaborate among themselves in taking their own learning responsibilities and develop positive attitude towards achieving better learning performance. This latter included, as most respondents emphasized, students' better ability to describe, explain, think, and ask in preparing for their group projects and assignments. Besides, the group works enabled students to overcome interpersonal and cultural barriers while teachers could focus more on setting effective learning problems for them.

Before this research, effects of cooperative learning in zoology in Bangladesh college education were not documented and published. This made it difficult to decide and predict on how the learning method can ensure enhanced learning performance, especially with regard to the students' active engagement and critical thinking that reportedly go missed largely in the traditional lecture classes (Janes, 2013; Johnson, Johnson, & Smith, 1991; Lord, 2001; Loh & Ang, 2020; Tadesse & Gillies, 2015).

Therefore, the findings in this work could reveal an evidential proposition of the promotion of students' active engagement and critical thinking through cooperative learning in zoology in a college of Bangladesh. At this point, the central argument to acknowledge cooperative learning as an effective tool for enhancing students' better engagement and critical thinking has been established. Besides, the research has added to existing knowledge on cooperative learning to lay out an empirical dataset that will guide further research in an otherwise least practiced teaching-learning technique in Bangladesh college education.

Notwithstanding, the challenges with effective cooperative learning underpinned in this study can be summarized into two main challenges. First, institutional capacity building and ensuring training and skills for the teachers so that teachers feel interest in cooperative pedagogies. Second, adapting cooperative learning into curricula and associating it with student course works and assessments.

Anyway, this work has suffered some limitations, like a relatively small sample size, dominance of one gender-the female, paucity of institutional practice and acknowledgement of cooperative learning, resource constraints, adverse situation of Covid-19 pandemic, and absence of case-control trial with performance tests. In spite of these challenges, limitations, and weakness, a strong positive attitude of the teachers and students to the cooperative learning's ability for helping students to engage themselves actively and in a critical way was

observed. Upon considering the theories and practical implications with cooperative learning, undertaking further research projects of both cross sectional and longitudinal types with larger sample size and settings could give more representative and convincing results. Moreover, conducting some experiments to understand the learning gaps between the traditional lecture method and cooperative method classes would help the teachers to better know the way students learn, adjust, and maneuver their instructional issues in engaging students actively and in a critical way. The teachers in this study should also take more classes in cooperative method for better student outcomes. This will need the institutional and academic maneuvering in the college to include cooperative pedagogy in academic routine. As an obligatory alternative instructional method, CL would allow students do more inquiry and problem based learning activities. This will ensure enhanced adoption of knowledge, skills, and attitudes not in zoology only but in any similar learning settings also. Therefore, it can finally be concluded that this work is just a beginning. It has laid a ground work to help educational researchers design proper context and contents in their future studies on addressing the implications with implementing cooperative learning and promote better student learning outcomes in life science in Bangladesh.

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Author's contributions

MAAK being the sole author, has conceptualized the study, analyzed the data, and drafted the manuscript.

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Ethics approval and consent to participate

This work was performed using human data collected under the provision of the Bangladesh College Education Development Project in proper site and time within the author's training period. This did not require any ethical clearance but informed consent only. All data were anonymized prior to analysis.

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