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Teachers' Perceptions and Practices of Collaborative Learning Instructions in Mathematics and Science Classroom

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Abstract

The aim of this study was to investigate instructors' perceptions and practices of collaborative learning approach in teaching mathematics and science, assess the extent to which instructors' perceptions influence their practices and identify factors affecting the implementation of collaborative learning. To conduct the study, descriptive survey design was employed. 76 instructors selected purposively and participated in the study and 70 of them completed the questionnaires. This was complemented by a qualitative approaches that used observation checklists and interviews for data gathering; seven lessons was observed while the instructors were teaching in the actual classes. In addition, semi-structured interviews were conducted with seven instructors. The data were analyzed using percentages and mean. The findings of the study revealed that the respondents have perceived collaborative learning positively. In spite of their good perceptions, their practices of collaborative learning are low. Among the major factors affecting the implementation of collaborative learning were instructors' tendency toward the traditional/lecture method, lack of students' interest, shortage of time, lack of instructional material and large class size. Finally, the study recommended that in-depth training on knowledge and implementation of collaborative learning approaches must be provided by the university. Moreover, the classroom conditions and instructional materials that may help to implement collaborative learning approaches must be provided.

INTRODUCTION

Background of the Study

Recently collaborative work received great attention in different sectors of governmental institutions as a mechanism to promote development in general and quality education in particular. Groups of people are increasingly acknowledged as the source of knowledge construction. It is expected that teams, bringing together people with different experiences, values, and knowledge, will be more effective in adequately solving the problems than are individuals. However, to be able to adequately solve problems, educators face the challenge of integrating these different perspectives and developing a shared understanding of the problem at hand. Collaborative learning can be established through rich interaction, interactive discussion, and negotiation (Daft & Weick, 1984; Roschelle, 1992; Littleton & Whitelock, 2005). The continuing implementation of group works at educational institutions and of teamwork in organizations are instances of attempts to build on the potential of teamwork. In collaborative learning students help other and therefore perform well on the ascribed tasks, hence, collaborative learning environments are used. However, research and practice shows that this potential effectiveness is not always reached (e.g., Barron, 2003).

Collaborative learning is the interaction and interdependence where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers. In all situations where people come together in groups, it suggests a way of dealing with people which respects and highlights individual group members' abilities and contributions. In collaborative

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learning there is a sharing of authority and acceptance of responsibility among group members for the group's actions. The underlying premise of collaborative learning is based upon consensus building through cooperation by group members, in contrast to competition in which individuals help other group members for better achievement. Teachers who used to practice collaborative learning apply this philosophy in the classroom, at committee meetings, with community groups, within their families and generally as a way of living with and dealing with other people (Panitz, 1996). There is research evidence to show that using group work can effectively enhance the learning experience of students in the classroom (Leight, Barcelona & Rockey, 2010; Mello, 2014). Group work is looked upon favorably by educators, as it can enhance creativity and critical thinking, build stronger interpersonal skills, and enhance relationships with the faculty.

Researchers have shown that if teachers are able to implement collaborative learning approaches properly in their teaching, the achievement level of students will be much better than the one in traditional method of teaching. Moreover, the educational settings of Ethiopia have also focused on the implementation of student centered learning methods in general and collaborative learning approaches in particular (MoE, 2002). Thus, teachers are expected to be at their best level in implementing collaborative learning approach across all subject areas and hence in mathematics and science as these fields are the basic tools to achieve the national educational goals of the country.

The pedagogical limitations that have been identified as the major shortcomings in some Ethiopian university education system are lecture-based instruction. Lecture-based instruction emphasized the passive acquisition of knowledge. In lecture based classroom setting, students become passive recipients of knowledge and resort to rote learning. Hence this study has aimed at looking on how collaborative learning is perceived and has been practicing among teachers in college of natural and computational science.

Statement of the Problem

The main teaching method being adopted by many mathematics and science teachers in Ethiopian higher institution in general and Assosa University in particular has been the lecture method which has its attendant shortcomings. Large-scale comparative international and national surveys continue to show poor performance of students in Mathematics and hence in science. As a result of this poor productivity, much research has sought to identify students in school and out-of-school experiences that influence achievement and related outcomes especially those that are alterable or partly alterable by educators and could be manipulated by policy makers (Silesh, 2000). In fact, all factors that contribute to educational outcomes exist in one way or another in classrooms that differ in terms of learning environments. They have unique effects on pupils learning independently of factors operating at school and individual levels (Richardson, 2003).

In Ethiopia today university teachers are being requested to shift from the traditional method of teaching and embrace the Active Learning Methods. This is based on the belief that the active learning methods will help to arouse the interest of students and improve their academic performance in mathematics and science. Collaborative learning approach is one of the components of active learning methods which encompassed different instructional approach in it. Although in our country, university teachers are being retrained through higher diploma program (HDP) on the use of active learning approach it has been realized that majority of them are not practicing it. For now there is documented evidence that Assosa University is to some extent (using 1-5 group formation) practicing some pieces of collaborative learning approach since 2014. But there is need to determine the extent to which our university mathematics and science teachers are ready to embrace the collaborative learning strategies. Therefore, the focus of this research is to explore the perception and practices of mathematics and science teachers towards the use of collaborative Learning strategies in the actual classrooms.

Objective of the Study

The study has the following general and specific objectives. The general objective of the study was to explore the perceptions and practices of mathematics and natural science teachers towards collaborative learning approach.

The specific objectives of the present study were to:

- Describe the conceptual understanding of teachers towards collaborative learning instructions.
- Examine the utilization of collaborative learning approach in teaching Mathematics and Science from the teacher's perspectives.
- Identify factors impairing utilization of collaborative learning approaches in teaching Mathematics and Science.

Research Questions

The following questions were used to guide the investigation:

1. How collaborative learning is perceived among mathematics and science teachers?
2. How is the implementation of the collaborative learning approach in teaching Mathematics and Sciences?
3. What are the potential threats for the implementation of collaborative learning approach in teaching Mathematics and Sciences?

Significance of the Study

A growing body of the research findings indicated that factors associated with the practicing of collaborative learning approach and the teacher's perception towards collaborative learning methods in teaching mathematics and science in the university. Thus the findings of the study help teachers to redesign their teaching approach in the manner that includes collaborative learning instructional approach so as to enable students to actively participate in mathematics and science. Moreover, the results of the study can be used for future researchers in the area.

Scope of the Study

The scope of the study was limited to Assosa University College of Natural and Computational Science. This College was selected purposively for the researcher's research title, teachers' perceptions and practices towards collaborative learning approach in mathematics and science. The researchers are also from mathematics department who have been facing the problems in implementing collaborative learning in mathematics.

METHOD

Study Area

Benishangul-Gumuz region is one of the regions of Ethiopia. According to the 2007 population and housing census conducted nationwide the population of the Benishangul-Gumuz region was 784,345 (398,655 male and 385,690 female). Assosa town, which is one of the border towns of Ethiopia, is the capital of Benishangul-Gumuz Regional State. Assosa was founded by Sheik Hojele Al-Hasan in 1929 E.C as his political center. The town located some 660 km. west of Addis Ababa, the capital of Ethiopia, and 90 km from border of Sudan. Its altitude ranges from 1580m- 1730 m.a.s.l. and

regarding the slope of the town, 44% of the town lies within 5-10% slope category. The town generally has significant large flat topography, which is suitable for settlement. The mean monthly temperature of the town varies between 18 and 25°C, implying tropical or Kolla climatic condition. According to National Metrological Service Agency, the dominant wind direction is toward west (31%) and east (21%) of the town. The mean annual rainfall of the town is about 1200mm. the highest rainfall concentration occurs in June, July, August and September (www.asu.edu.et).

Generally, Assosa University is one of Ethiopian higher public institutions which is found in Benishangul-Gumuz region particularly in Assosa town and established in 2001 E.C. In these study instructors in the College of Natural and Computational Science are the main focus point. This college consists of seven departments: Mathematics, Physics, Chemistry, Biology, and Geology, Statistics and Physical education and Health. Moreover, there were a total of 443 students in this college and total of 76 instructors were acting as a teaching staff (The number of staff that were on study leave were not considered).

Study Population

The study population was all teachers of College of Natural and Computational Science, Assosa University, Ethiopia. In this college there were 76 (seventy six) instructors (65 male and 11female). All instructors from each department in this college were study population.

Study Design

Descriptive survey design was employed to study instructor's perceptions and practices of collaborative learning in teaching mathematics and science. The study was conducted from October 2016 to June 2017 among teachers of College of Natural and Computational Science, Assosa University, Ethiopia.

Sample Size and Sampling Techniques

The participants of this study were all instructors in the College of Natural and Computational Science who were teaching during the year 2017. Purposive sampling techniques were used during the selection of the participants. The sampling techniques that were used in this study was due to the fact that the number of instructor was very low.

Data Collection Instruments

Both quantitative and qualitative data were collected using different data collecting instruments. Among these questionnaire, interview and observation were employed for the study to collect the data.

Questionnaire

A Questionnaire consisting of twenty eight closed ended items were prepared and administered. This allowed informants express their ideas and opinions freely. The questionnaires that were used helped to obtain appropriate information regarding the issues under the study.

Classroom Observation

Classroom observation were used to see the extent to which mathematics and science instructors employed collaborative learning approaches in their classroom and to cross-check their responses on questionnaire with their practices in the class room.

Interview

In this study, semi-structured interview was used to collect information about the perceptions and practices of instructors towards collaborative learning approaches in mathematics and science classrooms. More specifically, the researcher interviewed 7 instructors (one instructor from each department) before starting the interview the instructors were informed about the purpose of the study. Each of them were interviewed the same questions after class room observation were made.

Validity and Reliability

The researcher validated the instruments that were developed as follows: before the actual data collection was started the instruments were given to colleagues so as to get valuable comments and criticisms on the strengths and weaknesses of the items. Based on the comments obtained, necessary modifications were made.

Data Analysis and Procedures

The collected data were coded and entered in to SPSS software version 16 to perform the statistical analysis. The data collected from semi structured interview and classroom observation were analyzed qualitatively. Thus, the researchers used different analysis procedures like frequency, percentages and mean.

RESULTS AND DISCUSSION

This section presents the results on the extent to which College of Natural and Computational Science instructors perceived collaborative learning approaches. This includes the extent to which lecturers implement collaborative learning and as to how they are helping students to learn in groups in the teaching-learning process. The section also highlights the factors associated with implementing collaborative learning approaches and the support provided for the implementation of collaborative learning approaches in teaching mathematics and science.

Research Question One

How collaborative learning is perceived among mathematics and science teachers in college of natural and computational science?

Regarding collaborative work, an item (number 11) stated: "I think collaborative work in groups is good for efficient learning." Table 1 shows that 85.7.5% (54.3%+31.4%) of the instructors agreed with this statement (mean value of 4.1). Accordingly, they responded positively on the item that stated "through group learning I stimulate students' responsibility for their own learning" (item 8). Moreover, on encouraging students to work collaboratively, most (94.2%) instructors also agreed that teachers are responsible to facilitate students' learning together (mean value of 4.2). This means that the instructors realized that collaborative learning method is appropriate for successful students learning.

Table 1. Frequency Distribution and Mean Values of Data Collected on Perceptions of Instructors

Items	1		2		3		4		5		Mean
	S. Disagree		Disagree		Undecided		Agree		S. Agree		
	f	%	f	%	f	%	f	%	f	%	
1 I feel that good lectures enhance students' sense of commitment.	-	-	2	2.9	2	2.9	30	42.9	36	51.4	4.42
2 I use lectures to help students to develop critical thinking skills.	4	5.7	20	28.6	6	8.6	30	42.9	10	14.3	3.31
3 Current knowledge depends on the previous understanding.	-	-	6	8.6	-	-	42	60	22	31.4	4.14
4 The teacher holds most of the knowledge necessary for the students.	10	14.3	10	14.3	10	14.3	40	57.1	-	-	3.14
5 I believe lecture method is the most valuable teaching approach.	14	20	26	37.1	14	20	12	17.1	4	5.7	2.56
6 I believe students learn mathematics through repeated practice.	2	2.9	4	5.7	2	2.9	26	37.1	36	51.4	4.28
7 In collaborative learning the teacher's responsibility is to facilitate students' learning together.	-	-	2	2.9	2	2.9	44	62.8	22	31.4	4.22
8 Through group learning I stimulate students' responsibility for their own learning.	-	-	2	2.9	4	5.7	48	68.6	16	22.9	4.11
9 I believe students learn more effectively if they work in groups than individually.	-	-	6	8.6	2	2.9	34	48.6	28	40	4.2
10 I believe that collaborative learning is effective to actively involve students in science and mathematics learning process.	-	-	-	-	4	5.7	53	75.8	13	18.5	4.12
11 I think collaborative work in groups is good for efficient learning.	-	-	5	7.1	5	7.1	38	54.3	22	31.4	4.1

Majority of the respondents 94.3% believe that on the item (number 1) good lectures enhance students' sense of commitment (mean value of 4.42). Also, more than half of the respondents (55%) believed that lecture method help students to develop critical thinking skills. Moreover, on item (number 5) of Table 1 only 22.8% of the respondents (17.1 %and 5.7% Agree and Strongly Agree respectively) support the idea that says lecture method is the most valuable teaching approach. However, in item 6 of Table1 88.5% of the respondents (mean value of 4.28) believed that students learn mathematics and science through repeated practice. Moreover, on item (number 9) 89.2% of the respondents believed that students learn more effectively if they work in groups than individually.

Hence, one can deduce that the groups of instructors have positively perceived that the solely use of lecture method is not enough to learn mathematics and science effectively.

Research Question Two

How is the implementation of the collaborative learning approaches in teaching Mathematics and Sciences?

Table 2. Frequency Distribution and Mean Values of Data Collected on Instructor's Practices of Collaborative Learning

Items	1		2		3		4		5		Mean	
	Not at all		Rarely		Sometimes		Frequently		Always			
	f	%	f	%	f	%	f	%	f	%		
1	I try to create a classroom environment that supports group learning.	5	7.1	17	24.3	34	48.6	8	11.4	6	8.6	2.9
2	I encourage students to explain or reflect their own response to their peers.	-	-	10	14.3	14	20	29	41.4	17	24.3	3.72
3	I encourage students to make comments on someone else's ideas.	8	11.4	16	22.9	14	20	25	35.7	7	10	3.1
4	I promote discussion among students to solve practical problems.	-	-	5	7.1	15	21.4	31	44.3	19	27.1	3.91
5	I direct students to work together by themselves on their academic tasks.	1	1.4	10	14.3	14	20	29	41.4	16	22.9	3.7
6	I usually use the lecture method in my classroom teaching.	-	-	4	5.7	7	10	40	57.1	19	27.1	4.05

Table 2 indicates in order of importance (as indicated by the percentages and means) the following classroom practices of teachers are most dominant, as indicated by their responses. Instructor's indicated their view that:

- They usually use the lecture method in their classroom teaching (mean 4.05);
- They promote discussion among students to solve practical problems (mean 3.91);
- They encourage students to explain or reflect their own response to their peers (mean 3.72).
- They direct students to work together by themselves on their academic tasks (mean 3.7);
- They encourage students to make comments on someone else's ideas (mean 3.1);
- They try to create a classroom environment that supports group learning (mean 2.9);

According to Table 2, most instructors responded that they usually create a classroom environment that supports group learning. In contrast to the item 1 of Table 2, it was noted during classroom observations that the predominant mode of instruction was teacher-centered. The class was taught as a whole, and all students were passive listener of their instructor and they were busy in writing what their instructor was writing on the blackboard, in the same way, and at more or less the same pace. But one practical laboratory observation has indicated that there will be a promising turning point in helping students to discuss in groups and more or less students were fully engaged in the activities that were given by their instructors.

During the interviews, the lecturers were asked: Lecturers sometimes have positive views on collaborative learning approaches for teaching mathematics and science and yet do not implement this approach in their own teaching. Why do you think this is the case?

All Lecturers' responses indicated that the way they thought influenced their classroom practices not to use collaborative learning approaches in their teaching. Thus, the dominant trend (lecture method) that has been practiced for a long time affected the way they teach.

Research Question Three

What are the potential threats for the implementation of collaborative learning approach in teaching Mathematics and Sciences?

Table 3. Percentage and Mean Values of Factors Affecting Instructors' Implementation of collaborative Learning.

Items	1		2		3		4		5		Mean		
	S. Disagree		Disagree		Undecided		Agree		S. Agree				
	f	%	f	%	f	%	f	%	f	%			
1	There is a lack of time to actively involve groups of students in my classroom teaching.		-	-	10	14.3	5	7.1	31	44.3	24	34.3	3.98
2	The amount of content that needs to be covered prevents the use of group learning in the classroom.		1	1.4	7	10	8	11.4	24	34.3	30	42.9	4.05
3	Group learning will create problems in my classroom management.		11	15.7	35	50	9	12.9	10	14.3	5	7.1	2.47
4	It is impractical to implement group learning in large classes.		3	4.3	11	15.7	5	7.1	30	42.9	21	30	4.42
5	To involve students in group learning will add too much to my work load.		10	14.3	14	20	12	17.1	28	40	6	8.6	3.08
6	I think students have negative attitudes towards group learning approaches.		2	2.9	12	17.1	26	37.1	28	40	2	2.9	3.22
7	Lack of classroom space inhibits group work activities.		1	1.42	11	15.7	9	12.9	23	32.9	26	37.1	3.88
8	Lack of resources affects the implementation of group learning.		4	5.7	2	2.9	10	14.3	32	45.7	22	31.4	3.88
9	Group learning demands too much effort from lecturers.		7	10	11	15.7	2	2.9	32	45.7	18	25.7	3.61
10	I think that lack of instructional materials inhibits the implementation of group learning.		2	2.9	2	2.9	12	17.1	30	42.9	24	34.3	4.02

11	Lack of administrative support (eg. Financially, materially) inhibits group learning.	2	2.9	11	15.7	4	5.7	35	50	18	25.7	3.8
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Table 3 shows factors hindering the implementation of collaborative learning approaches. Eleven questions associated with the implementation of collaborative learning are presented. In order of importance (as indicated by the percentages and means), the following are mentioned as the most important factors hindering the implementation of collaborative learning approaches.

- It is impractical to implement group learning in large classes.(72.9%, mean4.42);
- I think that lack of instructional materials inhibits the implementation of group learning(77.2%, mean 4.31);
- The amount of content that needs to be covered prevents the use of group learning in the classroom (77.2%, mean 4.05);
- There is a lack of time to actively involve groups of students in my classroom teaching (78.6%, mean 3.98);
- Lack of classroom space inhibits group work activities. (70%, mean 3.88);
- Lack of resources affects the implementation of group learning (77.1%, mean 3.88);
- Lack of administrative support (e.g. Financially, materially) inhibits group learning (75.7%, mean 3.8);
- Group learning demands too much effort from lecturers (71.4%, mean 3.61);
- I think students have negative attitudes towards group learning (42.9%, mean 3.22);
- To involve students in group learning will add too much to my work load (48.6%, mean 3.08);
- Group learning will create problems in my classroom management (21.4%, mean 2.47);

Although questionnaire responses indicated that there was not enough space for group work, classroom observation showed that some of the classes had enough space for group discussion. It was observed that no lecturers arranged their students into groups for different activities except the practical laboratory lesson that was observed where most students were seen to work together.

During the interviews, participants were asked about their view about the issues of collaborative learning methods and the problems associated with the implementation of collaborative learning approaches?

Lecturers' responses focused on attitudes of lecturers, kind of support from the institution, the need to cover the syllabus, classroom conditions and shortage of time. Examples include:

Usually i am using collaborative learning in my teaching only outside the regular classroom teaching simply by mentoring the already formed group of students by the department. Practically in my class room teaching, one of the problems that affect the use of collaborative learning approaches is the lack of classroom space and sometimes even there are students who don't get a chair to sit. In the situation in which where the classrooms are disorganized and even no enough chairs for the students to sit it is unthinkable to implement group learning. [Lecturer A, April 20/2017].

I think collaborative learning approaches require group interaction. In my class room teaching, one of the problems that affect the use of collaborative learning approaches is my own fear if incase the syllabus may uncovered. In my department completion of course material is one of the evaluation criteria so I usually prefer to use the traditional lecture mode of delivery for many reasons. [Lecturer B, April 20/2017].

I experienced that collaborative learning method created too much workload on my actual classroom teaching and whenever in a rare case I use it I could observe less group interaction was occurred that resulted most group members only kept silent and depends on the better students. [Lecturer C, April 20/2017].

Theoretically collaborative learning is very useful, but practically impossible for a number of reasons like large class size, work load of lecturers, lack of teaching material, lack of interest from both sides (from students and teachers) and some complaints of both the lecturers and students. Therefore, we need more training on the use and implementation of collaborative learning so that we may in the future use it in our teaching methods [Lecturer D, April/2017].

Majority of my students are very weak and most of the time they ask me too much explanation of the lesson they also frequently ask me to arrange a tutorial class for further support. Due to this reason I have not been using collaborative learning method because students may not engage in the kinds of talk that can drive learning forward. [Lecturer E, April/2017].

I believe that collaborative learning approach is very useful method of teaching if it is used properly, especially for the kind of my students which are most of them weak academically, but if someone wants to use the collaborative learning method it requires teachers to have a great follow up of the students, this is the biggest challenge for us because it will add too much burden on our teaching. [Lecturer F, April/2017].

CONCLUSIONS

Based on the results and discussions that were made in the previous section the following conclusions were made:

1. Study participants demonstrated clear understanding of collaborative learning. However, after thoroughly studying the results many instructors are still dominated by the traditional method (lecture method) of teaching.
2. The study also revealed that many lecturers had positive attitudes towards collaborative learning practices but the implementation of such approaches was relatively scarce.
3. The practices of collaborative learning and the opportunities provided to students for active participation in the instructional process in this college was low and inadequate.
4. The study also revealed that the major factors/challenges in implementing collaborative learning approaches include:
 - a. Classroom conditions: lack of classroom space that inhibits group work;
 - b. Lack of time to involve students in teaching;
 - c. Lack of resources to implement collaborative learning;
 - d. Lecturers' think – too much effort expected from them;
 - e. Lack of instructional materials;
 - f. Lecturer's think students may have negative attitudes towards group learning
 - g. Lack of administrative support; and
 - h. The amount of content to be covered
 - i. Lecturers think group learning creates problems in their classroom management

RECOMMENDATIONS

Based on the conclusions of the study, the following recommendations were made:

1. In-depth training on the use and implementation of collaborative learning should be given for all instructors in the college of natural and computational science in the study area.
2. Classroom conditions should be organized by the university in the manner that enables instructors to implement collaborative learning approaches in their classroom teaching.
3. The university, faculties and departments should provide appropriate instructional aides that enable instructors to implement collaborative learning approaches.

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