Cooperative learning, problem solving and mediating artifacts

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Abstract

The present study deals with the influence of cooperative learning on the ability of students to solve the problems. The study also concerns the introduction of mathematical mediating artifacts as factors which effect the learning of mathematics by students. Experimental research method of pre-test and post-test types was carried out. Before the beginning of the study a questionnaire was given to students to elicit information about their accessibility to mediating artifacts, and the information gathered was effective for grouping the students. Doing so, 32 of the final-terms of BA Mathematics students were selected and were grouped into two equal peer-groups (groups of 16 pupils). After pre-test, the control group passed 15 sessions of traditional teaching (i.e. largely lectures), and experiment group carried out cooperative learning in the end, post-test was done and by analyzing the tests it was concluded that cooperative learning approach that involved the use of the dialectical method is much better than giving lectures, and it effects students` problem solving much more efficient.

Keywords cooperative learning, dialectical method, problem solving abilities, mathematical mediating artifacts

Introduction

Today, one of the teaching techniques, which concern a lot of the teaching systems of the world, is cooperative learning in the classroom. Unlike giving lectures, that is teacher-centered, in cooperative learning students play an active part. Cooperative learning helps students to express their attitudes and to justify their beliefs and causes each student knows others` beliefs.

Supporting group learning activities requires an understanding of the process of collaborative learning. This process is complex, coupling task-based and social elements. These interaction patterns contain information about the students` roles, understanding of the subject matter, engagement, degree of shared understanding, and ability to follow and contribute to the development of ideas and solutions (Soller & Lesgold 2007)

Collaborative learning takes place when the following conditions are met: students have a common goal, share responsibilities, are mutually dependent, and need to reach agreement through open interaction (Linden, Erkens, Schmidt & Renshaw, 2000). Teaching through cooperative learning has various methods, and its stages can be defined as follows (Seif, 2009):

- Topic selection: which can be selected by the group of peers or arising a debatable issue by teacher of course it should be noted that these topics must be familiar and

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understandable.

- Finding a common background for a discussion: which can be a reading of a book, or an article, reading some part of newspaper, seeing a film, etc.
- Presenting teaching objectives: One of the most important stages of collaborative activities is objective selection. Because when teachers specify the goals, individuals` minds are ready to accept and debate about it. The essence of group work is that students discuss about one of the objectives or problems, and look for solutions together. These are called intentionality and planning (Koçaka, Bozana, Isıka,2009). Time range: determination of a time range is vital for cooperative learning. It helps to discussion forming and proper conclusion.
- The order of sitting for people in groups: different groups should have specific homogenous, that is, in each group people with different educational talents, socioeconomic and cultural conditions should be present. For example, groups should not be divided into talented and weak individuals.
- Conducting of discussion flow: despite the previous stages, in this stage teacher`s role should be less tangible and students should be managers of this stage. Teachers must have the role of checkers. In this stage teachers have to: a) prevent the class from deviating of the main goal, b) keep the discipline of the classroom, and c) encourage inattentive students to take part in discussions.

Collaborative groups have remarkable effect on learning of mathematics and problem solving. Constructive learning theories and research provide support for the notion that cooperative and collaborative problem solving can be an effective aid in the teaching and learning of mathematics (Davidson, 1990; Davidson, Kroll, 1991, Johnson et al, 1991 b, Reynolds et al. 1995, Vidakovic, 1997; acoording to Draga Vidakovica, 2004). Among the cases that should be considered when grouping in mathematics classroom, are socioeconomic conditions and mediating artifacts. The student`s socioeconomic background is an attribute that may impact mathematics learning and hence affect equity in the opportunity of learning and succeeding in math. Many Factors contribute to the student` s socioeconomic background, such as the income of the student` s family compared to the average national income, the occupation of the parents and their educational level, among other things [6]. Now, we introduce the mathematical mediating artifacts.

The mediating artifacts are cultural products that have accumulated as a result of the evolution of a specific culture. These artifacts are symbolic and physical tools which act as intermediary agents in effecting the internalization of the meanings they carry and the externalization of their use in new contexts. Perhaps the most important symbolic artifact is language. Many issues in mathematic learning are related to the language of instruction of mathematics, such as teaching math in a foreign language or having multilingual classrooms. The language of mathematics is another symbolic artifact that may impact mathematics learning. Concrete learning materials, textbooks, and computers are physical artifacts that mediate math teaching and learning (Jurdak, 2009). Also, it is important to consider the fact that language is a vital tool to transfer common point of mathematics knowledge.

Method

Research Design

This study is experimental in design the use of control and experimental group with pretest-post test.

Population and sample:

Sample consists of 32 senior students enrolled in problem solving course at Shahid Chamran University of Ahvaz, which were divided in two groups of 16 randomly.

Instrument

First, a questionnaire was given the students which elicited data on the students' socioeconomic background and accessibility to mediating artifacts. Then using an analysis of the data from the questionnaire and considering students` scientific level, 32 female students were selected. This questionnaire, first, was distributed among 287 of mathematics students of Khouzestan province and its Cronbach`s alpha was estimated about 85%

Procedure

Two groups each consisted of 16 students (32 altogether) were selected; one as an experimental group and one as control group by random. Before taking place the study, a test was given to two groups as pre-test; then the control group had passed 15 sessions of traditional mathematics teaching, while experimental group in groups of four was taught by cooperative method. Then a final test was taken as post-test by two groups.

Results

Tables 1 and 2 show the t-test results for the pretest and posttest with respect to the two groups.

Table 1 The results of t-tests for dependent groups

	Pre-test		Post-test				
Group	**Mean**	**std. deviation**	**Mean**	**std. deviation**	**t**	**df**	**Significance**
Control	22.34	12.77	29.68	8.05	-1.8	14	0.087
Experimental	14.56	9.51	49.60	10.56	-13.25	14	0.00

Table 2 The results of t-tests for independent groups

	Control		Experimental				
	Mean	std. deviation	Mean	std. deviation	t	df	Significance
Pre-test	22.34	12.77	14.56	9.51	1.9	28	0.49
Post-test	29.68	8.05	49.60	10.56	-6.02	28	0.00

According to the results of t-student test for independent groups (table. 2), there was not significance difference between the averages of two pretests, and two groups were equally from the performance perspective (t=1.9, df=28, p-value=0.49 > 0.05). Table 1 also shows there was not much significance difference between the averages of pretest and posttest of control group; but the performance of students improved after the posttest (t=-1.8, df=14,p- value = 0.087 > .05).

However, a significance difference was observed between the average marks for contrast analysis of posttest and pretest of experimental group, and the performance of students improved after the posttest (t=-13.25,df=14,p-value =0 .00 < 0.05; see Table 1). Also there was significance difference between the mark averages of two groups and experimental group performed better than control group (t=-6.02, df=28, p-value = 0.00< 0.05). So, according to above it can be concluded that using cooperative learning in mathematics classes is very beneficial.

Discussion

Underlying a move to small-group work is a belief that when students discuss their thinking about problems with others it helps them develop rich and powerful understanding of mathematical concepts, perhaps by a structural organization and connection of mental constructs (Hiebert, Carpenter, 1992)

- Any intelligent effort to contribute to collaborative learning by participating in conversations among learners will need to include the ability to recognize the likely presence or absence of one of these four possible group activities (explaining, criticizing, sharing, and motivating) and to offer suggestions based upon their presence or absence. (Vidakovica, William, Martinb,2004)
- Considering the social interaction of individuals is very important before they take part in groups.
- Teachers should create a learning environment stimulating students towards the construction of powerful knowledge (Harris and Alexander, 1998; cited in Dolmans, 2003).
- The main way for students to learn through cooperative learning is to involve themselves into learning and teaching processes.

- Explicitly structuring positive goal interdependence in groups and ensuring that students are trained in the social skills required to promote to group interaction appears to be critical for successful cooperative learning (Gillies,2003)
- The fundamental principle of group work depends on that each person should do what he/she is supposed to (Koçaka, Bozana,. Isıka,2009)
- The less frequently students work together in small groups, the higher the mathematics achievement. It seems that the excessive use of this practice does not necessarily promote mathematics achievement (Jurdak, 2009)

The benefits of cooperative learning use can be summarized as follow:

- The advantages of cooperative learning is that stronger students help weaker learners to a better mathematics understanding, and they will know their weak-points too.
- Student's socialize increase in groups rather than individually, and learn to respect others, thoughts.
- Increases students' self-confidence for problem solving.
- It is very beneficial for students who are shy or worried.
- The feelings of cooperation increase in daily lives of group members.

From a theoretical perspective, both the help-giver and the help-receiver may benefit from sharing information, especially explanations or detailed descriptions of how to solve problems or carry out tasks. Gibing explanations may help the explainer to recognize and clarity material, recognize misconceptions, fill in gaps in his or her own understanding, internalize and acquire new strategies and knowledge, and develop new perspectives and understanding (Bargh & Schul 190; King 1992; Peterson et al.1981; Rogoff 1991; Saxe et al.1993; Valsiner 1987; Webb 1991;acoording to Noreen Webb,2008)

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