Vol 6 Issue 12 June 2017 ISSN No :2231-5063

International Multidisciplinary Research Journal

Golden Research Thoughts

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RNI MAHMUL/2011/38595 **ISSN No.2231-5063**

Golden Research Thoughts Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial board.Readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.aygrt.isrj.org

ISSN: 2231-5063 IMPACT FACTOR : 4.6052(UIF)

GRT GOLDEN RESEARCH THOUGHTS

VOLUME - 6 | ISSUE - 12 | JUNE - 2017

FACTORS AFFECTING STUDENTS' OPINION OF IMPLEMENTATION OF CO-OPERATIVE LEARNING

Dr. Shefali Pandya
Professor , Department of Education ,
University of Mumbai.

ABSTRACT

The research is aimed at studying the factors affecting students' opinion of co-operative learning implementation. The methodology adopted for this was the pre-test, post-test quasi-experimental research. The sample consisted of 78 students of standard IX from English medium school affiliated to the SSC board. Using the technique of multiple correlation, it was found that there is a large effect of students' conceptions of mathematics, mathematics self-efficacy, student engagement in mathematics and academic achievement in mathematics on students' opinion of co-operative learning implementation. Student engagement in mathematics and mathematics self-efficacy contributed approximately 42% of variance in students' opinion of co-operative learning implementation.

KEY WORDS- *Conceptions of Mathematics, Mathematics Self-Efficacy, Student Engagement, Academic Achievement, Co-operative Learning Implementation.*

INTRODUCTION

Co-operative learning has been a popular topic in the field of education for more than two decades. Researchers and practitioners have found that students working in small co-operative groups can develop the type of intellectual discussion that nurtures creative thinking and fruitful problem-solving.Student interaction makes co-operative learning significant. In order to realize their group's task, students must exchange ideas, make plans and recommend solutions.

Many researches have been conducted in India as well as abroad on co-operative learning. However, little research has been done on the factors affecting students' opinion of implementation of co-operative learning in mathematics class in the urban scenario.

AIM OF THE STUDY

To study the combined effect of students' conceptions of mathematics, mathematics self-efficacy, student engagement in mathematics and academic achievement in mathematics on students' opinion of co-operative learning implementation.

METHODOLOGY

The present study is aimed at studying the effect of student-outcomes on students' opinion of co-operative learning implementation in co-operative learning class in terms of the combined relationship of students' conception of mathematics, mathematics self-efficacy, student engagement and academic

achievement in mathematics. For this purpose, the researcher has implemented the co-operative learning approach and ascertainedthe effect ofall the four variables, namely, students' conceptions of mathematics, mathematics self-efficacy, student engagementandacademic achievement on students' opinion of co-operative learning implementation. Hence the methodology selected is the experimental one. In the present investigation, the researcher has used the pre-test post-test quasi-experimental design as follows :$O_1 X O_2$

Where,
O_1 : Pre-test Scores
O_2 : Post-test Scores
X : Experimental Group

Intervention Programme: In the present research, the researcher developed an instructional programmes based onCo-operative Learning Approachon chapters on linear equations in two variables, graphs, ratio and statistics was developed. The techniques used under Co-operative Learning Approach in the present investigation included Jigsaw Technique and Think-Pair-Share. The researcher obtained permission from two selected schools for administering the tests and administering the treatment. The researcher first administered the pre-test on Students' Conceptions of Mathematics, Mathematics Self-Efficacy Scale, Student Engagement in Mathematics Scale and Academic Achievement Test to the experimentalgroup. After the pre-test, the experimental group was taught using the Co-operative Learning Approach. At the end of this, the post-test on Students' Conceptions of Mathematics, Mathematics Self-Efficacy Scale, Student Engagement in Mathematics Scale and Academic Achievement Test were administered to students. Besides, Co-operative Learning Implementation Opinionnaire and scores were analysed using statistical techniques. The researcher has used this design as it was the most feasible one and the interpretation of the results has been cautiously done. The students of standard IX of both the schools were taught selected topics in Mathematics subject. The treatment was given on the basis of content from the text books prescribed by Maharashtra state text book production and curriculum research, Pune. In the experimental group, twenty-two periods from the school time table were taken up to teach the content. It was spread over twelve working days. Five days per week were taken up for three weeks, teaching one to two school periods a day of thirty-five minutes' duration each. The content was taught in both the schools in the mornings.

Sample

In the present research, the sample selected consisted of 78 students including boys and girls from standard IX of English medium schools situated in Greater Mumbai. The experimental group consisted of 78 students with42 boys (53.85 %)and 36 girls (46.15 %). The school selected for the study was affiliated to the SSC Board, Mumbai with English as the medium of instruction. The school was selected randomly using lottery method. However, the experiment was conducted on intact classes due to reasons beyond the researcher's control.

Tools

1.Students' Conceptions of Mathematics Scale(2015) : This scale developed bythe researcher consists of 20 items, 10 each measuring Fragmented and Cohesive Conceptions of Mathematics. Its reliability was 0.91(Cronbach's Alpha)and 0.86 (Test-Retest Reliability). All items were measured on a 4-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). Here, a positive score implies Cohesive Conception of Mathematics whereas a negative score implies Fragmented Conception of Mathematics.

2.Mathematics Self-Efficacy Scale (2015) : This scale developed by the researcher consists of two parts. In the first part, general beliefs of students about their confidence in learning mathematics are measured using 15 items. In the second part, a student's confidence about using mathematics in daily life using 10 items is measured. Its reliability was found to be 0.90 (Cronbach's Alpha) and 0.81 (Test-Retest). All items in Part I were measured on a 4-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). In Part II, items were measured on a 4-point Likert-type scale (1 = very confident, 2 = confident, 3 = somewhat confident and 4 = not at all confident).

3.Student Engagement in Mathematics Scale (Kong, Wong and Lam, 2003): It consists of three dimensions, namely, Cognitive Engagement (Surface Strategy, Deep Strategy and Reliance), Affective Engagement (Interest, Achievement Orientation, Anxiety and Frustration) and Behavioural Engagement (Attentiveness and Diligence). It contains 21, 22 and 12 items respectively to measure Cognitive Engagement, Affective Engagement and Behavioural Engagement (total 55 items). Its reliability was found to be 0.89 (Cronbach's Alpha) and 0.81 (Test-Retest Reliability). All items were measured on a 5-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

4.Academic Achievement Test Test in Mathematics(2015) : This is a researcher-made test consisting of total 40 marks and covering topics included in the intervention (instructional) programme. There are two parallel form tests, Form A for the Pre-Test and Form B for the Post-Test. This was developed on the basis of a blue-print developed by the researcher.

5.Co-operative Learning Implementation Opinionnaire(2014) : It consists of 20 Likert-type statements measuring students' opinion towards implementation of co-operative learning. These are structured or closed-ended statements with four response categories and scoring, namely, 4 = strongly agree, 3 = agree, 2 = disagree and 1 = strongly disagree. Its reliability and validity were established in the Indian context during a pre-pilot study (Cronbach's Alpha = 0.80 and Test-Retest Reliability = 0.78).

TECHNIQUES OF DATA ANALYSIS

The present research used statistical techniques of multiple correlation coefficient and Cohen's formula of effect size.

DATA ANALYSIS

1.Research Hypothesis H_1: There is a significant combined relationship of students' conception of mathematics, mathematics self-efficacy, student engagement and academic achievement in mathematics on students' opinion of co-operative learning implementation.

Null Hypothesis H_{01}: There is a significant combined relationship of students' conception of mathematics, mathematics self-efficacy, student engagement and academic achievement in mathematics on students' opinion of co-operative learning implementation.

In order to test this hypothesis, the statistical technique of multiple regression correlation was used wherein, multiple correlation coefficient was computed of students' Opinion of Co-operative Learning Implementation (OCLI) on their Conceptions of Mathematics (COM), Mathematics Self-Efficacy (MSE), Student Engagement in Mathematics (SEM) and Academic Achievement in Mathematics (AAM).

Multiple Correlation of OCLI with COM, MSE, SEMand AAM of Students

Here, the variable OCLI is denoted by 5, variable COM is denoted by 1, variable MSE is denoted by 2, variable SEM is denoted by 3 and the variable AAM is denoted by 4.

Table 1 shows the matrix of correlation of OCLI with COM, MSE, SEM and AAM of students.

TABLE 1 : MATRIX OF CORRELATION OF OCLI WITH COM, MSE, SEM AND AAM OF STUDENTS

	COM (1)	MSE (2)	SEM (3)	AAM (4)	OCLI (5)
COM (1)	1.00	0.3412	0.3965	0.3115	0.2973
MSE (2)	0.3412	1.00	0.4298	0.4784	0.4282
SEM (3)	0.3965	0.4298	1.00	0.5961	0.5311
AAM (4)	1.00	0.3412	0.3965	0.3115	0.3167
OCLI (5)	0.2973	0.4282	0.5311	0.3167	1.00

The Issue of Multi-Collinearity : The extent of multi-collinearity was computed using the following two methods :

a)The determinant of 'XX can be used as an index of multi-collinearity. Since the matrix is in correlation form, the possible range of values of the determinant is $0 \leq |XX'| \leq 1$ If $|'XX| = 1$, the regressors are orthogonal, while if $|'XX| = 0$, there is an exact linear dependence among the regressors. The degree of the multi-collinearity becomes more severe as $|'XX|$ approaches zero (Paul, 2012). In the present case, $|'XX| = 0.858953961292643$. This implies that the magnitude of partial multi-collinearity is very low and within tolerable limits.

Table 2 shows Variance Inflation Factors (VIF) for the independent variables included in the study :

TABLE 2 :MAGNITUDE OF VIF

No.	Variable	VIF
1	COM-MSE	1.95
2	COM-SEM	1.03
3	COM-AAM	2.56
4	MSE-SEM	1.47
5	MSE-AAM	1.62
6	SEM-AAM	2.19
Mean VIF		**1.80**

Since the individual VIF as well as Mean VIF < 10, the extent of multi-collinearity is much below the permissible limit (Jeeshim and KUCC, 2002). Hence it may be concluded that the multi-collinearity is not statistically significant.

Before proceeding further, Mardia's Multivariate Normality Test was computed which showed that (a) g1p = 0.0762, chi.skew = 0.7965 and p.value.skew = 0.8931, (b) g2p = 8.1311, z.kurtosis = 0.0679 and p.value.kurt = 0.9123 and (c) chi.small.skew : 0.8561 and p.value.small : 0.8659. This implies that the data are multivariate normal.

The relationship of OCLI with other variables is shown mathematically as follows :

OCLI= f (COM, MSE, SEM, AAM)

This implies that OCLI is a function of COM,MSE, SEM and AAM.

The relationship of OCLI (5) with COM (1), MSE (2), SEM (3) and AAM (4) of students is shown statistically through the multiple regression equation as follows :

$$R^2_{5.1234} = \beta_{51.234} r_{15} + \beta_{52.134} r_{25} + \beta_{53.124} r_{35} + \beta_{54.123} r_{45}$$

The following are the statistics obtained from the data :

The following are the statistics obtained from the data :

Multiple Correlation of OCLI with COM, MSE, SEMand AAM:

$$R^2_{5.1234} = 0.5599 \text{ (P<0.0001) and } R_{5.1234} = 0.7483$$

$$R^2_{5.1234} = 0.0569 + 0.1766 + 0.2514 + 0.075 = 0.5599$$

This is followed by testing the significance of the β coefficients obtained in the preceding multiple regression equation as follows in table3.

TABLE 3 :SIGNIFICANCE OF β COEFFICIENTS FOR OCLI

Variable	Standardised Regression Weight	Magnitude	t	LoS
COM	$\beta_{15.234}$	0.1913	2.52	0.01
MSE	$\beta_{25.134}$	0.4125	4.37	0.01
SEM	$\beta_{35.124}$	0.4734	6.17	0.01
AAM	$\beta_{45.123}$	0.2368	3.18	0.01

The research hypothesis is accepted at P<0.0001. In other words, there is a significant combined relationship of students' opinion on co-operative learning implementation with their conception of mathematics, mathematics self-efficacy, student engagement and academic achievement of students.

It may be seen that 5.69%, 17.66%, 25.14% and 7.5% of the variance in OCLI is explained by COM, MSE, SEM and AAM respectively. Overall, 55.99% of the variance in OCLIis explained by these four variables taken together.

Table 7 shows a comparison of the contribution of COM, MSE, SEM andAAM to OCLI of students.

TABLE 4 : CONTRIBUTION OF COM, MSE AND SEM TO AAM IN CG AND EG

VARIABLE	EG
COM	5.69%
MSE	17.66%
SEM	25.14%
AAM	7.5%
Total $100R^2$	**55.99%**

Formula of Cohen's Effect Size in Multiple Correlation (http://www.real-statistics.com/multiple-regression/statistical-power-sample-size-multiple-regression/):

$$f^2 = \frac{R^2}{1 - R^2}$$

$f2$ = 0.02 represents a small effect, $f2$ = 0.15 represents a medium effect and $f2$ =0.35 represents a large effect.

Table5 showsthe effect size of the multiple correlation.

TABLE 5 : EFFECT SIZE OF MULTIPLE CORRELATION

Effect Size	Magnitude
1.2722	Large Effect

It can be seen from table 5 that in the co-operative learning approach, the effect size of COM, MSE, SEM and AAM is large.

Conclusion : It can be seen from the preceding analysis that :

a.The contribution of conception of mathematics (5.69%) and academic achievement in mathematics (7.5%) of students to students' opinion on implementation of co-operative learning is the lowest.

b.The contribution of student engagement in mathematics (25.14%) is the highest followed by their mathematical self-efficacy (17.66%).

Discussion : It can be seen from the conclusion that students' opinion on implementation of co-operative learning depends largely on their student engagement in mathematics and mathematical self-efficacy (42.80%). The

contribution of students' academic achievement in mathematics and conceptions of mathematics is relatively smaller (13.19%).

When students are exposed to co-operative learning approach in the class, they get social and academic support from their peers. This is expected to strengthen their mathematics self-efficacy beliefs. On the other hand, students exposed to traditional teaching of mathematics may have a feeling of inadequacy in comparison with peers which is likely to undermine their mathematics self-efficacy beliefs.

Besides, Linnenbrink and Pintrich (2003)opine that behavioural engagement is the observable behaviour seen in the classroom. This involves the efforts put in by students into mathematical tasks and how students interact with their peers the teacher in terms of their readiness to seek help, attend the classes and so on. Higher self-efficacy is expected to boost perseverance while handling difficult mathematical concepts and problems. On the other hand, lower self-efficacy leads to feelings of helplessness and an early acceptance of failure. Moreover, students with low self-efficacy are less likely to seek help from peers as they fear that others will interpret their difficulty as foolishness or ignorance. Co-operative learning reduces such feelings of foolishness or ignorance in the students through positive interdependence among students and thus students' behavioural engagement is enhanced. Besides, the way that co-operative learning sessions are structured and how the peers and teacher interact with students is significant in cognitive engagement of students. Strong self-efficacy beliefs imply that student believes that they can complete a task. A student with a strong self-efficacy is likely to engage with appropriate cognitive strategies in order to complete it. Students who doubt their ability to undertake and complete a task are less likely to persevere in applying cognitive and meta-cognitive strategies and will become disengaged if success is not immediate. In addition, affective engagement includes the personal interest that the student has in the mathematics, the utility that the student feels the subject brings and the general importance of mathematical knowledge and skills to longer term goals or desires and hence is motivated to engage in learning.

Regarding student engagement, Ganotice and King (2014) in their study on social influences on students' academic engagement and science achievement found that peer support seemed to be more salient compared to parental and teacher support in enhancing student engagement. Co-operative learning provides ample social and academic peer support. Hence, student engagement in co-operative learning is found to be higher as compared to students from the traditional class. Besides, engagement leads to sustained interaction and practice (Ervin, Meltzer and Dukes, 2007). Social involvement is a source of influence on learning and intellectual development of students (Pascarella, 1985; Pike, 1999; Pike, Kuh&Gonyea, 2003). This in turn leads to stronger influence academic achievement of students in the co-operative learning group as compared to those in the control group.

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