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Effect of Computer supported Cooperative and Competitive Learning Strategies on achievement in Science in relation to Goal Orientation

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ABSTRACT

The present study investigates the effect of computer supported cooperative learning strategy and computer supported competitive learning strategy on science achievement in relation to goal orientation, along with its two dimensions – mastery goal orientation and performance goal orientation. The study was confined to class IX science students of English medium government co-educational schools of Chandigarh, affiliated to CBSE, New Delhi. The study was experimental in nature, employing pre-test and post-test factorial design. 300 students selected by purposive multi-stage random sampling technique were divided into experimental groups – I & II and control group of composition 100 each. These groups were taught instructional material based on computer supported cooperative and competitive learning strategies and conventional teaching strategy respectively by investigators themselves. Tools used to collect data were science achievement test developed by investigators themselves, and goal orientation scale developed by Sreekala (2013). In order to analyze the data, descriptive statistics (like mean and standard deviation) and inferential statistics such as Analysis of Variance (3×3) and t-ratio were used. The results revealed statistically significant difference in favour of experimental groups (computer supported cooperative and competitive learning strategies) for increasing science achievement, in comparison to conventional teaching strategy. Further analysis revealed that the science achievement of groups taught through computer supported cooperative and competitive learning strategies was not significantly different from each other. In light of findings, the research work concludes by discussing educational implications and suggestions for future research.

1. Introduction

Achievement is the end product of all educational endeavours (Balasubriamaniam, 1993). Importance of achievement is much more pronounced in competitive world of today. At each stage in the school, some measures of achievement are used as a determinant of the status of student in classroom and as a basis for decision about the further opportunities for learning that can be provided in further upcoming stages. Hence, needless to mention, higher achievement is strong predictor of success in further education, employment and self development (Pannu, 2010). The referred issue of registering high achievement of the students has acquired much significance, particularly in the field of science, because presently we live in a society that is characterized by scientific and technological revolution. It wouldn't be an exaggeration if one claims that modern society has science as part and parcel of life. Given the pervasive and ramifying impact of science in every department of life, every man must be acquainted with science, both as a product as well as a process (Darchhingpuii, 1988). Given this background, demand of accomplishment of high achievement in science for all students lays well pronounced.

Resultantly, curriculum and pedagogical pundits continue to execute search operation on teaching methods, curriculum contents, instructional materials, and other assistant factors which they believe may influence the ability of the learners to want to learn more science, and thereby help deliver high science achievement. As far as teaching methods go, different teaching techniques have been suggested and hence adopted to enhance students' performance in science, ranging from some teacher-centered techniques to other learner-centered methods (Oloyede, Adebowale, & Ojo, 2012). Debatable area in this domain is whether time-tested formula of teacher-centered instructional method will be successful in making students understand the so-called intricacies involved in a subject like science; or whether students need to be engaged in creative acquisition of knowledge through learner centered methods (may be in form of combination of technology and certain social interactional pattern like cooperation/competition based activities) in order to better understand scientific concepts and principles.

Literature evidence concerning the relative effectiveness of these teaching techniques, the ones based on cooperative or competitive learning strategy, along with their preferences on practical grounds have been varied and mixed (Oloyede, Adebowale, & Ojo, 2012). Infact, a consensus on superiority of computer supported cooperative learning strategy or computer supported competitive learning strategy, as learner centered methods proposed in present work, is pending till date. Another area of concern is that though it is admitted by one and all that technology affects almost all components of education, still there is disagreement among researchers as to whether the instructional use of computers affects students' achievement in positive way or negative way. While Kulik, Bangert and Williams (1983) reported that the individualistic use of computers, based

on one computer-one student approach, raises student achievement; Clark (1994) opined that the computer is a vehicle that imparts instruction but does not in and of itself affect student achievement in any way.

Now if a conclusion surfaces that cooperatively structured learning tends to promote higher achievement than do competitive learning situations (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981), then the argument of "computer is only a vehicle" would predict that computer supported cooperative instruction will promote higher achievement than will computer supported competitive instruction. If, on the other hand, the computer increases student achievement owing to the opportunity grabbed by each student to work on a computer individually, on competitive lines, then it may be hypothesized that computer supported competitive instruction may promote higher achievement than computer supported cooperative instruction (Johnson, Johnson, & Stanne, 1986). The major purpose of this study is to clarify relative effect of these two instructional strategies in light of fact that particular individual results of an interactional pattern (cooperative or competitive learning strategy), or computer based instruction, on science achievement of students, just cannot be arithmetically added to account for the composite result of using computer along with the referred interactional pattern.

Besides the emphasis on environmental control attempted by the teacher in form of adoption of particular learning strategy, adopting an integrated approach to learning by emphasizing the cognitive/affective state of learner can go a long way in keeping all learners satisfied in process of attaining high science achievement. Goal orientation is one of the significant cognitive/affective states of learner that can affect the learning outcomes as the learner's mental mediator or moderator. Peng (2007) quotes that goal orientation refers to the purposes or reasons behind the achievement pursuits of an individual (Dweck & Leggett, 1988; Maehr, 1989). Ames (1992) defined goal orientation as a set of integrated patterns of behavior that are manifested by varied ways of approaching or engaging in different tasks (Berry, 2007).

The original conception of goal orientation resorted to dichotomous classification in the sense that a student can adopt just one goal orientation – mastery goal orientation or performance goal orientation. Nevertheless, recent trend is one of a multiple-goal perspective. This perspective assumes that endorsement of both mastery and performance-oriented goals may be most fruitful in that a person may reap the benefits from both goals (Pintrich, 2000; Barron &Harackiewicz, 2001). For instance, simultaneous adoption of both mastery and performance-oriented goals may enable students to maintain more interest as predicted by mastery goals and higher classroom performance as predicted by performance goals (Peng, 2007). Nevertheless, any kind of competency involved in concept of goal orientation can cross the path of any learning strategy adopted to enhance science achievement; so extent of aspired upgradation of science achievement is likely to be influenced by the interaction between the learner's referred mental mediator (goal orientation) and the specific treatment presented (computer supported cooperative learning strategy v/s computer supported competitive learning strategy).

2. Need and Significance

Educational research has always shown keen interest in exploration of relationship of various variables with academic achievement. However, in this relation, it is a recently observed phenomenon that it has shifted its focus from emphasis on specific pupil characteristics to the influence of broad situational factors on academic achievement (Rzoska& Ward, 1991). In this regard, despite an already extensive collection of research examining the effects of one of such situational factors - social interdependence (positive interdependence as manifested in cooperative learning structure, negative interdependence as manifested in competitive learning structure) on various learning outcomes (Hilk, 2013), a significant opportunity has been grabbed by the researcher to generate refined understanding of relative effects of these two interdependence forms - cooperative and competitive learning structures in a computer-supported form, on achievement of students in Indian context.

As far as rationale behind taking goal orientation (as a classifying variable) goes, the present study intents to provide empirical evidence to resolve the debate concerning relative potential benefits or detriments of adopting mastery goal orientation or performance goal orientation. Matter of resolving this debate becomes all together more important in light of certain research studies' argument that achievement behaviour is motivated by different goals (Nicholls, 1989; Tauer & Harackiewicz, 1999; King, McInerney, & Watkins, 2012). While individuals with performance goal orientation are the one motivated by competition, individuals with mastery goal orientation don't like competitive situations (Franken & Brown, 1995). Nevertheless, there is some disagreement about how students with different entering personal achievement goals respond to the goal structure of the classroom. As such, placing the students with pre-existing personal goals (in terms of mastery and performance goal orientation), in different experimentally manipulated classroom goals (in terms of computer supported cooperative and competitive learning strategy) may reveal interesting aspects on learning outcomes.

3. Objectives

1. To compare the achievement in science of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy.
2. To compare the achievement in science of groups having high, average and low goal orientation.
    a. To compare the achievement in science of groups having high, average and low mastery goal orientation.
    b. To compare the achievement in science of groups having high, average and low performance goal orientation.
3. To examine the interaction effect of instructional strategies and goal orientation on achievement in science.
    a. To examine the interaction effect of instructional strategies and mastery goal orientation on achievement in science.

b. To examine the interaction effect of instructional strategies and performance goal orientation on achievement in science.

4. Hypotheses

H_1: There exists no significant difference between the achievement in science of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy.

H_2: There exists no significant difference between the achievement in science of groups having high, average and low goal orientation.

$H_{2\ (i)}$: There exists no significant difference between the achievement in science of groups having high, average and low mastery goal orientation.

$H_{2\ (ii)}$: There exists no significant difference between the achievement in science of groups having high, average and low performance goal orientation.

H_3: There exists no significant interaction effect of instructional strategies and goal orientation on achievement in science.

$H_{3\ (i)}$: There exists no significant interaction effect of instructional strategies and mastery goal orientation on achievement in science.

$H_{3\ (ii)}$: There exists no significant interaction effect of instructional strategies and performance goal orientation on achievement in science.

5. Sample

The purposive random sampling was used to select two schools out of English medium government co-educational schools of Chandigarh, affiliated to Central Board of Secondary Education, New Delhi. Further, the selected schools were compared with regards to the criteria that the schools have almost same school and classroom environment, physical facilities, computer labs, etc. The two schools taken for the study are listed such as: (i) Government Model High School, Manimajra, Chandigarh (ii) Government Model Senior Secondary School, Sector-19, Chandigarh. After selecting schools, the intact sections of each school were randomly taken for experimental groups - I & II and control group with the intention to take an initial sample of atleast 150 from each school. Specifically, the present study was conducted on a initial sample of 330 students of IX class. The initial sample consisted of 330 students, as at least 150 students were intended to be selected from each school to be included in the sample for the study, for allocation of 100 students each to experimental group-I, experimental group-II and control group. However, certain dropout cases were observed during experimental treatment. On exclusion of dropout cases, the sample got reshaped and eventually consisted of 309 (103 + 105 + 101) students. However, in order to bring uniformity in structure of group allocation, three cases from experimental group-I, five cases from experimental group-II, and one case from control group was randomly selected and left out during data analysis intentionally. So, as per final uniform structure of group allocation, experimental groups – I & II, and control group comprised of 100 students each, making a total of 300 students whose scores were subjected to data analysis.

6. Design

The present study was experimental in nature. A pre-test and post-test factorial design was employed. In order to analyze the data, Analysis of Variance (3×3) was used. The experimental groups- I & II were taught through computer supported cooperative and competitive learning strategy and control group was taught through conventional teaching strategy. The study covered two independent variables, i.e. instructional strategy and goal orientation with its two dimensions. The variable of instructional strategy was studied at three levels such as computer supported cooperative and competitive learning strategy and conventional teaching strategy. The variable of goal orientation was studied at three levels, viz. high, average and low goal orientation. Further, sub-dimensions of goal orientation were studied at high, average and low level of mastery and performance goal orientation. The main dependent variable was science achievement which has been calculated as the difference in post-test and pre-test scores of the students.

7. Tools Used

The following tools were used for data collection:

i. A Criterion Referenced Test in Science was developed by the investigator herself.
ii. An Achievement Test in Science was developed by the investigator herself.
iii. Instructional Material for Computer Supported Cooperative Learning Strategy, Computer Supported Competitive Learning Strategy and Conventional Teaching Strategy, on topics such as states of matter, cells, tissues, motion, etc. from the prescribed syllabus of IX class for subject science, was developed by the investigator herself.
iv. Goal Orientation Scale by Sreekala (2013) was used.

8. Procedure

After selection of the students sample and allocation of the students in three groups for instructional strategies, the experiment was conducted in four phases. *Firstly*, goal orientation scale was administered for the classification of students on the variable of goal orientation along with its two dimensions, i.e. mastery and performance goal orientation. This step not only enabled classification of sample into three groups having high, average and low goal orientation but also with respect to its two dimensions, in terms of three groups having high, average and low mastery goal orientation, as well as three groups having high, average and low performance goal orientation. *Secondly*, achievement test in science as pre-test was administered to the students of experimental and control groups. The answer sheets of science achievement test were scored, as per scoring key, to obtain the information with regard to achievement in science. *Thirdly*, treatment was given to the experimental groups by the investigators. The experimental groups – I & II were taught through computer supported cooperative and competitive learning strategy. 15 lesson plans in science based on computer supported cooperative and competitive learning strategy were delivered to the students. On the other hand, the control group was taught the same topics through conventional teaching strategy by the investigators themselves. The duration of instructional treatment was 18

sessions in each group, and time for each session was about 45 minutes. *Fourthly*, after the completion of the experiment, same achievement test in science was administered as post-test to the students of all the groups. The answer sheets were scored with the help of scoring key. The scores of experimental and control groups were compared according to their pre-test and post-test scores with respect to achievement in science.

9. Analysis and Interpretation

The obtained data was analyzed through descriptive statistics like mean and standard deviation to see the nature of distribution of the scores. The data was also analyzed through inferential statistics, like two-way analysis of variance (3×3) was employed on mean gain science achievement scores to test various hypotheses.

• *Analysis of Descriptive Statistics*

The means and standard deviation for obtained gain science achievement scores of experimental and control groups with respect to mastery, performance and overall goal orientation have been presented in table-1

Table 1: Mean and SD of gain science achievement for different sub-groups of goal orientation

Dependent Variable	Goal Orientation	Sub-Groups of Goal Orientation	Experimental Group-I			Experimental Group-II			Control Group		
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Science Achievement	Mastery Goal Orientation	High	34	19.00	4.76	46	16.83	5.45	45	11.96	3.97
		Average	55	18.15	6.03	35	18.20	5.88	38	11.97	5.17
		Low	11	16.36	7.00	19	18.53	5.33	17	11.76	5.54
		Total	100	18.24	5.74	100	17.63	5.58	100	11.93	4.68
	Performance Goal Orientation	High	26	19.77	5.03	35	16.69	5.53	26	12.38	4.32
		Average	54	17.74	5.74	43	18.26	5.68	52	12.27	5.14
		Low	20	17.60	6.47	22	17.91	5.49	22	10.59	3.83
		Total	100	18.24	5.74	100	17.63	5.58	100	11.93	4.68
	Overall Goal Orientation	High	33	18.70	4.73	41	16.49	5.37	34	12.35	3.88
		Average	49	18.82	5.65	39	18.31	5.90	52	11.92	5.14
		Low	18	15.83	7.20	20	18.65	5.18	14	10.93	4.88
		Total	100	18.24	5.74	100	17.63	5.58	100	11.93	4.68

Source: Field Study, 2016

Table-1 reveals that total mean gain science achievement scores of experimental group-I taught through computer supported cooperative learning strategy was higher than that of experimental group-II taught through computer supported competitive learning strategy and control group taught through conventional teaching strategy. It further indicates that the science achievement of high mastery, performance and overall goal orientation scorers, and average overall goal orientation scorers is higher in experimental group-I than that of experimental group-II and control group, while science achievement of average as well as low mastery and performance goal orientation scorers, and low overall goal orientation scorers is higher in experimental group-II than that of experimental group-I and control group. The mean gain science achievement scores of high and average overall goal orientation group taught through computer supported cooperative learning strategy and conventional teaching strategy were higher than that of low group, while the mean gain science achievement scores of low overall goal orientation group taught through computer supported competitive learning strategy were higher than that of high and average group. To probe deeper, analysis of variance was employed for the data.

• *Analysis of Variance on Gain Science Achievement Scores*

For different sub-groups, sum of squares, degree of freedom, mean sum of squares and F-ratio on gain science achievement scores with respect to mastery, performance and overall goal orientation have been presented in table-2.

Table 2: Summary of Analysis of Variance (3×3) factorial design on gain achievement scores

Dependent Variable	Classifying Variable	Source of Variance	Sum of Squares	df	Mean Sum of Squares	F-ratio
Science Achievement	Overall Goal Orientation	Instructional Strategies (A)	1928.88	2	964.44	33.95**
		Goal Orientation (B)	56.68	2	28.34	1.00
		Interaction (A × B)	189.09	4	47.27	1.66
		Error Term	8266.30	291	28.41	
	Mastery Goal Orientation	Instructional Strategies (A)	1912.51	2	956.25	33.17**
		Mastery Goal Orientation (B1)	10.13	2	5.07	0.18
		Interaction (A × B1)	111.88	4	27.97	0.97
		Error Term	8390.27	291	28.83	

	Performance Goal Orientation	Instructional Strategies (A)	2289.88	2	1144.94	40.03**
		Performance Goal Orientation (B2)	33.42	2	16.71	0.58
		Interaction (A × B2)	156.61	4	39.15	1.37
		Error Term	8323.04	291	28.60	

***Significant at 0.01 level*
(Critical Value 3.03 at 0.05 and 4.68 at 0.01 levels, df 2/291)
(Critical Value 2.41 at 0.05 and 3.38 at 0.01 levesl, df 4/291)

Main Effects

Instructional Strategies (A)

Table-2 reveals that the F-ratio for difference in gain science achievement scores of different instructional strategies groups was 33.95, which in comparison to the table value was found highly significant at 0.01 levels of significance. It shows that the experimental and control groups were different beyond the contribution of chance. Hence the null hypothesis H1: There exists no significant difference between the achievement in science of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy, was rejected. The result indicates that the science achievement of experimental teaching strategy groups was higher than that of conventional teaching strategy group.

In order to probe deeper, F-ratio was followed by t-test. The values of the t-ratio for different combination of gain science achievement scores of experimental and control groups have been given in table-3.

Table-3: t-ratio for various combinations of different instructional strategies

Variable	Experimental Group-I			Experimental Group-II			Control Group		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
	100	18.24	5.74	100	17.63	5.58	100	11.93	4.68
Experimental Group-I N 100 Mean 18.24 SD 5.74	…			0.76			8.52**		
Experimental Group-II N 100 Mean 17.63 SD 5.58	…			…			7.83**		
Control Group N 100 Mean 11.93 SD 4.68	…			…			…		

*** Significant at 0.01 level*
(Critical Value 1.97 at 0.05 and 2.60 at 0.01 level, df = 198)

Table-3 shows that the gain science achievement scores of experimental group-I taught through computer supported cooperative learning strategy was 18.24, which is more than the corresponding mean gain science achievement scores of 17.63 for the experimental group-II taught through computer supported competitive learning strategy. The t-value testing the significance of mean difference in science achievement scores of experimental groups - I and II was 0.76, which in comparison to the table value was not found significant even at 0.05 levels of significance. The result indicates that there is no significant difference between the mean gain science achievements scores of students taught through computer supported cooperative learning strategy group than that of computer supported competitive learning strategy group.

Table-3 also shows that the gain science achievement scores of experimental group-I taught through computer supported cooperative learning strategy was 18.24, which is more than the corresponding mean gain science achievement scores of 11.93 for the control group taught through conventional teaching strategy. The t-value testing the significance of mean difference in science achievement scores of experimental group-I and control group was 8.52, which in comparison to the table value was found significant at 0.01 level of significance. The result indicates that the students taught through computer supported cooperative learning strategy group perform significantly better than that of conventional teaching strategy group.

Table-3 further shows that the gain science achievement scores of experimental group-II taught through computer supported competitive learning strategy was 17.63, which is more than the corresponding mean gain science achievement scores of 11.93 for the control group taught through conventional teaching strategy. The t-value testing the significance of mean difference in science achievement scores of experimental group-II and control group was 7.83, which in comparison to the table value was found significant at 0.01 levels of significance. The result indicates that the students taught through computer supported competitive learning strategy group perform significantly better than that of conventional teaching strategy group.

Goal Orientation (B)

Table-2 indicates that the F-ratio for difference in gain science achievement scores for students having high, average and low goal orientation was 1.00, which in comparison to the table value was not found significant even at 0.05 levels of significance. Hence, the null hypothesis **H_2:** There exists no significant difference between the achievement in science of groups having high, average and low goal orientation, was

accepted. The result indicates that the groups having high, average and low goal orientation are not significantly different with respect to gain science achievement scores.

i. Mastery Goal Orientation (B_1)

Table-2 indicates that the F-ratio for difference in gain science achievement scores for students having high, average and low mastery goal orientation was 0.18, which in comparison to the table value was not found significant even at 0.05 levels of significance. Hence, the null hypothesis **$H_{2\,(i)}$:** There exists no significant difference between the achievement in science of groups having high, average and low mastery goal orientation, was accepted. The result indicates that the groups having high, average and low mastery goal orientation are not significantly different with respect to gain science achievement scores.

ii. Performance Goal Orientation (B_2)

Table-2 indicates that the F-ratio for difference in gain science achievement scores for students having high, average and low performance goal orientation was 0.58, which in comparison to the table value was not found significant even at 0.05 levels of significance. Hence, the null hypothesis **$H_{2\,(ii)}$:** There exists no significant difference between the achievement in science of groups having high, average and low performance goal orientation, was accepted. The result indicates that the groups having high, average and low performance goal orientation are not significantly different with respect to gain science achievement scores.

Interaction Effect

Interaction between Instructional Strategies and Goal Orientation (A×B)

Table-2 reveals that the F-ratio for interaction between instructional strategies and goal orientation groups was 1.66, which in comparison to the table value was not found significant even at 0.05 levels of significance. It shows that the variable of instructional strategy do not interact with goal orientation to yield significant difference with respect to gain science achievement scores. Hence, the null hypothesis **H_3:** There exists no significant interaction effect of instructional strategies and goal orientation on achievement in science, was accepted. The result indicates that there is no significant difference in gain science achievement scores due to interaction effect of instructional strategies and goal orientation groups.

Interaction between Instructional Strategies and Mastery Goal Orientation ($A×B_1$)

Table-2 reveals that the F-ratio for interaction between instructional strategies and mastery goal orientation groups was 0.18, which in comparison to the table value was not found significant even at 0.05 levels of significance. It shows that the variable of instructional strategies do not interact with mastery goal orientation to yield significant difference with respect to gain science achievement scores. Hence, the null hypothesis **$H_{3\,(i)}$:** There exists no significant interaction effect of instructional strategies and mastery goal orientation on achievement in science, was accepted. The result indicates that there is no significant difference in gain science achievement scores due to interaction effect of instructional strategies and mastery goal orientation groups.

Interaction between Instructional Strategies and Performance Goal Orientation ($A×B_2$)

Table-2 reveals that the F-ratio for interaction between instructional strategies and performance goal orientation groups was 0.58, which in comparison to the table value was not found significant even at 0.05 levels of significance. It shows that the variable of instructional strategies do not interact with performance goal orientation to yield significant difference with respect to gain science achievement scores. Hence, the null hypothesis **$H_{3\,(ii)}$:** There exists no significant interaction effect of instructional strategies and performance goal orientation on achievement in science, was accepted. The result indicates that there is no significant difference in gain science achievement scores due to interaction effect of instructional strategies and performance goal orientation groups.

10. Discussion

Instructional Strategies and Achievement

The present study reveals that there exists difference between achievement in science of groups taught through computer supported cooperative learning strategy, computer supported competitive learning strategy, and conventional teaching strategy. Hence, the null hypothesis **H_1:** There exists no significant difference between the achievement in science of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy, was rejected. A discussion of results with regard to comparative account of different instructional strategies is as follows:

- **Computer Supported Cooperative Learning Strategy and Conventional Teaching Strategy**

The present study reveals that the computer supported cooperative learning strategy was more effective than conventional teaching strategy. This result is supported by the finding of Signer (1992) who investigated a model of computer based cooperative learning and reported positive findings concerning its potential in improving team performance. Yaibua (2005)suggested that multimedia computer assisted instruction in cooperative learning situation delivers significantly better results in terms of achievement in vocational subjects as compared to conventional learning. Ragasa (2008) pointed out that combination of computer assisted instruction and cooperative learning in basic statistics improves learning in comparison to traditional approach. Gambari, Shittu and Taiwo (2013) showed that performance in mathematical concepts of students exposed to cooperative computer instruction was better than their counterparts exposed to conventional classroom instruction.

However, this finding of present study is contradicted by some studies like Underwood, McCaffrey and Underwood (1990) found that performance of mixed gender pairs did not

improve while engaging in group work in computer based classroom, in comparison to conventional classroom setup.

- **Computer Supported Competitive Learning Strategy and Conventional Teaching Strategy**

The present study reveals that the computer supported competitive learning strategy was more effective than conventional teaching strategy. This result is supported by the finding of Okereke and Ugwuegbulam (2014) which recommended that students should be motivated to learn through healthy quiz competitions as competitive learning strategies were found to enhance students' learning outcomes in chemistry. Chen, Law and Chen (2017) found that incorporation of element of competition in game based learning environment enhances performance of science students in comparison to conventional approach.

However, this finding of present study is contradicted by studies like one conducted by Ladd and Fiske (2003) who concluded that element of competition generates negative effects on the quality of student learning and other aspects of schooling.

- **Computer Supported Cooperative and Competitive Learning Strategies**

The present study reveals that though mean gain science achievement scores of group taught by computer supported cooperative learning strategy was higher than that of computer supported competitive learning strategy, but no significant difference exists between the two strategies in terms of science achievement. This finding is supported by Johnson, Johnson and Stanne (1985) who indicated that computer assisted cooperative instruction promotes greater quality and quantity of daily achievement than does computer assisted competitive learning. However, Sherman (1989) concluded that groups involving in cooperative or competitive techniques were not statistically different from each other with respect to achievement in biology and hence neither of the two treatments can be said to be superior over the other in promoting academic achievement.

However, this finding of present study is contradicted by some studies like Wang (2012) highlighted favourable effect of competition in form of external pressure that enhances group cohesion and assist students' meaningful learning in chemistry.

Goal Orientation and Achievement

The present study reveals that there exists no significant difference between the achievement in science of groups having high, average and low goal orientation. Hence, the null hypothesis **H_2:** There exists no significant difference between the achievement in science of groups having high, average and low goal orientation, was accepted. This result is supported by thefindings of Peng (2007) which indicated that level of goal orientation does not influence student achievement in arts and general academic classrooms. Likewise, Stankov and Lee (2014) pointed out that measure of goal orientation has lowest possible correlation with achievement. However, this finding of present study is contradicted by some studies like Henry (1969) supported salience of goal orientation in understanding academic achievement motivation and hence serve as better predictor of academic achievement. Frese, Stewart and Hannover (1987) too found substantial correlation between goal orientation and performance measure namely grade point average in students. Church, Elliot and Gable (2001) revealed that goal orientation of students tend to directly influence graded performance of students.

i. Mastery Goal Orientation and Achievement

The present study reveals that there exists no significant difference between the achievement in science of groups having high, average and low mastery goal orientation. Hence, the null hypothesis **$H_{2\ (i)}$:** There exists no significant difference between the achievement in science of groups having high, average and low mastery goal orientation, was accepted. This result is supported by the findings of Peklaj and Levpuscek (2006) which found mastery goal orientation in terms of intrinsic motivation as unrelated to academic achievement. Meissel and Rubie-Davies (2016) suggested that there was no significant relationship between the levels of mastery goal orientation and end-of-year achievement. However, this finding of present study is contradicted by some studies like Pintrich and DeGroot (1990) found motivational orientation in terms of intrinsic value (mastery goal orientation) as positively related to classroom academic performance in science and English. Alrakaf et al. (2015) revealed statistically significant positive relationship between mastery goal orientation and academic performance of pharmacy students.

ii. Performance Goal Orientation and Achievement

The present study reveals that there exists no significant difference between the achievement in science of groups having high, average and low performance goal orientation. Hence, the null hypothesis **$H_{2\ (ii)}$:** There exists no significant difference between the achievement in science of groups having high, average and low performance goal orientation, was accepted. This finding is supported by Mattern (2005) whose results did not indicate performance goal orientation to be significantly related to course grades. However, this finding of present study is contradicted by some studies like Bouffard, Boisvert, Vezeau and Larouche (1995), Carpenter (2007), and Elliot, Jury and Murayama (2017) which pointed out systematic positive relation existing between performance goal orientation and academic achievement. Further, Phillips and Gully (1997) highlighted negative relation of performance goal orientation with individual performance.

Instructional Strategies, Goal Orientation and Achievement

The present study reveals that that there was no significant difference in gain achievement scores in science due to interaction effect of instructional strategies and goal orientation groups. Hence, the null hypothesis **H_3**: There exists no significant interaction effect of instructional strategies and goal orientation on achievement in science, was accepted. This result is supported by the findings of Butler and Kedar (1990) which indicated that group engaging in learning which

emphasizes competitive values and activities did not relate to different levels of goal orientation and consequent performance. However, this finding of present study is contradicted by some studies like Katz (2001) highlighted interaction effect of instructional strategy and goal orientation on achievement as his research result indicated that differences existed in achievement outcomes of learners with varying levels of goal orientation in an interactive hypermedia environment.

i. Instructional Strategies, Mastery Goal Orientation and Achievement

The present study reveals that there exists no significant interaction effect of instructional strategies and mastery goal orientation on achievement in science. Hence, the null hypothesis **$H_{3\,(i)}$:** There exists no significant interaction effect of instructional strategies and mastery goal orientation on achievement in science, was accepted. This result is supported by the findings of Tauer and Harackiewicz (2004) which did not indicate differences between effect of activities structured on lines of cooperation and competition, on task enjoyment or performance, with regard to intrinsic motivation (mastery goal orientation), thereby suggesting no interaction effect amongst these variables. However, this finding of present study is contradicted by studies of the kind attempted by Lin (1997) who found that students with varying level of mastery goal orientation in cooperative and competitive learning structures were different from each other in terms of mathematics achievement.

ii. Instructional Strategies, Performance Goal Orientation and Achievement

The present study reveals that there exists no significant interaction effect of instructional strategies and performance goal orientation on achievement in science. Hence, the null hypothesis **$H_{3\,(ii)}$**: There exists no significant interaction effect of instructional strategies and performance goal orientation on achievement in science, was accepted. This finding is supported by Pearson (2015) whose results indicated that despite their respective level of performance goal orientation, participants in a cooperative learning situation yield results in terms of achievement by cooperating with others who were perceived to demonstrate higher competency on task. However, this finding of present study is contradicted by some studies like Bergin and Cooks (2002) who in a qualitative research concluded that performance goal orientation amongst high-achieving students of color in competitive learning structure is adaptive in terms of higher grade point average. Soltani (2007) found performance goal orientation in a competitive environment to result in negative learning outcomes amongst graduate students.

11. Findings

1. The science achievement of group taught through computer supported cooperative learning strategy was better than that of computer supported competitive learning strategy and conventional teaching strategy. Further analysis revealed that:
   i. The science achievement of groups taught through computer supported cooperative and competitive learning strategies was not significantly different from each other.
   ii. The science achievement of group taught through computer supported cooperative learning strategy was significantly higher than that of conventional teaching strategy.
   iii. The science achievement of group taught through computer supported competitive learning strategy was significantly higher than that of conventional teaching strategy.
2. The performance of high, average and low goal orientation groups was not significantly different from each other with respect to science achievement.
   i. The performance of high, average and low mastery goal orientation groups was not significantly different from each other.
   ii. The performance of high, average and low performance goal orientation groups was not significantly different from each other.
3. There was no significant interaction effect of instructional strategies and goal orientation groups on science achievement.
   i. There was no significant interaction effect of instructional strategies and mastery goal orientation groups on science achievement.
   ii. There was no significant interaction effect of instructional strategies and performance goal orientation groups on science achievement.

12. Educational Implications

i. The case built in favour of experimental teaching strategies in comparison to conventional teaching strategy highlights the importance of specific pedagogical interventions for upgrading science achievement. This need becomes much more pronounced when traditional ‘chalk and talk’ method has become outdated, rendering it as ineffective.

ii. Technology should be increasingly utilized in instructional situations. For successful integration of technology in classrooms, chosen technology should be the one that students can ‘own’ and feel free to learn the subject material presented through it.

iii. Use of computers should not be restricted to individualized learning experiences. Students can be engaged in creative acquisition of knowledge through computers by employing combination of technology and certain social interactional pattern (in form of cooperation or competition).

iv. Though both computer supported cooperative learning strategy and computer supported competitive learning strategy can potentially impact students’ science achievement, still cooperative learning environment proves to be more fruitful than competitive set-ups. This is because cooperative learning involves working together of pupils in heterogeneous grouping, which helps in producing positive effects with respect to learners of varied abilities.

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