CODEN:IJHER   **ORIGINAL ARTICLE**

EFFECT OF COMPUTER SUPPORTED COOPERATIVE AND COMPETITIVE LEARNING STRATEGIES ON SCIENCE ANXIETY IN RELATION TO GOAL ORIENTATION

Ram Mehar[*] and Neha Singh[**]

*Associate Professor, Department of Education, USOL,
Panjab University, Chandigarh, India
** Department of Education, Panjab University, Chandigarh, India
Email: rammehar2008@gmail.com

Abstract

The present study investigates the effect of computer supported cooperative learning strategy and computer supported competitive learning strategy on science anxiety 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 anxiety scale developed by investigators themselves, and goal orientation scale developed by Sreekala (2013). In order to analyze the data, descriptive statistics such as 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 conventional teaching strategy in reducing science anxiety as compared to experimental groups i.e. computer supported cooperative and competitive learning strategies. Further, the results highlighted significant interaction effect of instructional strategies and overall goal orientation as well as mastery goal orientation on science anxiety. In light of findings, the research work concludes by discussing educational implications and suggestions for future research.

Introduction

Present society is characterized by scientific and technological revolution. A man without contact with science or its manifestations can be considered a complete misfit in such society. If we consider education as a process for preparation of a socially fit citizen, then it is imperative that every student as future citizen must register significant academic achievement, more particularly in science (Darchhingpuii, 1988). However, educational research has suggested that

science anxiety, as not an uncommon phenomenon, does exist in many students. Science anxiety is a fear or aversion toward science concepts, scientists, and/or science-related activities (Mallow, 1981). As per Mallow (1987), science anxiety is a debilitating interaction of emotion (fear) with cognition (science learning). Mallow and Greenburg (1982) proposed that though some amount of anxiety may actually help in the learning process, but a high level of anxiety hinders optimum performance in case of science learning. Given poor teaching techniques, lack of appropriate role models, and societal prejudices in relation to science, the baggage of science anxiety can be perceived as both cognitive and emotional. Hence, doing away with the ill-effects associated with such form of anxiety, can be regarded as one of the important steps toward improvement of science education for the coming generations (Mallow, 2006).

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 overcome science anxiety. 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 centred 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' learning outcomes 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 the bar of

student learning outcomes; Clark (1994) opined that the computer is a vehicle that imparts instruction but does not in and of itself affect student learning outcomes in any way.

Now if a conclusion surfaces that cooperatively structured learning tends to promote better learning outcomes 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 better learning outcomes than will computer supported competitive instruction. If, on the other hand, the computer raises the bar of student learning outcomes 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 better learning outcomes 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 anxiety 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 combating science anxiety. Goal orientation is one of the significant cognitive/affective state 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 tackle science anxiety; so extent of aspired reduction in science anxiety 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).

Need and Significance

Science anxiety is one factor that has capability of paralyzing students with respect to subject science, who by intelligence and hard work would have performed well otherwise (Hong, 2010). Science anxiety not only affects the self-image of students with respect to giving scores in science, but their subsequent capability as adult citizens as well, to make informed judgements with respect to science and technology components (Mallow et al, 2010). Given the cognitive as well as emotional baggage of science anxiety (Mallow, 2006), finding a way out to do away with ill effects associated with such form of anxiety is utmost need of the hour. In this relation, exploration of the relative effect of referred learning strategies (whether learner-centered methods of computer supported cooperative learning strategy v/s computer supported competitive learning strategy is more apt than time-tested formula of teacher-centered instructional method in form of conventional teaching strategy) can do the needful, and hence justifies the present study. Further, given the scarcity of studies in relation to science anxiety (though there is good amount of literature on anxiety in general), present attempt becomes all together more important to get a more precise picture of the effects of particular learning strategies on science anxiety.

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.

Objectives

1. To compare the science anxiety of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy.

2. To compare the science anxiety of groups having high, average and low goal orientation.

   2.1 To compare the science anxiety of groups having high, average and low mastery goal orientation.

   2.2 To compare the science anxiety of groups having high, average and low performance goal orientation.

3. To examine the interaction effect of instructional strategies and goal orientation on science anxiety.

   3.1 To examine the interaction effect of instructional strategies and mastery goal orientation on science anxiety.

   3.2 To examine the interaction effect of instructional strategies and performance goal orientation on science anxiety.

Hypotheses

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

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

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

   $H_{2(ii)}$: There exists no significant difference between the science anxiety 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 science anxiety.

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

H$_{3(ii)}$: There exists no significant interaction effect of instructional strategies and performance goal orientation on science anxiety.

Sample

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 atleast150 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.

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 anxiety which has been calculated as the difference in post-test and pre-test scores of the students.

Tools Used

The following tools were used for data collection:

(i)   Science Anxiety Scale was developed by the investigator herself.

(ii)   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.

(iii) Goal Orientation Scale by Sreekala (2013) was used.

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*, science anxiety scale as pre-test was administered to the students of experimental and control groups. The answer sheets of science anxiety scale were scored, as per scoring key, to obtain the information with regard to level of science anxiety in students. *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 science anxiety scale 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 science anxiety.

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 anxiety scores to test various hypotheses.

- **Analysis of Descriptive Statistics**

The means and standard deviation for obtained gain science anxiety 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 anxiety 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 Anxiety	Mastery Goal Orientation	High	34	-29.32	28.97	46	-17.09	13.20	45	-15.73	13.58
		Avg	55	-14.58	16.80	35	-17.14	11.40	38	-27.42	29.37
		Low	11	-19.45	17.14	19	-14.26	9.18	17	-29.24	20.43
		Total	100	-20.13	22.57	100	-16.57	11.85	100	-22.47	22.58
	Performance Goal Orientation	High	26	-21.73	22.67	35	-18.14	11.83	26	-20.00	17.09
		Avg	54	-18.87	23.72	43	-14.84	12.12	52	-21.58	21.76
		Low	20	-21.45	19.98	22	-17.45	11.42	22	-27.50	29.48
		Total	100	-20.13	22.57	100	-16.57	11.85	100	-22.47	22.58
	Overall Goal Orientation	High	33	-26.61	28.31	41	-17.66	13.43	34	-14.44	10.52
		Avg	49	-16.90	19.96	39	-15.59	10.52	52	-23.21	23.73
		Low	18	-17.06	14.56	20	-16.25	11.23	14	-39.21	30.31
		Total	100	-20.13	22.57	100	-16.57	11.85	100	-22.47	22.58

Source: Field Study, 2016

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

- **Analysis of Variance on Gain Science Anxiety Scores**

For different sub-groups, sum of squares, degree of freedom, mean sum of squares and F-ratio on gain science anxiety 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 anxiety scores

Dependent Variable	Classifying Variable	Source of Variance	Sum of Squares	df	Mean Sum of Squares	F-ratio
Science Anxiety	Overall Goal Orientation	Instructional Strategies (A)	3414.97	2	1707.48	4.67[*]
		Goal Orientation (B)	1185.54	2	592.77	1.62
		Interaction (A × B)	7540.05	4	1885.01	5.15[**]
		Error Term	106491.13	291	365.95	
	Mastery Goal Orientation	Instructional Strategies (A)	2767.96	2	1383.98	3.79[*]
		Mastery Goal Orientation (B_1)	83.74	2	41.87	0.12
		Interaction (A × B_1)	8274.69	4	2068.67	5.66[**]
		Error Term	106342.29	291	365.44	
	Performance Goal Orientation	Instructional Strategies (A)	1775.96	2	887.98	3.05[*]
		Performance Goal Orientation (B_2)	622.62	2	311.31	0.80
		Interaction (A × B_2)	539.64	4	134.91	0.35
		Error Term	113613.95	291	390.43	

[*]*Significant at 0.05 level*   [**]*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 levels, df 4/291)

MAIN EFFECTS

Instructional Strategies (A)

Table-2 reveals that the F-ratio for difference in gain science anxiety scores of different instructional strategies groups was 4.67, which in comparison to the table value was found significant at 0.05 levels of significance. It shows that the experimental and control groups were different beyond the contribution of chance. Hence the null hypothesis **H_1**: There exists no significant difference between the science anxiety of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy, was rejected. The

result indicates that the science anxiety of conventional teaching strategy group was lower than that of experimental teaching strategy groups.

In order to probe deeper, F-ratio was followed by t-test. The values of the t-ratio for different combination of gain science anxiety 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	-20.13	22.57	100	-16.57	11.85	100	-22.47	22.58
Experimental Group-I			...			1.40			0.73		
N	Mean	SD									
100	-20.13	22.57									
Experimental Group-II			...			...			2.31^{*}		
N	Mean	SD									
100	-16.57	11.85									
Control Group			...			...			...		
N	Mean	SD									
100	-22.47	22.58									

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

Table-3 shows that the gain science anxiety scores of experimental group-I taught through computer supported cooperative learning strategy was -20.13, which is lower than the corresponding mean gain science anxiety scores of -16.57 for the experimental group-II taught through computer supported competitive learning strategy. The t-value testing the significance of mean difference in science anxiety scores of experimental groups - I and II was 1.40, 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 anxiety 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 anxiety scores of experimental group-I taught through computer supported cooperative learning strategy was -20.13, which is higher than the

corresponding mean gain science anxiety scores of -22.47 for the control group taught through conventional teaching strategy. The t-value testing the significance of mean difference in science anxiety scores of experimental group-I and control group was 0.73, which in comparison to the table value was not found significant even at 0.05 level of significance. The result indicates that there is no significant difference between the mean gain science anxiety scores of students taught through computer supported cooperative learning strategy group than that of conventional teaching strategy group.

Table-3 further shows that the gain science anxiety scores of experimental group-II taught through computer supported competitive learning strategy was -16.57, which is higher than the corresponding mean gain science anxiety scores of -22.47 for the control group taught through conventional teaching strategy. The t-value testing the significance of mean difference in science anxiety scores of experimental group-II and control group was 2.31, which in comparison to the table value was found significant at 0.05 levels of significance. The result indicates that the students taught through conventional teaching strategy group show less science anxiety than that of computer supported competitive learning strategy group.

Goal Orientation (B)

Table-2 indicates that the F-ratio for difference in gain science anxiety scores for students having high, average and low goal orientation was 1.62, 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 science anxiety 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 anxiety scores.

(i) Mastery Goal Orientation (B_1)

Table-2 indicates that the F-ratio for difference in gain science anxiety scores for students having high, average and low mastery goal orientation was 0.12, 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 science anxiety 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 anxiety scores.

(ii) Performance Goal Orientation (B₂)

Table-2 indicates that the F-ratio for difference in gain science anxiety scores for students having high, average and low performance goal orientation was 0.80, 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 science anxiety 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 anxiety 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 5.15, which in comparison to the table value was found significant at 0.01 levels of significance. It shows that the variable of instructional strategies do interact with goal orientation to yield significant difference with respect to gain science anxiety scores. Hence, the null hypothesis H_3: There exists no significant interaction effect of instructional strategies and goal orientation on science anxiety, was rejected. The result indicates that there is significant difference in gain science anxiety scores due to interaction effect of instructional strategies and goal orientation groups.

(i)Interaction between Instructional Strategies and Mastery Goal Orientation (A×B₁)

Table-2 reveals that the F-ratio for interaction between instructional strategies and mastery goal orientation groups was 5.66, which in comparison to the table value was found significant at 0.01 levels of significance. It shows that the variable of instructional strategies do interact with mastery goal orientation to yield significant difference with respect to gain science anxiety scores. Hence, the null hypothesis $H_{3(i)}$: There exists no significant interaction effect of instructional strategies and mastery goal orientation on science anxiety, was rejected. The result indicates that

there is significant difference in gain science anxiety scores due to interaction effect of instructional strategies and mastery goal orientation groups.

(ii)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 0.35, 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 difference in science anxiety scores. Hence, the null hypothesis **H$_{3(ii)}$**: There exists no significant interaction effect of instructional strategies and performance goal orientation on science anxiety, was accepted. The result indicates that there is no significant difference in gain science anxiety scores due to interaction effect of instructional strategies and performance goal orientation groups.

Discussion

Instructional Strategies and Science Anxiety

The present study reveals that there exists significant difference between the science anxiety 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 science anxiety of groups taught through computer supported cooperative, competitive learning strategy and conventional teaching strategy, was rejected. Discussion of result 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 though the gain science anxiety scores of group taught by conventional teaching strategy was found lower than that of computer supported cooperative learning strategy, but no significant difference was discovered between the two strategies in terms of science anxiety. This result is supported by the findings of Altun (2015) which indicated that cooperative learning method has favourable effect on students' achievement in science, but at the same time cause science anxiety as well because it required students to be successful at all stages. Furthermore, no significant difference was discovered between cooperative learning practices and conventional teaching approach in terms of test anxiety in science as per Fournier, Couret, Ramsay and Caulkins (2017).

However, this finding of present study is contradicted by some studies like Pedersen (1992) indicated that study material presented in cooperative controversy framework tended to

decrease students' science anxiety. Minger (2000)concluded that in addition to providing a vehicle to learn the content material, the cooperative learning model also provides an environment that may help reduce science anxiety in students by allowing them to effectively discuss science topics in ways that promote success. Hong (2010) revealed that experimental group students resorting to collaborative science intervention experienced significant impact on reduction of their science anxiety.

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

   The present study reveals that the science anxiety of group taught by conventional teaching strategy reduced to significantly larger extent from pre-treatment level, in comparison to group taught by computer supported competitive learning strategy. The result indicates that conventional teaching strategy is more effective than computer supported competitive learning strategy for reduction of science anxiety. This result is supported by the finding of Singh and Jha (2013) which indicated that competitive environment tend to result in high level of science anxiety in case of as many as 56% medical students. However, this finding of present study is contradicted by some studies like Kaya and Yildirim (2014) found that lecture-based sessions as commonly employed in conventional teaching strategy tend to generate science anxiety in students, as such sessions tend to negatively influence students' feelings about the course.

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

   Though the gain science anxiety scores of group taught by computer supported cooperative learning strategy was found lower than that of computer supported competitive learning strategy, but no significant difference was discovered between the two strategies in terms of science anxiety. In other words, though the science anxiety of group taught by computer supported cooperative learning strategy reduced to larger extent from pre-treatment level, in comparison to group taught by computer supported competitive learning strategy; still in the absence of statistically significant difference between the two strategies in terms of science anxiety, neither of the two strategies can be said to be more effective for reduction of science anxiety.

Goal Orientation and Science Anxiety

   The present study reveals that there exists no significant difference between the science anxiety of groups having high, average, and low goal orientation. Hence, the null hypothesis H_2: There exists no significant difference between the science anxiety of groups having high, average and low goal orientation, was accepted. Though the investigator could not find any study related to this finding, but the investigator spotted some studies contradicting the referred result with

respect to anxiety of any other type or kind, though not science anxiety in particular. Like, Eum and Rice (2011) observed similar negative relationship between goal orientation and cognitive test anxiety. Vasquez-Colina, Gonzalez-DeHass and Furner (2014) reported that model including achievement goals predict a significant amount of variation in math anxiety, thereby indicating that level of goal orientation in students do relate to their level of math anxiety.

(i)   Mastery Goal Orientation and Science Anxiety

The present study reveals that there exists no significant difference between the science anxiety of groups having high, average, and low mastery goal orientation. Hence, the null hypothesis $H_{5(i)}$: There exists no significant difference between the science anxiety of groups having high, average and low mastery goal orientation, was accepted. Again, though the investigator could not find any study related to this finding, but the investigator spotted some studies contradicting the referred result with respect to anxiety of any other type or kind, though not science anxiety in particular. Like, Wolters, Shirley and Pintrich (1996) in a regression analyses revealed that adopting a mastery goal orientation results in a generally positive pattern of motivational beliefs including adaptive level of test anxiety. Koul, Lerdpornkulrat and Chantara (2011) found that mastery goal orientation is positively related to students' psychological wellness in terms of reduced physics and biology classroom anxiety.

(ii) Performance Goal Orientation and Science Anxiety

The present study reveals that there exists no significant difference between the science anxiety of groups having high, average, and low performance goal orientation. Hence, the null hypothesis $H_{2(ii)}$: There exists no significant difference between the science anxiety of groups having high, average and low performance goal orientation, was accepted. Again, though the investigator could not find any study related to this finding, but the investigator spotted some studies contradicting the referred result with respect to anxiety of any other type or kind, though not science anxiety in particular. Like, Sideridis (2005) undertook an investigation to evaluate and expand the goal orientation model of depression vulnerability and confirmed that performance goal orientation is negatively associated with anxiety and depression.

Instructional Strategies, Goal Orientation and Science Anxiety

The present study revealed that there is significant difference in mean gain science anxiety scores due to interaction effect of instructional strategies and goal orientation. Hence, the null hypothesis H_3: There exists no significant interaction effect of instructional strategies and goal orientation on science anxiety, was rejected. This result is supported by the findings of Neber and Schommer- Aikins (2002) which indicated that kind of learning structure in science classrooms

and individual prerequisites in terms of level of goal orientation has pronounced effect on test anxiety in science of highly gifted high school students. Muis, Ranellucci, Franco and Crippen (2013) too found that test anxiety of students in undergraduate chemistry course is reflective of assigned learning structure and individual goal orientation.

(i)   Instructional Strategies, Mastery Goal Orientation and Science Anxiety

The present study reveals that there is significant difference in mean gain science anxiety scores due to interaction effect of instructional strategies and mastery goal orientation. Hence, the null hypothesis $H_{3(i)}$: There exists no significant interaction effect of instructional strategies and mastery goal orientation on science anxiety, was rejected. This result is supported by the findings of Lodewyk, Winne and Jamieson-Noel (2009) which indicated that school tasks assigned to science students in varied learning structures interact with students' mastery goal orientation to influence their respective anxiety level.

(ii)   Instructional Strategies, Performance Goal Orientation and Science Anxiety

The present study reveals that there is no significant difference in mean gain science anxiety scores due to interaction effect of instructional strategies and performance goal orientation. Hence, the null hypothesis $H_{3(ii)}$: There exists no significant interaction effect of instructional strategies and performance goal orientation on science anxiety, was accepted. Though the investigator could not find any study related to this finding, but the investigator spotted some studies contradicting the referred result with respect to anxiety of any other type or kind, though not science anxiety in particular. Like, Koul, Roy and Lerdpornkulrat (2012) indicated that performance goal orientation of students is linked to cooperative or competitive learning environment and has pronounced effect on students' level of biology and physics classroom anxiety.

Findings

1. The science anxiety of group taught through conventional teaching strategy was lower than that of computer supported cooperative and competitive learning strategy.Further analysis revealed that:

   (i)   The science anxiety of groups taught through computer supported cooperative and competitive learning strategies was not significantly different from each other.

(ii) The science anxiety of groups taught through computer supported cooperative learning strategy and conventional teaching strategy was not significantly different from each other.

(iii) The science anxiety of group taught through conventional teaching strategy was significantly lower than that of computer supported competitive learning strategy.

2. The performance of high, average and low goal orientation groups was not significantly different from each other with respect to science anxiety.

    (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 significant interaction effect of instructional strategies and overall goal orientation groups on science anxiety.

    (i) There was significant interaction effect of instructional strategies and mastery goal orientation groups on science anxiety.

    (ii) There was no significant interaction effect of instructional strategies and performance goal orientation groups on science anxiety.

Educational Implications

(i) As indicated in present study, experimental teaching strategies like computer supported cooperative learning strategy and computer supported competitive learning strategy were not as effective in reducing science anxiety as conventional teaching strategy. This strikes a chord of importance of 'human element' while dealing with affective component like anxiety. Importance of such 'human element' perhaps becomes much more pronounced while using technology. This is because usage of technology can itself be a source of anxiety for some individuals who are not tech-savvy.

(ii) The present study indicated that students engaging in computer supported cooperative learning strategy exhibited lower science anxiety than computer supported competitive learning strategy, though not at significant level. This implies potential role of cooperation in reducing science anxiety, as students experience catharsis of feelings while engaging in group activities.

(iii)   Significant interaction effect of instructional strategies and goal orientation on science anxietyhas implications for teachers who can develop ways to mould goal orientation of students to target reduction in science anxiety when employing a particular instructional strategy.

References

Altun, S. (2015).The effect of cooperative learning on students' achievement and views on the science and technology course. *International Electronic Journal of Elementary Education*, *7*(3), 451-468.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*(3), 261-271.

Barron, K. E., & Harackiewicz, J. M. (2001). Achievement goals and optimal motivation: Testing multiple goal models. *Journal of Personality and Social Psychology*, *80*(5), 706-722
.

Berry, L. S. (2007). *Achievement goal orientation and hope: Predicting success on the ACT*. Unpublished Doctoral Dissertation, Illinois: Aurora University. Retrieved May 13, 2017 from https://search.proquest.com/docview/304704748?accountid=28367. (304704748)

Clark, R. E. (1994). Media will never influence learning. *Educational Technology Research and Development*, *42*(2), 21-29.

Darchhingpuii, A. (1988).*A study of science achievement, attitude toward science and problem solving ability among the secondary school students in Aizawl.* Unpublished Doctoral Thesis, Aizawl: North Eastern Hill University. Retrieved May 9, 2017 from shodhganga.inflibnet.ac.in/handle/10603/61435.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality.*Psychological Review*, *95*(2), 256-273.

Eum, K., & Rice, K. G. (2011). Test anxiety, perfectionism, goal orientation, and academic performance. *Anxiety, Stress, & Coping*, *24*(2), 167-178.

Fournier, K. A., Couret, J., Ramsay, J. B., & Caulkins, J. L. (2017).*Using collaborative two-stage examinations to address test anxiety in a large enrolment gateway course.* Retrieved June 26, 2017 from http://onlinelibrary.wiley.com/doi/10.1002/ase.1677/full.

Franken, R. E., & Brown, D. J. (1995). Why do people like competition? The motivation for winning, putting forth effort, improving one's performance, performing well, being instrumental, and expressing forceful/aggressive behaviour. *Personality and Individual Differences*, *19*(2), 175-184.

Hong, Z. R. (2010).Effects of a collaborative science intervention on high achieving students' learning anxiety and attitudes toward science.*International Journal of Science Education*, *32*(15), 1971-1988.

Johnson, D. W., Maruyama, G., Johnson, R. T., Nelson, D., &Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89*(1), 47-62.

Johnson, R. T., Johnson, D. W., & Stanne, M. B. (1986).A comparison of computer-assisted cooperative, competitive, and individualistic learning.*American Educational Research Journal*, *23*(3), 382-392.

Kaya, E., & Yildirim, A. (2014).Science anxiety among failing students.*Elementary Education Online, 13*(2), 518-525.

King, R. B., McInerney, D. M., & Watkins, D. A. (2012). Competitiveness is not that bad… at least in the East: Testing the hierarchical model of achievement motivation in the Asian setting. *International Journal of Intercultural Relations*, *36*(3), 446-457.

Koul, R., Lerdpornkulrat, T., & Chantara, S. (2011).Relationship between career aspirations and measures of motivation toward biology and physics, and the influence of gender. *Journal of Science Education and Technology*, *20*(6), 761-770.

Koul, R., Roy, L., & Lerdpornkulrat, T. (2012).Motivational goal orientation, perceptions of biology and physics classroom learning environments, and gender. *Learning Environments Research*,*15*(2), 217-229.

Kulik, J. A., Bangert, R. L., & Williams, G. W. (1983).Effects of computer-based teaching on secondary school students. *Journal of Educational Psychology*, *75*(1), 19-26.

Lodewyk, K. R., Winne, P. H., & Jamieson-Noel, D. L. (2009). Implications of task structure on self-regulated learning and achievement. *Educational Psychology*, *29*(1), 1-25.

Maehr, M. L. (1989).Thoughts about motivation. In C. Ames, & R. Ames (Eds.), *Research on motivation in education: Goals and cognitions* (pp. 299-315). New York, NY: Academic Press.

Mallow, J. V. (1981).*Science anxiety: Fear of science and how to overcome it*. New York, NY: Thomond Press.

Mallow, J. V. (1987).Science anxiety and gender. *Bulletin of Science, Technology & Society*, *7*(3-4), 958-962.

Mallow, J. V. (2006). Science anxiety: Research and action. In J. J. Mintzes, & W. H. Leonard (Eds.), *Handbook of college science teaching*(pp. 3-14). Virginia, USA: NSTA Press.

Mallow, J. V., & Greenburg, S. L. (1982). Science anxiety: Causes and remedies. *Journal of CollegeScience Teaching, 11*(6)*,* 356–358.

Mallow, J. V., Kastrup, H., Bryant, F. B., Hislop, N., Shefner, R., & Udo, M. (2010). Scienceanxiety, science attitudes, and gender: Interviews from a binational study. *Journal ofScience Education and Technology, 19*(4), 356-369.

Minger, M. A. (2000).*Lived experiences of self-reported science-anxious students taking an interdisciplinary undergraduate science course*. Unpublished Doctoral Thesis, Minneapolis: University of Minnesota. Retrieved May 18, 2017 from http://search.proquest.com/docview/304608382?accountid=28367. (304608382)

Muis, K. R., Ranellucci, J., Franco, G. M., &Crippen, K. J. (2013).The interactive effects of personal achievement goals and performance feedback in an undergraduate science class. *The Journal of Experimental Education*, *81*(4), 556-578.

Neber, H., & Schommer-Aikins, M.(2002). Self-regulated science learning with highly gifted students: The role of cognitive, motivational, epistemological, and environmental variables. *High Ability Studies*, *13*(1), 59-74.

Nicholls, J. G. (1989). *The competitive ethos and democratic education.*Cambridge, Massachusetts: Harvard University Press.

Oloyede, E. O., Adebowale, O. F., & Ojo, A. A. (2012).The effects of competitive, cooperative, and individualistic classroom interaction models on learning outcomes in mathematics in Nigerian senior secondary schools.*International Scholarly Research Network*, *2012*.Retrieved March 29, 2014 from http://www.isrn.com/journals/education/2012/263891/cta/.

Pedersen, J. E. (1992). The effects of a cooperative controversy presented as an STS issue on achievement and anxiety in secondary science. *School Science and Mathematics*, *92*(7), 374-380.

Peng, P. (2007).*Investigating achievement goal orientation in arts and general academic classrooms: A cross-domain study*. Unpublished Doctoral Thesis, Columbia: University of South Carolina. Retrieved December 8, 2014 from http://search.proquest.com/docview/304821739?accountid=28367. (304821739)

Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, *92*(3), 544-555.

Sideridis, G. D. (2005). Goal orientation, academic achievement, and depression: Evidence in favour of a revised goal theory framework. *Journal of Educational Psychology*, *97*(3), 366-375.

Singh, I., & Jha, A. (2013). Anxiety, optimism and academic achievement among students of private medical and engineering colleges: A comparative study. *Journal of Educational and Developmental Psychology*, *3*(1), 222-233.

Sreekala, E. (2013). *Manual for goal orientation scale*. Agra: National Psychological Corporation.

Tauer, J. M., & Harackiewicz, J. M. (1999). Winning isn't everything: Competition, achievement orientation, and intrinsic motivation. *Journal of Experimental Social Psychology*, *35*(3), 209-238.

Vasquez-Colina, M. D., Gonzalez-DeHass, A. R., & Furner, J. M. (2014).Achievement goals, motivation to learn, and mathematics anxiety among pre-service teachers. *Journal of Research in Education*, *24*(1), 38-52.

Wolters, C. A., Shirley, L. Y., & Pintrich, P. R. (1996).The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learning and Individual Differences*, *8*(3), 211-238.