Boosting Science Self-efficacy of Eighth Graders through Cooperative Learning

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Abstract

The present study was conducted to compare the effect of the cooperative learning techniques (JIGSAW IV and STAD) on science self-efficacy of VIII graders with different cognitive styles. The data was collected from a set of 240 students of VIII graders randomly chosen from three government schools of Chandigarh. Pre-test, post-test with one control group design was used and the data obtained was subjected to 2-way Analysis of Variance.

The major findings of the study were: 1) The field-independent and field-dependent group of students yielded a significant difference in the mean difference on science self-efficacy scores. Field-dependent students exhibited better science self-efficacy than field-independent students. 2) Students exposed to cooperative learning strategies JIGSAW IV and STAD exhibited better science self-efficacy than the students belonging to conventional group. Among the two cooperative learning strategies, students belonging to JIGSAW IV yielded better science self-efficacy scores than students belonging to STAD and control group. 3) Interaction between treatments and cognitive styles was found to be significant.

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Introduction

Self-belief is a guiding facet that may affect the performance of the students academically. A learner's belief about the capability to perform is the key to her competence in academics. Pajares (2009) identified three critical issues related to individual self-beliefs—"that students difficulties in basic academic skills are often directly related to their beliefs that they cannot read, write, handle numbers, or think well that they cannot learn, even when such things are not objectively true; That many students have difficulty in school not because they are incapable of performing successfully, but because they are incapable of believing that they can perform successfully—they have learned to see themselves as incapable of handling academic work or to see in the work as irrelevant to their perceptual world; and that many if not most academic crises are crises of confidence."

Two main factors responsible for academic success are cognitive styles and self-efficacy (Sankar and Raju, 2011). The construct of cognitive styles was originally proposed by Allport (1937), as a common method of perceiving, remembering, thinking, and problem solving. Since then, there has been considerable research in this area. Tennant (1988) defined cognitive styles as "an individual's characteristic and consistent approach to organising and processing information." Riding, Glass, and Douglas (1993) termed cognitive styles as static and relatively in-built features of the individual. The field-independence or dependence theory has become one of the most extensively researched cognitive styles today. According to Witkin and Goodenough (1981) when it comes to numbers, science, and problem-solving tasks, field-independent people are more likely to do well. They tend to analytically approach problem and perceive a particular and relevant item in a field of distracting items. On the other hand, field-dependent people tend to be better at recalling such social information as conversations and relationships. They prefer to approach a problem in a more global way and are capable of perceiving the total picture in a situation. Many studies on field-independent and field-dependent cognitive style for education have indicated that the individuals 'different cognitive styles have direct impact upon their achievement performance (Tinajero and Paramo, 1997; Wieseman, Portis, and Simpson, 1992). In a study conducted by Paramo and Tinajero's (1990) study field-independent people tend to out perform field-dependent people in overall school performance. Dillon and Gabbard (1998), Tinajero and Paramo (1998) found "strong evidence of a relationship between field-dependence or independence and achievement in school." Smith (2002) investigated that field independent students favour areas of study that are impersonal and require cognitive skills (such as the physical and biological sciences and mathematics) while field-dependent students make study choices that require interpersonal skills, such as social sciences. Using varied instructions based on their cognitive styles, every student can be given opportunity to study through their own cognitive styles. It allows for all students to be engaged and active in their learning. To create such positive learning environment, it is vital to understand how to incorporate student cognitive styles in the classroom and enhance the efficacy of students (Graham, 2015). DeTure (2004) reported that field-independent students tended to have higher online technologies self-efficacy than field-dependent students, whereas, Valncia-Vallejo, Lopez-Vargas and Sanebria-Rodriguez (2018) found that field-independent and field-dependent students achieve comparable learning and academic self-efficacy perception when provided motivational scaffolding in an e-learning environment.

Efficacy of an individual in a field can only be judged when he communicates the notion. The feedback in response to the performance ultimately turns out to be contributing towards his high or low confidence to perform. In this situation, the schools and teachers have a crucial role to play. Being the facilitators for learning, what they can best do to improve upon the efficacy of students is to provide them a practical learning environment including student's participation that may enhance their conceptualisation of ideas. Self-efficacy is a foundation of human agency (Bandura, 1999). "Percieved self-efficacy concerns people's beliefs in their capabilities to mobilise the motivation, cognitive resources and courses of action needed to exercise control over events in their lives" (Wood and Bandura, 1989). Student academic success can largely be attributed to the use of cognitive styles and attention to self-efficacy (Graham, 2015). Arslan (2013) found that majority of students' self-efficacy benefited from the use of cognitive styles in the classroom. Sankar and Raju (2011) also discovered that the instructional style when aligned with their personal cognitive style enhanced the self-efficacy of the students. When focusing on creating the best learning environment to promote academic success, schools should keep cognitive styles and self-efficacy in mind.

Self-efficacy shouldn't be confused with confidence. It isn't merely a general belief in one's ability. As mentioned, it is much larger in scope as assessment of one's capabilities in three complex and crucial areas: motivation, resources, and action. In addition, self-efficacy is not a generalised trait (Bandura, 1982, 1986), it is a person belief in his or her ability to perform a specific task. At a given point of time, it determines the initial decision to perform a task, the amount of effort to be expended, and the level of persistence (Gardner and Pierce, 1998). As suggested by Gist and Mitchell (1992), self-efficacy has three dimensions: magnitude, strength, and generality. Magnitude involves the level of task difficulty; strength describes whether the conviction regarding magnitude is strong or weak and generality conveys the degree to which the expectation is generalised across situations. Another principle of self-efficacy is that it changes over time with new information and experience, i.e., it is dynamic (Gardner and Pierce, 1998).

Bandura (1994) tells that human functioning is affected by self-efficacy through four psychological processes: cognitive, motivational, and affective and selection processes.

- Self-efficacy impacts the *cognitive process* by influencing the anticipatory scenarios humans construct, analytical thinking and rehearse. It means that individuals with high self-efficacy beliefs tend to anticipate success scenarios, while those with low self-efficacy beliefs tend to dwell on pitfalls and anticipate failure.
- It impacts *motivation* by determining goal level, perseverance and resilience to failures. Those with high sense of self-efficacy set higher goals than those with low self-efficacy.
- *Affective processes* which regulate emotional states and elicitation of emotional or physiological reactions are influenced by self-efficacy at several fronts. Those with a greater sense of efficacy tend to be more successful in reducing health-promoting habits into their lifestyle.

Self-efficacy also influences the type of *activities and environments people choose*. Bandura (1999) asserts that people avoid situations that they believe are beyond their capabilities, but readily undertake challenges that they think themselves capable of handling. Higher self-efficacy beliefs will lead to more challenging undertakings. In cooperative learning the students in group get an opportunity to share and make each other understand the content of the syllabus. The element of social acceptance, social criticism and validation of the formed perceptions by the group members, solidifies the belief of the students in them. Followed by the re-enforcements they get in the form of appreciation for augmentation of individual as well as group scores sums up towards their insight of self-efficacy about the subject. Cooperative learning Strategies are based on the idea that cooperation among peers is the most important way of influencing their conditions, posing individual and group challenges at the same time. In the strategy, a pupil is not only responsible for their own learning but others as well. The sense of competition within group and with other groups — both act as a motivation to perform.

Although Slavin (1990) proposed a two-element theory of cooperative learning comprising positive interdependence and individual accountability, the five-component theory of Johnson, Johnson and Holubec (1991); Johnson, Johnson and Smith (1991a); Johnson, Johnson and Smith (1991b) is used mostly. According to this conceptualisation, the following five elements are essential for increasing the likelihood of success of the cooperative learning endeavor; (a) positive interdependence, (b) face-to-face promotive interaction, (c) individual accountability, (d) social skills, and (e) group processing.

Positive interdependence: refers to each student recognising that he or she is linked with others in such a way that one cannot be successful unless all the remaining group members are successful.

Face-to-face promotive interaction: involves students' enhancing each other's goals by using such techniques as supporting, praising, encouraging and scaffolding.

Individual accountability: involves being responsible for completing one's share of the work or to master the task assigned within the group. In doing so, social loafing (i.e., disproportionately benefiting from another's work) are assumed to be minimised.

Social skills: requires a positive interaction among all group members. Skills such as effective communication, building and maintaining trust, and constructively resolving conflicts are emphasised.

Group processing: refers to students being able to assess how well their group is working towards achieving its goals (Johnson and Johnson, 1991).

A rigorous literature survey reveals that there exists a significant relationship between cooperative learning strategies and self-efficacy among students (Yoruk, 2016; Darnon, Buchs and Desbar, 2012; Torchia, 2012). Adding to it, some researches in support of JIGSAW IV a cooperative learning strategy discovered that it can bring about a change in the level of self-efficacy (Darnon, Buchs and Desbar, 2012), liking of school, self-esteem, reduction of prejudices (Aronson and Patnoe, 1997); awareness about environment, self-confidence and helps to socialise (Yoruk, 2016) and is responsible for enhancement of achievement and intrinsic motivation (Torchia, 2012). It has been found that teaching methodologies like collaborative mobile learning activities (Sung, Hwang and Chang, 2016), Collaborative group skills (Mattson, 2011), Participatory approaches (Määttä and Järvelä, 2013), Concept Mapping (Wilson and Kim, 2016), Online learning (Ashford, 2014) and Problem based learning (Boren, 2012) also have a positive effect on self-efficacy of students. Suggesting that, a change in the teaching methodologies that are child-centric can certainly enhance their self-efficacy in academics. However, in a study conducted by Hevedanli (2015) it was observed that no significant difference in self-efficacy beliefs about biology among pre-service teachers was observed under application of Web-based cooperative learning environment. Even Robertson (2012) using collaborative learning and Wilson and Kim (2016) employing concept mapping technique discovered that there was no significant relationship between the teaching strategies and self-efficacy of students. In contrary, when Santosh (2012) compared the effect of STAD and JIGSAW methods on achievement and self-concept in mathematics, observed no significant difference in the self-concept attainment of the two groups but the achievement of students was found to be significantly higher in JIGSAW group.

As the mentioned studies, reflect a contradiction upon whether the use of cooperative learning strategies and those involving group processing in classroom environment can really bring about a change in self-efficacy among students. So, there arises a need to study whether cooperative learning is a better option to work upon the enhancement of self-efficacy among students or not.

To reach upon the answers to all these, science self-efficacy among the students has been examined under treatments of cooperative learning strategies in the present study.

Objectives of the study

Following are the objectives of the study

1. To compare the mean difference scores on science self-efficacy of field-independent and field-dependent group of students.
2. To compare the mean difference scores on science self-efficacy of the students when taught through three different instructional treatments (two cooperative learning techniques, viz., JIGSAW IV and STAD and conventional group learning).
3. To compare the mean difference scores on four domains of science self-efficacy, viz., self-confidence, physiological arousal, performance outcome expectation and social persuasion.
4. To evaluate the interaction effect between instructional treatments and cognitive styles with respect to science self-efficacy.

Delimitations of the study

1. The study was delimited and conducted in three Govt. Senior Secondary Schools of the Union Territory Chandigarh.
2. Only two types of cognitive styles, viz., field-independence and field-dependence were studied.
3. The experiment was restricted to 50 working days of the academic session.
4. Five topics of science were selected from the syllabi prescribed by NCERT.

Hypotheses

H1 Field-independent and field-dependent group of students yield comparable mean difference scores on science self-efficacy.

Further hypotheses were framed to analyse mean difference scores on science self-efficacy with respect to four domains.

Field-independent and field-dependent group of students yield comparable mean difference scores on

H1.01 Self-confidence

H1.02 Physiological arousal (Positive attitude towards science)

H1.03 Performance outcome expectation (Expecting Specific results)

H1.04 Social persuasion (To influence others deliberately)

H2 The three instructional treatments yield comparable mean gain scores on science self-efficacy. Students taught through the three instructional treatments yield comparable mean difference scores on.

H2.01 Self-confidence

H2.02 Physiological arousal (Positive attitude towards science)

H2.03 Performance outcome expectation (Expecting Specific results)

H2.04 Social persuasion (To influence others deliberately)

H3 There exist no significant interaction between instructional treatments and cognitive styles with respect to science self-efficacy.

When exposed to different instructional treatments field-independent and field-dependent group of students yield comparable mean difference scores.

H3.01 Self-confidence

H3.02 Physiological arousal (Positive attitude towards science)

H3.03 Performance outcome expectation (Expecting Specific results)

H3.04 Social persuasion (To influence others deliberately)

Methodology

Sample

The research was carried out on a sample of 240 grade VIII students from three government schools of Chandigarh. For classification, Group Embedded Figures Test (GEFT) was administered to a sample of 300. After scoring, students scoring 13 or above were kept in field independent group while those who scored 8 or below were kept in field-dependent group. Those students who scored between 9 and 12 were dropped. Thus, on the basis of the scores obtained by the students in GEFT, theywere divided into field-independent and field-dependent group of students. The students belonging to two groups were randomly allocated to experimental and control group. There were 80 students in each group (two experimental and a control group).

Table 1
Bifurcation of sample in the study

Treatments	Field Independent	Field Dependent	Total
Experimental Group 1 (Cooperative Learning – JIGSAW IV settings)	40	40	80
Experimental Group 2 (Cooperative Learning – STAD settings)	40	40	80
Control Group (Traditional Instruction Settings)	40	40	80
Total			240

Design of the Study

Pre-test and post-test with one control group design was employed. A 2x3 ANOVA was employed for the analysis of mean difference scores on science self-efficacy. The dependent variable was the mean difference scores of Science Self-efficacy and the independent variable of instructional treatment was studied at three levels namely, experimental group (T1) which was taught through cooperative learning settings JIGSAW IV, experimental group (T2) taught through teacher-directed instruction followed by cooperative learning settings STAD and control group (T3) which was taught by conventional method. The variable of cognitive style was studied at two levels, viz., field-independence (C1) and field-dependence (C2). The schematic layout of the design has been presented in Figure 1 below:

T1 – Experimental group 1
T2 – Experimental group 2
T3 – Control group

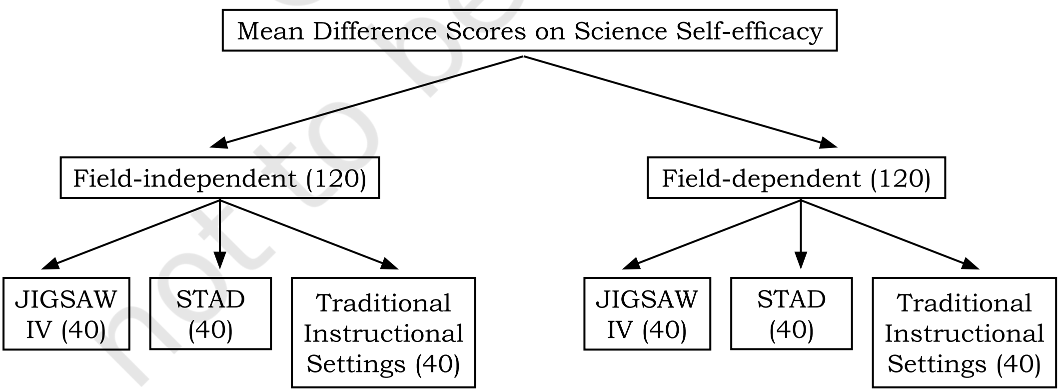

Figure 1: Schematic Layout of design of the study

Tools Used

Following tools were used:

1. Group Embedded Figures Test (Witkin, Oltman, Raskin and Karp, 1971)
2. Science Self-Efficacy Scale (SSES) developed by the investigator comprised of 37 items in four domains, viz., Self-confidence, Physiological arousal (Positive attitude towards science), Performance outcome expectation, Social persuasion.

   Reliability of the scale

   (i) By Test-Retest was 0.93

   (ii) By Split-Half method was 0.81 (Spearman Brown's) and 0.86 (Guttman's formula)
3. Instructional material for STAD and JIGSAW IV and worksheets

Procedure

After the selection of the sample from three different government schools of Chandigarh, the experiment was conducted following three stages.

Stage 1: Administration of the pre-test

This phase involved the administration of the science self-efficacy scale to the students of both the experimental groups and the control group.

Stage 2: Conducting the instructional program

The instructional treatment was manipulated in the form of teacher directed instruction followed by cooperative learning settings (JIGSAW IV and STAD) to the experimental group, whereas the control group was taught through conventional method. All the groups were taught 5 chapters of science syllabus prescribed by NCERT. The instructional treatment was carried out for 50 days.

The method of cooperative learning JIGSAW IV was used in the first experimental group. In this method, first of all the learning material was divided into four sections. The students were assigned into the group of four called home groups. Each student in a group of 4 gets a different section to learn. The students having same sections meet in expert group to teach and understand the content from each other. Next, students take group quiz and move towards their home groups to teach them and perform on individual worksheets, which contribute to team scores. The students are given reinforcement as gifts, prizes or display of the names of the winning team and a shining star pupil whose scores have improved gradually.

In the second experimental group, another cooperative learning method used was STAD. The students were divided into a group of four (Slavin, 1997). In team study, students worked on worksheets followed by teacher-directed instruction to master the material which was presented in the skill being taught.

The students were re-assigned to different groups from time to time so that they were able to interact with other members of the class.

For team study all the members were given the following instructions in both the groups:

- You have to finish studying only when you are certain that everyone in the team understands the given question.
- If there is a disagreement among team members then they are to present their arguments and resolve the problem themselves.
- When you have questions, ask your teammates first.
- Encourage and praise your teammates from time to time.
- Listen patiently to the points presented by your teammates.
- Have patience in explaining the concept or skill to weaker student.

Stage III: Administration of the post-test

After the instructional treatment of 50 days, science self-efficacy scale was again administered to both the experimental and control groups to discern the effect of treatment.

Analysis of mean difference scores on science self-efficacy

After scoring the difference between post-test and pre-test scores on science self-efficacy were computed. The obtained mean difference was subjected to 2×3 analysis of variance. The means and SD's of different sub-samples were computed and have been presented in Table 2 and the summary of ANOVA for 2×3 design for mean difference scores on science self-efficacy is presented in Table 3.

Table 2
Means and SD's of sub-samples of 2×3 design for mean difference scores on science self-efficacy

	Groups	T1	T2	T3	Total
Total	**C1**	M=16 n=40 SD=11.44	M=10.37 n=40 SD=9.63	M=5.07 n=40 SD=7.52	M=10.48 n=120 SD=10.58
	C2	M=19.6 n=40 SD=11.01	M=14.27 n=40 SD=9.40	M=7.42 n=40 SD=7.90	M=13.76 n=120 SD=10.68
	Total	M=17.8 n=40 SD=11.30	M=12.32 n=40 SD=9.65	M=6.25 n=40 SD=7.76	
Domain 1: Self confidence	**C1**	M=4.02 n=40 SD=3.33	M=2.40 n=40 SD=2.20	M=0.97 n=40 SD=2.21	M=2.46 n=40 SD=2.90
	C2	M=4.60 n=40 SD=3.75	M=3.30 n=40 SD=2.39	M=2.05 n=40 SD=2.38	M=3.31 n=40 SD=3.07

	Total	M=4.31 n=40 SD=3.54	M=2.85 n=40 SD=2.33	M=1.51 n=40 SD=2.34	
Domain 2: Physiological arousal	**C1**	M=3.92 n=40 SD=4.74	M=3.35 n=40 SD=5.27	M=1.22 n=40 SD=2.57	M=2.83 n=40 SD=4.47
	C2	M=4.62 n=40 SD=4.25	M=3.02 n=40 SD=3.64	M=2.10 n=40 SD=3.33	M=3.25 n=40 SD=3.87
	Total	M=4.27 n=40 SD=4.49	M=3.18 n=40 SD=4.50	M=1.66 n=40 SD=2.99	
Domain 3: Performance Outcome Expectation	**C1**	M=2.72 n=40 SD=3.14	M=2.87 n=40 SD=3.14	M=3.41 n=40 SD=2.39	M=2.72 n=40 SD=3.08
	C2	M=3.57 n=40 SD=4.54	M=3.07 n=40 SD=5.11	M=11.26 n=40 SD=2.95	M=3.57 n=40 SD=4.41
	Total	M=4.35 n=40 SD=3.89	M=3.31 n=40 SD=4.29	M=1.78 n=40 SD=2.68	
Domain 4: Social Persuasion	**C1**	M=3.92 n=40 SD=3.94	M=2.15 n=40 SD=2.30	M=1.32 n=40 SD=2.43	M=2.46 n=40 SD=3.15
	C2	M=5.80 n=40 SD=4.64	M=4.15 n=40 SD=3.83	M=1.25 n=40 SD=2.04	M=3.73 n=40 SD=4.10
	Total	M=4.86 n=40 SD=4.38	M=3.15 n=40 SD=3.29	M=1.28 n=40 SD=2.23	

Table 3
Summary of 2×3 ANOVA of mean differences on total scores and on four domains of Science self-efficacy Scale

Source of Variation	df	Sum of Squares	MSS	F-ratio
Total				
T	2	5340.9	2670.45	29.72**
C	1	646.81	646.81	7.20**
TXC	2	559.30	279.65	3.11*
Within Sets	234	21021.2	89.83	

Domain 1: Self confidence				
T	2	313.80	156.90	20.26**
C	1	43.35	43.35	5.59*
TXC	2	2.57	1.28	0.16(NS)
Within Sets	234	1811.45	7.74	
Domain 2: Physiological arousal				
T	2	275.55	137.77	8.31**
C	1	10.41	10.41	0.62(NS)
TXC	2	16.80	8.40	0.50(NS)
Within Sets	234	3878.8	16.57	
Domain 3: Performance Outcome Expectation				
T	2	265.82	132.91	9.83**
C	1	0.75	0.75	0.05(NS)
TXC	2	60.62	30.31	2.24(NS)
Within Sets	234	3163.4	13.51	
Domain 4: Social Persuasion				
T	2	511.52	255.76	22.81**
C	1	96.26	96.26	8.58**
TXC	2	54.15	27.07	2.41(NS)
Within Sets	234	2623.65	11.21	

NS-Not Significant
**-Significant at 0.05 level of confidence*
***- Significant at 0.01 level of confidence*

MAIN EFFECTS AND DISCUSSION OF RESULTS

Cognitive Style C

F-ratio (Table 3) for the mean differences on science self-efficacy scores of the two cognitive styles was found to be significant at 0.01 level of confidence. An examination of means indicate that the field-dependent group of students exhibited better science self-efficacy than field-independent group of students. Thus, H1 was rejected. Further evidences of the result are supported by the study of Pintrich and de Groot (1990). The results of the present study contradicted with the findings of DeTure (2004) who found results in favour of field-independent students outperforming field-dependent students whereas Valncia-Vallejo, Lopez-Vargas and Sanebria-Rodriguez (2018) found that cognitive style do not have significant effect on academic self-efficacy in e-learning environment. These researchers have used web-based environments, whereas the present research incorporates cooperative learning environment.

For all the four domains namely self-confidence, physiological arousal, performance outcome expectation and social persuasion of science self-efficacy the F-ratio (Table 3) was found to be significant for self-confidence and social persuasion. An examination of means indicate that field-dependent group of students exhibited better on the domains of self-confidence and social persuasion. Thus H1.01 and H1.04 were rejected, whereas F-ratio for physiological arousal and performance outcome expectation was found to be not significant. Thus, H1.02 and H1.03 were retained.

Treatment (T)

F-ratio (Table 3) for the variation in mean differences on science self-efficacy scores of the three instructional treatments was found to be significant at 0.01 level of confidence. Thus, H2 was rejected.

For further investigation t-ratios were computed for comparison between the three treatments. Significant difference was found on mean difference scores among the group of students when taught through JIGSAW IV and STAD (t ratio=2.26*), among the group of students when taught through STAD and conventional method (t ratio=3.93**) and the group of students taught through JIGSAW IV and conventional method (t ratio=5.47**). This implies that students when exposed to JIGSAW IV and STAD exhibited better science self-efficacy than the conventional group. Among the cooperative learning strategies, it infers that students who were taught through JIGSAW IV yielded better results than the students exposed to STAD method.

Note: *Significant at 0.05 level of confidence
**Significant at 0.01 level of confidence

F-ratio (Table 3) for the difference in the three instructional treatments on the mean difference scores of science self-efficacy was found to be significant on all the four domains namely- self-confidence, physiological arousal, performance expectation and social persuasion at 0.01 level of confidence. Thus, H2.01, H2.02, H2.03 and H2.04 were rejected.

Cooperative learning strategy JIGSAW IV and STAD were found to be more effective than conventional methods on science self-efficacy. The results were consistent with the findings of Yoruk (2016), Darnon, Buchs and Desbar (2012), Santosh (2012), Torchia (2012), Ames (1984) and Nichols and Miller (1994). Among cooperative learning strategies JIGSAW IV was found to yield better results as compared to STAD method. It might be due to the reason that STAD provides less independent situations of learning as compared to JIGSAW IV, which has contributed towards better science self-efficacy mean difference scores. This implies that if group learning experiences that incorporate more individual accountability are provided in the classroom, it helps to build the academic self-confidence of the students and later increases students' responsibility for their own learning. There is also pressure for performance as created by cooperative learning techniques enhances the student's science self-efficacy through self-evaluation and the sense of contributing towards the group scores.

Interaction effects

Treatments and Cognitive styles (TXC)

F-ratio (Table 3) for the interaction between the treatments and cognitive styles was found to be significant at 0.05 level of confidence. Leading to the inference that two variables interact with each other. Hence, H3 was rejected.

To investigate further interaction between treatment and cognitive style the t-ratios were computed.

Field-independent and field-dependent group of students yielded comparable mean difference on science self-efficacy scores when taught through cooperative learning strategies JIGSAW IV (t=0.90), STAD (t=1.39) and conventional method (t=1.65).

Field-independent students exhibited comparable mean difference scores for JIGSAW IV and STAD cooperative learning strategies on science self-efficacy (t=1.86). Field-independent students yielded better mean difference scores through cooperative learning strategy JIGSAW IV than the conventional method (t= 4.11**) and better mean difference scores through cooperative learning strategy STAD than the conventional method (t= 2.90**).

Field-dependent students yielded comparable mean difference scores on science self-efficacy for cooperative learning strategies JIGSAW IV and STAD (t=1.38). Field-dependent students yielded better mean difference through cooperative learning strategy JIGSAW IV than conventional method (t=3.67**) and through cooperative learning strategy STAD than conventional method (t=2.69**).

Comparable mean differences on science self-efficacy scores were exhibited by field-independent students when taught through cooperative learning strategy JIGSAW IV and field-dependent students when taught through STAD (t=0.50), and among field-independent students when taught through cooperative learning strategy STAD and field-dependent students when taught through conventional method (t= 1.46).

On science self-efficacy, field-dependent students yielded better mean difference scores through cooperative learning strategy JIGSAW IV than field-independent students in cooperative learning strategy STAD (t=2.63**), field-dependent students yielded better mean difference scores through cooperative learning strategy JIGSAW IV than field-independent students when taught through conventional method (t=4.53**), field-dependent students yielded better mean difference scores through cooperative learning strategy STAD than field-independent students when taught through conventional method (t= 3.84**), and field-independent students yielded better mean difference scores through cooperative learning strategy JIGSAW IV than the field-dependent students when taught through conventional method (t=3.07**).

Note: *Significant at 0.05 level of confidence
**Significant at 0.01 level of confidence

With respect to four domains of science self-efficacy namely—self-confidence, physiological arousal, performance outcome expectation and social persuasion field-independent and field-dependent groups for different instructional treatments yielded comparable mean difference scores on science self-efficacy as F-ratio (Table 3) was found not to be significant even at 0.05 level of confidence. Hence, H3.01, H3.02, H3.03 and H3.04 were retained.

It is inferred that treatments interact with cognitive style on the whole but not with the rest of the four domains of science self-efficacy.

Conclusion

As revealed in the study, cooperative learning strategies have a positive effect on the science self-efficacy of students. Among both the cooperative learning strategies Jigsaw IV yielded better results. Field-dependent students yielded higher mean difference scores on self-efficacy than field-independent students. The interaction results too revealed that both field-independent and field-dependent students exhibited better self-efficacy in the cooperative learning classrooms than their counterparts in the conventional classroom. The results indicate that if classroom learning environment aligns with the student's cognitive style, their self-efficacy is enhanced. Also in context of the Indian school environment whereby a group of students are facilitated with smart classes to learn, while others strife to learn even through the conventional methods of learning. In this scenario, cooperative learning methods can prove to be a help. The behavior of students towards others and the way of interaction should be observed very carefully. Some changes that can be brought about in Indian classrooms to benefit students can be:

- Group learning methods should be adopted to enhance self-confidence of students, providing opportunities to perform in front of others, display one's intelligence and mutual agreements to solutions.

- Students' cognitive styles of learning if identified, can be used as a medium to understand each student's necessity, and the classroom environments and teaching methodologies can be changed accordingly.
- While involved in group processing, the teacher should make sure that the students are discussing the concept in right direction or guidance should be provided wherever need arises.
- Emphasis should be given to create classroom situations that compel the students to involve in discussions, involving eye-contact, accepting others ideas, showing patience with group members and reaching conclusions or solutions collectively.
- If the understanding of the scientific concepts, is approved by the classmates, it gives the child confidence in himself to perform again and again.
- Motivation must be given through certain subject based activities to pupils to arrive at solutions with the help of classmates.
- Teacher should ensure frequent use of reinforcements given to students for performing good in groups and even by the students of the groups to each other for putting in good efforts.
- Constant rewards in the form of prizes, display of names on notice board for improvement in performance should be used to arouse interest in the science of subject.

To conclude, Indian classrooms can be made a better place to learn by introducing cooperative learning strategies through regular activities of evaluation like formative tests to train students in aspiring according to their competence. As much group activities can be planned in classrooms to enhance science self-efficacy of students creating a situation of dependence on the others for success. Students can be taught to take responsibility of others learning by promoting group study. Self-study in groups, project work and assignments should be recommended as a mode of learning. If implemented properly, cooperative learning strategies can certainly bring about a change in the scenario of Indian science classrooms.

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