RESEARCH REVIEW JOURNALS
Volume-04
Issue-03
March-2019

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com[UGC Listed Journal]

Effect of Radical and Social Constructive Learning Approaches on Self-Perceptions in Mathematics in Relation to Attitude towards Mathematics

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ARTICLE DETAILS

Article History
Published Online: 13 March2019

Keywords
Radical and Social Constructive Learning Approach, Self-Perceptions, Attitude towards Mathematics.

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ABSTRACT

The present study investigates the effect of radical and social constructive learning approaches on self-perceptions in mathematics of secondary school students in relation to their attitude towards mathematics. The sample consisted of class7th students selected from three different schools of Ropar affiliated to Central Board of Secondary Education, New Delhi. Raven's standard progressive matrices test was administered for matching the students of three groups. Attitude towards mathematics was administered for the classification of students. The students were classified into three groups with high, average and low scores in attitude towards mathematics. Self-Perceptions in mathematics scale as pre-test were administered to the students of experimental and control group. Instructional materials based on radical and social constructive learning approaches were prepared and utilized to teach the experimental group after pre-testing. The gain self-perceptions in mathematics scores were computed after implementing pre and post test on all the students. A two-way analysis of variance (3×3) was used to arrive at conclusions: (i) The self-perceptions in mathematics scores of groups taught through radical constructive learning approach and social constructive learning approach was found significantly higher than that of traditional teaching approach in mathematics.. (ii) The self-perceptions in mathematics of high, average and low attitude towards mathematics groups were found significantly different from one another.(iii) There was significant interaction effect of instructional approaches and attitude towards mathematics on self-perceptions in mathematics.

1. Introduction

The constructivist approach to mathematics instruction views learning as an active process. Constructivism challenges the assumption that meanings reside in words, actions, and objects independently of an interpreter. Teachers and students are viewed as active meaning-makers who continually give contextually based meanings to each other's words and actions as they interact (Cobb, 1988). Constructivism is a theory of knowledge with roots in philosophy, psychology, and cybernetics. It asserts two main principles whose application has far-reaching consequences for the study of cognitive development and learning as well as for the practice of teaching, psychotherapy, and interpersonal management in general. The two principles are: (a) knowledge is not passively received but actively built up by the cognizing subject; and (b) the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality (Von-Glaserfeld, 1989).

Brooks and Brooks (1999) in his book "In search of understanding: The case of constructivism classroom" defines, the role of teacher for constructive classroom teaching such as, constructivist teacher: (i) motivate and accept learner's ideas and initiatives, (ii) apply raw data and primary resources, along with manipulative, interactive and physical materials; (iii) allow learners responses to derive lessons, shift instructional strategies and other contents; (iv) use cognitive terminology such as classify, analyze, predict and create; (v) motivate learners to engage in dialogue, both with the teachers and with other students; (vi) Try to seek elaboration of initial responses; (vii) engage learners in experience that might engender contradictions to their initial hypotheses and then encourages discussion; (viii) provide time for learners to construct relationships and create metaphors; (ix) inquire about learners understanding, ideas and thoughts of the concepts before sharing their own understanding of those concepts; (x) encourage learner's enquiry by asking thoughtful, open ended questions and motivates learners to ask questions to each other.

Von-Glasersfeld (1995) suggested that based on his radical constructivism theory known as "radical constructivism: A way of knowing and learning", when individuals deal with the physical world, their minds construct, through certain mental mechanisms and collections of cognitive structures, their conceptualization, reason, and coordination of their engagements. He has given the ideas of abstraction and added that abstraction has several levels: At its perceptual level (most basic), abstraction isolates an item in the stream of an experience and seizes it as a unit. He has presenting his radical constructivism theory, stated that understanding requires more than abstraction; it requires reflection which is the conscious process of re-presenting experiences, actions, or mental processes and considering their results or how they are composed. Reflective abstraction takes mental operations performed on previously abstracted items as elements and coordinates them into new forms or structures that, in turn, can become the content -what is acted upon- in future acts of abstraction.

According to Mitchell and Myles (1988) social constructivism provides explanation for how learning can be fostered effectively through interactive methodologies. It emphasizes that learning takes place in a socio cultural environment and views learners as "active constructors of their own learning environment. Vygotsky (1978) the father of social constructivism, claimed that learning occurs through dialogue". This dialogue is initially takes place between teacher and student, between students, or even between text and reader. However, the learner makes sense of what is said or written through internal dialogue. Therefore learning is interactive in the sense that learners must interact with sources of ideas/knowledge in social settings, as well as in the sense that they must take an active part in reconstruction of ideas within their own minds. Further, he points out that learning depends on the purpose or motivation for learning which calls activity theory.

Since the birth of psychology, researchers have been interested in ascertaining how well people know themselves and what psychological processes promote accuracy versus distortion in self-perception" (Robins & John, 1997). Attachment theory, which has received considerable attention in the field of developmental psychology over the past thirty years (Masten & Coatsworth, 1998) offers a particularly interesting perspective on the development of self-views. Bem (1972) to begin with, what is self-perception? Classic theories in social psychology regard self-perception as an individual's self-knowledge or views of the self. While there is a vast body of theoretical literature on self-perception, means of empirically assessing the accuracy of self-judgments are controversial since there is no absolute, objective standard for measuring a person's traits, capabilities, emotions, and so forth. Researchers have only recently begun to recognize the need for objective assessments of self-perception accuracy and to formulate methods for empirically measuring self-judgment.

Robins and John (1997) suggested that a growing number of researchers in the fields of personality and social psychology operationally define and measure accuracy of self-perception in terms of social consensus criteria. According to social consensus criteria, accurate self-insight is seeing oneself as others see one. Kruglanski (1989) for instance, posits that an accurate self-judgment is a judgment that is congruent with judgments by others. Similarly, Funder (1999) suggests that a realistic approach to objectively measuring accuracy of self-perception is to examine the mutuality of self- and other-judgments.

In general, the concepts students hold about mathematics determine how they approach the subject. In many cases, students have been found to approach mathematics as procedural and rule oriented. This prevents them from experiencing the richness of mathematics and the many approaches that could be used to develop competence in the subject (Borasi, 1990). Farooq and Shah (2008) in a study of secondary school students in Pakistan found that there was no significant difference in confidence of male and female students towards mathematics at secondary school level. They rather found that students' success in mathematics depended on attitude towards the subject. Nonetheless, some studies have found gender difference in students' confidence in mathematics.

Attitudes can be seen as more or less positive. A positive attitude towards mathematics reflects a positive emotional disposition in relation to the subject and, in a similar way, a negative attitude towards mathematics relates to a negative emotional disposition (Zan & Martino, 2008). These emotional dispositions have an impact on an individual's behavior, as one is likely to achieve better in a subject that one enjoys, has confidence in or finds useful. For this reason positive attitudes towards mathematics are desirable since they may influence one's willingness to learn and also the benefits one can derive from mathematics instruction (Eshun, 2004).

2. Need and Significance of the Study

Constructivism have different types but in the present study investigator focusing upon two of its types i.e. radical constructivism and social constructivism. Radical constructivism is a subversive way of thinking that might change a person's ways of being in the world—but never a truth for all to adopt and apply to all circumstances, and especially not an instrument for the oppression of non-believers (Tobin, 2007). Learning in today's classroom happens in a social context since there is students-teacher and students-students interaction. Hence Social Constructivism has gained importance in today's context. It mainly focuses on the importance of culture and context in understanding what are the demands or expectations of the society and constructing knowledge based on this understanding. Learners have different views for the subject of mathematics. They have different self-perceptions about the subject and its various attributes. Many of the students have negative self-perceptions for the subject of mathematics. For this there are many possible reasons and teaching methodology is one of major reasons. So during the review of related literature it is observed that if the mathematics teachers wants to bring change in the learners self-perceptions in mathematics they have to bring constructive leaching learning strategies in their classroom.

The significance of the study lies in the fact that although many studies might have been conducted on radical and social constructive approach but they are done mostly in foreign countries. There is a need to do more and more research on radical and social constructivism in Indian school system, to support its importance and also to formulate more practical and effective instructional design for it. Thus this study could contribute to validate and effective instructional design for it. The need and significance of the study increases as the very few studies are conducted on radical and social constructive learning approaches in relation to attitude towards mathematics. Thus, this research is intended to explore and find out the effect of radical and social constructive learning approach on self-perceptions of secondary school students in relation to their attitude towards mathematics.

3. Objectives

1. To compare the effectiveness of radical, social constructive learning approaches and conventional teaching approach on the self-perceptions in mathematics.

2. To compare the effectiveness of radical, social constructive learning approaches and conventional teaching approach on the self-perceptions in mathematics of learners with high, average and low attitude towards mathematics.
3. To study the interaction effect of instructional approaches and attitude towards mathematics on the self-perceptions in mathematics.

4. Hypotheses

H_1: There exists no significant difference between the groups taught through radical, social constructive learning approaches and conventional teaching approach on self-perceptions in mathematics

H_2: There exists no significant difference between the groups having high, average and low attitude scores towards mathematics with regards to self-perceptions in mathematics.

H_3: There exists no significant interaction effect of instructional approaches and attitude towards mathematics with regards to self-perceptions in mathematics.

5. Sample

The sample was drawn from representative secondary school of District Ropar in Punjab who was affiliated to Central Board of Secondary Education, New Delhi. The three private schools i.e Rayat International School, Sahibzada Ajit Singh Academy and Sant Karam Singh Academy of Roper District in Punjab were selected by the random sampling technique. Further, the selected three schools were compared on ground of class room environment, physical infrastructure, mathematics lab, etc. After the selection of schools, the intact sections of each school were randomly taken for the experimental and control groups to take final sample of at least 100 from each school, making a total of 300 students whose scores were subjected to data analysis. On the whole in sampling procedure of the students, multistage randomization of sampling at school level and section level was done. At the first stage purposive random sampling was used to select three schools of Ropar District in Punjab. In the second stage, the intact sections of class 7^{th}were randomly selected out of these three schools. The matching was done on the basis of Raven's intelligence test scores. All the selected students were divided into three groups' i.e. experimental group-I & II and control group. In the third stage attitude towards mathematics test was administered to classify the students into three groups having high, average and low attitude towards mathematics.

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, (3×3) Analysis of Variance was applied on the self-perceptions in mathematics. The experimental groups were taught through radical and social constructive learning approaches respectively, whereas, control group was taught same topics with conventional teaching approach by the investigator. It covers two independent variables such as instructional approaches and attitude towards mathematics. The variable of instructional approach was studied at three levels, namely radical, social constructive learning approaches and traditional teaching approach. The variable of attitude towards mathematics was studied at three levels, such as high, average and low attitude scores in mathematics. These variables are the independent variables. The dependent variable self-perceptions in mathematics was calculated as the difference in post-test and pre-test scores of the subject.

7. Tools used

The following tools were used for data collection:

1. Standard Progressive Matrices (SPM) by Raven, Raven and Court (2000) was used for matching the groups.
2. Attitude towards Mathematics Scale was developed by the investigators.
3. Self-Perceptions in Mathematics Scale was developed by the investigators.
4. Instructional Material in Mathematics for Radical, Social Constructive Learning Approaches and Traditional Teaching Approach on selected units of 7^{th} class mathematics such as Number System, Ratio and Proportion, Geometry, Mensuration and Data Handling were developed by investigators.

8. Procedure

After the selection of sample and allocation of students in the groups for instructional approaches, the experiment will be conducted in six phases such as: *Firstly*, the investigators fixed meeting with the principals and teachers of selected schools to conduct the experiment. The intact sections of both the schools were considered as experimental group-I, experimental group-II and control group. *Secondly,* Raven's Standard Progressive Matrices Test was administered for matching the students of three groups. *Thirdly,* attitude towards mathematics was administered for the classification of students. The students were classified into three groups with high, average and low scores in attitude towards mathematics. *Fourthly,* self-perceptions in mathematics scale as pre-test was administered to the students of experimental and control group. The answer-sheets were scored to obtain the information regarding the previous self-perceptions in mathematics of the student and for the equivalent group formation. *Fifthly,* treatment was given to the experimental groups. The experimental groups were taught through radical and social constructive approaches respectively. 15 lessons based on radical and social constructive learning approaches in mathematics were taught to students. On the other hand, the control group was taught through conventional teaching approach. *Sixthly*, after the completion of the course, same self-perceptions in mathematics scale as a post-test were administered to the students of experimental and control group. The answer-sheets were scored with the help of scoring key. The scores of experimental and control group were compared according to their pre and post-test scores. The difference was the gain scores of different groups and different variables.

9. Analysis and Interpretations of the Results

- ***Analysis of Descriptive Statistics***

The data were analyzed to determine the nature of the distribution of scores by employing mean and standard deviation. The two way analysis of variance was used to test the hypotheses related to approaches of teaching and attitude

towards mathematics. The mean and standard deviation of different sub groups have been presented in Table- 1.

Table-1: A summary of descriptive statistics of mean gain self perceptions scores in mathematics of experimental and control groups

Attitude towards Mathematics	Experimental Group-I			Experimental Group-II			Control Group			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
High Attitude Towards Mathematics	**27**	**28.48**	**10.68**	**27**	**30.77**	**12.03**	**27**	**16.59**	**4.40**	**81**	**25.28**	**11.38**
Average Attitude Towards Mathematics	**46**	**20.23**	**5.63**	**46**	**21.71**	**4.14**	**46**	**15.84**	**3.95**	**138**	**19.26**	**5.24**
Low Attitude Towards Mathematics	**27**	**17.70**	**3.90**	**27**	**19.25**	**4.23**	**27**	**13.25**	**3.09**	**81**	**16.74**	**4.52**
Total	**100**	**21.78**	**8.14**	**100**	**23.50**	**8.45**	**100**	**15.35**	**4.05**	**N = 300**		

Source: Field Study, 2017

Table-1 reveals that mean gain self perceptions scores of total attitude towards mathematics of experimental group-I taught through radical constructive learning approach was 21.78, experimental group- II taught through social constructive learning approach was 23.50 and that of control group taught through traditional teaching approach was 15.35. It shows that the mean gain self perceptions scores were higher for the social constructive learning approach than that of radical constructive learning approach and the traditional teaching approach group. Further, it shows that the mean gain self perceptions score for high attitude towards mathematics group taught through radical constructive learning approach was 28.48, social constructive learning approach was 30.77 and traditional teaching approach was 16.59. It shows that the mean gain self perceptions scores of high attitude towards mathematics group were higher for social constructive learning approach than that of radical constructive learning approach and traditional teaching approach group. The above table shows that the mean gain self perceptions score for average attitude towards mathematics group taught through radical constructive learning approach was 20.63, social constructive learning approach group was 21.71 and traditional teaching approach group was 15.84. It shows that the mean gain self perception scores of average attitude towards mathematics group were higher for the social constructive learning approach than that of radical constructive learning approach and traditional teaching approach group. The above table reveals that the mean gain self perceptions scores for low attitude towards mathematics group taught through radical constructive learning approach was 17.70, social constructive learning approach group was 19.25 and traditional teaching approach group was 13.25. It shows that the mean gain self perception scores of low attitude towards mathematics group were higher for social constructive learning approach than that of radical constructive learning approach and traditional teaching approach group.

Analysis of Variance on Gain Self -Perceptions Scores

The sum of squares, degree of freedom, mean sum of squares and F-ratios on gain self perceptions scores in mathematics with respect to attitude towards mathematics have been presented in table-2.

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

Source of Variance	Sum of Squares	df	Mean Sum of Squares	F-ratio
Instructional Approaches (A)	3954.81	2	1977.40	51.11**
Attitude towards Mathematics (B)	3182.66	2	1591.33	41.13**
Interaction (A×B)	820.68	4	205.17	5.30**
Error Term	11259.55	291	38.69	

***** *Significant at 0.05 level* ****** *Significant at 0.01 level*

(Critical Value 3.03 at 0.05 and 4.68 at 0.01 level, df 2/291)

(Critical Value 2.41 at 0.05 and 3.38 at 0.01 level, df 4/291)

• ***Instructional Approaches (A)***

The table 2 reveals that F-ratio for difference in mean gain self perceptions scores for radical constructive learning approach, social constructive learning approach and traditional teaching approach was 51.11, which in comparison to the table value was found highly significant at 0.01 level of significance. It shows that the experimental and control groups are different beyond the contribution of chance. Thus, the null hypothesis **H_1**: There exists no significant difference between the groups taught through radical and social constructive learning approaches and conventional teaching approach on self perceptions in mathematics**,** was rejected**.** The result indicates that self perceptions in mathematics of group taught through radical constructive learning approach and social constructive learning approach is much higher than that of traditional teaching approach.

In order to probe deeper, the F-ratio was followed by t-test. The values of t –ratio for different combinations of mean gain scores of experimental and control groups for different teaching strategies have been presented 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	27.78	8.14	100	23.50	8.45	100	15.35	4.05
Experimental Group-I									
N	Mean	SD	---			**1.46**			**7.06****
100	21.78	8.14							
Experimental Group-II									
N	Mean	SD	---			---			**8.68****
100	23.50	8.45							
Control Group									
N	Mean	SD	---			----			---
100	15.35	4.05							

***** *Significant at 0.05 level* ****** *Significant at 0.01 level*

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

Table-3 shows that the mean gain self perceptions scores of experimental group-I taught through radical constructive learning approach group was 21.78 which is lower than the corresponding mean gain score of 23.50 for experimental group–II taught through social constructive learning approach group. The t-value testing the significance of mean difference on self perceptions of experimental group-I and II was 1.46, which, in comparison to the table value was not found significant even at 0.05 level of significance. Hence, it may be inferred that the students imparted instruction through radical constructive learning approach and social constructive learning approach did not yield significant mean gain scores on self perceptions in mathematics.

Table-3 shows that the mean gain self perceptions scores in mathematics of experimental group-I taught through radical constructive learning approach group was 21.78 which is higher than the corresponding mean gain score of 15.35 for control group taught through traditional teaching approach. The t-value testing the significance of mean difference on self perceptions of radical constructive learning approach and traditional teaching approach was 7.06, which in comparison to the table value was found significant at 0.01 level of significance. The result indicates that the students taught through radical constructive learning approach perform significantly better than that of traditional teaching approach.

Table-3 reveals that the mean gain self perceptions scores in mathematics of experimental group-II taught through social constructive learning approach group was 23.50 which is higher than the corresponding mean gain score of 15.35 for control group taught through traditional teaching approach. The t-value testing the significance of mean difference on self perceptions of social constructive learning approach and traditional teaching approach was 8.68, which in comparison to the table value was found significant at 0.01 level of significance. The result indicates that the students taught through social constructive learning approach perform significantly better than traditional teaching approach.

- ***Attitude towards Mathematics (B)***

Table-2 shows that the F-ratio for difference in the mean gain self perceptions scores in mathematics scores of different attitude towards mathematics groups was 41.13 , which in comparison to the table value was found significant at 0.01 level of significance. Thus, the null hypothesis **H_2**: There exists no significant difference between the groups having high, average and low scores attitude scores towards mathematics with regards to self perceptions, was rejected. The result indicates that high, average and low attitude towards mathematics group was different on self perceptions in mathematics.

To investigate further, F-ratio is followed by t-test. The values of the t-ratio for different combination have been given in the following table-4.

Table-4: t-ratio for different attitude towards mathematics groups

Variable	High Attitude Towards Mathematics			Average Attitude Towards Mathematics			Low Attitude Towards Mathematics		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
	81	25.28	11.38	138	19.26	5.24	81	16.74	4.52
High Attitude Towards Mathematics									
N	Mean	SD	----			**5.32****			**6.27****
81	25.28	11.38							
Average Attitude Towards Mathematics			----			**----**			**3.62****
N	Mean	SD							

138	19.26	5.24			
Low Attitude Towards Mathematics			----	----	----
N	Mean	SD			
81	16.74	4.52			

***** *Significant at 0.05 level* ****** *Significant at 0.01 level*

(Critical Value 1.98 at 0.05 and 2.61 at 0.01 level, df 160)

(Critical Value 1.97 at 0.05 and 2.60 at 0.01 level, df 217)

Table-4 shows that the mean gain scores of high attitude towards mathematics group was 25.28, which is higher than the corresponding mean gain scores of 19.26 for the average attitude towards mathematics group. The t-value testing the significance of mean difference of high and average attitude towards mathematics groups was 5.32, which in comparison to the table value was found significant at 0.01 level of significance. Hence, the hypothesis of significant difference was rejected in case of high and average attitude towards mathematics irrespective of grouping across other variables. The result indicates that high attitude towards mathematics group of students perform significantly better than that of average attitude towards mathematics group with regard to gain self perceptions scores in mathematics.

Table-4 shows that the mean gain scores of high attitude towards mathematics group was 25.28, which is higher than the corresponding mean gain scores of 16.74 for the low attitude towards mathematics group. The t-value testing the significance of mean difference of high and low attitude towards mathematics group was 6.27, which in comparison to the table value was found significant at 0.01 level of significance. Hence, the hypothesis of significant difference was rejected in case of high and low attitude towards mathematics irrespective of grouping across other variables. The result indicates that high attitude towards mathematics group of students perform significantly better than that of low attitude towards mathematics group with regard to gain self perceptions scores in mathematics.

Table-4 shows that the mean gain score of average attitude towards mathematics group was 19.26, which is higher than the corresponding mean gain score of 16.74 for low attitude towards mathematics group. The t-ratio for difference in gain scores of average and low attitude towards mathematics group was 3.62, which in comparison to the table value was found significant at 0.01 level of significance. Hence, the hypothesis of significant difference was rejected in case of average and low attitude towards mathematics irrespective of grouping across other variables. The result indicates that average attitude towards mathematics group of students perform significantly better than that of low attitude towards mathematics group with regard to gain self perceptions scores in mathematics.

- ***Interaction between Instructional Approaches and Attitude towards Mathematics (A×B)***

Table-2 shows that the F-ratio for interaction between instructional approaches and attitude towards mathematics group was 5.30, which in comparison to the table value was found significant at 0.01 level of significance. It indicates that different teaching approaches do interact with attitude towards mathematics group to yield significant difference in respect of gain self perceptions scores in mathematics. Hence, the null hypothesis $\mathbf{H_3}$: There exists no significant interaction effect of instructional approaches and attitude towards mathematics with regards to self perceptions, was rejected. The result indicates that there is significant difference in gain scores on self perceptions in mathematics scores due to interaction effect of teaching approaches and attitude towards mathematics group.

To ascertain significance of difference among means of various combination groups of instructional approaches and attitude towards mathematics, t-ratios are calculated which have been shown in table-5.

Table-5: t-ratio for difference in gain self- perceptions scores of instructional approaches and different attitude towards mathematics groups

Variables			Experimental Group-I			Experimental Group-II			Control Group		
			B_1	B_2	B_3	B_1	B_2	B_3	B_1	B_2	B_3
			Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD
			28.48 10.68	20.63 5.63	17.70 3.90	30.77 12.03	21.71 4.14	19.25 4.23	16.59 4.40	15.84 3.95	13.25 3.09
Experimental Group-I	High Attitude Towards Mathematics N Mean SD 27 28.48 10.68		---	4.32**	4.92**	0.74	3.84**	4.16**	5.34**	7.24**	7.11**
	Average Attitude Towards Mathematics N Mean SD 46 20.63 5.63		---	---	2.06*	5.08**	7.64**	0.78	2.83**	4.32**	5.92**
	Low Attitude Towards Mathematics N Mean SD 27 17.70 3.90		---	---	---	5.36**	4.08**	1.40	0.98	1.94	4.63**
Experimental Group-II	High Attitude Towards Mathematics N Mean SD 27 30.77 12.03		---	---	---	---	4.67**	4.68**	5.79**	7.75**	7.32**
	Average Attitude Towards Mathematics N Mean SD 46 21.71 4.14		---	---	----	---	---	9.13**	4.98**	11.27**	9.19**
	Low Attitude Towards Mathematics N Mean SD 27 19.25 4.23		---	---	---	---	---	---	2.26*	3.46**	5.94**
Control Group	High Attitude Towards Mathematics N Mean SD 27 16.59 4.40		---	---	---	---	---	---	---	0.74	3.21**
	Average Attitude Towards Mathematics N Mean SD 46 15.84 3.95		---	---	---	---	---	---	---	---	2.91**
	Low Attitude Towards Mathematics N Mean SD 27 13.25 3.09		---	----	---	---	---	---	---	---	---

**Significant at 0.05 level* ***Significant at 0.01 level*

Here B_1, Stands for High Attitude towards Mathematics, B_2 Stands for Average Attitude towards Mathematics and B_3 Stands for Low Attitude towards Mathematics

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group-I exhibits higher mean gain scores than average attitude towards mathematics group with mean 20.63 of experimental group- I. The t-ratio for difference in mean gain scores of high and average attitude towards mathematics of experimental group-I was 4.32, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-I perform significantly better than that of low attitude towards mathematics of experimental group- I.

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group-I exhibits higher mean gain scores than low attitude towards mathematics group with mean 17.70 of experimental group-I. The t-ratio for difference in mean gain scores of high and low attitude towards mathematics of experimental group- I was 4.92, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-I perform significantly better than that of low attitude towards mathematics of experimental group-I.

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group- I exhibits higher mean gain scores than average attitude towards mathematics group with mean 21.71 of experimental group-II. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group- I and average attitude towards mathematics of experimental group-II was 3.84, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group- I perform significantly better than that of average attitude towards mathematics of experimental group-II.

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group- I exhibits higher mean gain scores than low attitude towards mathematics group with mean 19.25 of experimental group-II. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group- I and low attitude towards mathematics of experimental group-II was 4.16, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group- I perform significantly better than that of low attitude towards mathematics of experimental group-II.

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group-I exhibits higher mean gain scores than high attitude towards mathematics group with mean 16.59 of control group. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group-I and control group was 5.34, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-I perform significantly better than that of high attitude towards mathematics of control group.

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group-I exhibits higher mean gain scores than average attitude towards mathematics group with mean 15.84 of control group. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group-I and average attitude

towards mathematics of control group was 7.24, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-I perform significantly better than that of average attitude towards mathematics of control group.

Table-5 indicates that high attitude towards mathematics group with mean of 28.48 of experimental group-I exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group-I and low attitude towards mathematics of control group was 7.11, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-I perform significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 20.63 of experimental group-I exhibits higher mean gain scores than low attitude towards mathematics group with mean 17.70 of experimental group- I. The t-ratio for difference in mean gain scores of average and low attitude towards mathematics experimental group-I was 2.06, which in comparison to the table value ($t_{0.05}$=2.00 and $t_{0.01}$=2.65, df 71) was found significant at 0.05 level of significance. The result indicates that the average attitude towards mathematics of experimental group-I perform significantly better than that of low attitude towards mathematics of experimental group-I.

Table-5 indicates that average attitude towards mathematics group with mean of 20.63 of experimental group-I exhibit lower mean gain scores than high attitude towards mathematics group with mean 30.77 of experimental group-II. The t-ratio for difference in mean gain scores of average attitude towards mathematics of experimental group-I and high attitude towards mathematics of experimental group-II was 5.08, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group- II perform significantly better than that of average attitude towards mathematics of experimental group-I.

Table-5 indicates that average attitude towards mathematics group with mean of 20.63 of experimental group-I exhibit lower mean gain scores than average attitude towards mathematics group with mean 21.71 of experimental group-II. The t-ratio for difference in mean gain scores of average attitude towards mathematics of experimental group-I and experimental group-II was 7.64, which in comparison to the table value ($t_{0.01}$=2.63, df 90) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group- II perform significantly better than that of average attitude towards mathematics of experimental group-I.

Table-5 indicates that average attitude towards mathematics group with mean of 20.63 of experimental group- I exhibits higher mean gain scores than high attitude towards mathematics group with mean 16.59 of control group. The t-ratio for difference in mean gain scores of average attitude towards mathematics group of experimental group- I and high attitude towards mathematics of control group was 2.83, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group-I perform significantly better than that of high attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 20.63 of experimental group- I exhibits higher mean gain scores than average attitude towards mathematics group with mean 15.84 of control group. The t-ratio for difference in mean gain scores of average attitude towards mathematics group of experimental group- I and control group was 4.32, which in comparison to the table value ($t_{0.01}$=2.63, df 90) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group-I perform significantly better than that of average attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 20.63 of experimental group- I exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of average attitude towards mathematics group of experimental group- I and low attitude towards mathematics of control group was 5.92, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group-I perform significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that low attitude towards mathematics group with mean of 17.70 of experimental group-I exhibit lower mean gain scores than high attitude towards mathematics group with mean 30.77 of experimental group-II. The t-ratio for difference in mean gain scores of low attitude towards mathematics of experimental group- I and high attitude towards mathematics of experimental group-II was 5.36, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-II perform significantly better than that of low attitude towards mathematics of experimental group-I.

Table-5 indicates that low attitude towards mathematics group with mean of 17.70 of experimental group-I exhibit lower mean gain scores than average attitude towards mathematics group with mean 21.71 of experimental group-II. The t-ratio for difference in mean gain scores of low attitude towards mathematics of experimental group- I and average attitude towards mathematics of experimental group-II was 4.08, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group-II perform significantly better than that of low attitude towards mathematics of experimental group-I.

Table-5 indicates that low attitude towards mathematics group with mean of 17.70 of experimental group-I exhibit higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of low attitude towards mathematics of experimental group-I and control group was 4.63, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the low attitude towards mathematics of experimental group-I perform significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that high attitude towards mathematics group with mean of 30.77 of experimental group-II exhibit higher mean gain scores than average attitude towards mathematics group with mean 21.71 of experimental group-II. The t-ratio for difference in mean gain scores of high and average attitude towards mathematics of experimental group- II was 4.67, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance . The result indicates that the high attitude towards mathematics of experimental group-II performs significantly better than that of average attitude towards mathematics of experimental group- II.

Table-5 indicates that high attitude towards mathematics group with mean of 30.77 of experimental group-II exhibit higher mean gain scores than low attitude towards mathematics group with mean 19.25 of experimental group-II. The t-ratio for difference in mean gain scores of high and low attitude towards mathematics of experimental group- II was 4.68, which in comparison to the table value ($t_{0.01}$=2.68, df 50) was found significant at 0.01 level of significance . The result indicates that the high attitude towards mathematics of experimental group-II performs significantly better than that of low attitude towards mathematics of experimental group- II.

Table-5 indicates that high attitude towards mathematics group with mean of 30.77 of experimental group-II exhibits higher mean gain scores than high attitude towards mathematics group with mean 16.59 of control group. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group-II and high attitude towards mathematics of control group was 5.79, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group-II performs significantly better than that of high attitude towards mathematics of control group.

Table-5 indicates that high attitude towards mathematics group with mean of 30.77 of experimental group- II exhibits higher mean gain scores than average attitude towards mathematics group with mean 15.84 of control group. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group-II and average attitude towards mathematics of control group was 7.75, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group- II performs significantly better than that of average attitude towards mathematics of control group.

Table-5 indicates that high attitude towards mathematics group with mean of 30.77 of experimental group- II exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of high attitude towards mathematics of experimental group-II and low attitude towards mathematics of control group was 7.32, which in comparison to the table value ($t_{0.01}$= 2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of experimental group- II performs significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 21.71 of experimental group-II exhibits higher mean gain scores than low attitude towards mathematics group with mean 19.25 of experimental group-II. The t-ratio for difference in mean gain scores of average and low attitude towards mathematics of experimental group-II was 9.13, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics experimental group- II performs significantly better than that of low attitude towards mathematics of experimental group-II.

Table-5 indicates that average attitude towards mathematics group with mean of 21.71 of experimental group-II exhibits higher mean gain scores than high attitude towards mathematics group with mean 16.59 of control group. The t-ratio for difference in mean gain scores of average attitude towards mathematics of experimental group- II and high attitude towards mathematics of control group was 4.98, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group- II performs significantly better than that of high attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 21.71 of experimental group-II exhibits higher mean gain scores than average attitude towards mathematics group with mean 15.84 of control group. The t-ratio for difference in mean gain scores of average attitude towards mathematics of experimental group- II and control group was 11.27 , which in comparison to the table value ($t_{0.01}$=2.63, df 90) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental group- II performs significantly better than that of average attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 21.71 of experimental group-II exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of average attitude towards mathematics of experimental group- II and low attitude towards mathematics of control group was 9.19, which in comparison to the table value ($t_{0.01}$=2.63, df 90) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of experimental

group- II performs significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that low attitude towards mathematics group with mean of 19.25 of experimental group-II exhibits higher mean gain scores than high attitude towards mathematics group with mean 16.59 of control group. The t-ratio for difference in mean gain scores of low attitude towards mathematics of experimental group-II and high attitude towards mathematics of control group was 2.26, which in comparison to the table value ($t_{0.05}$=2.01 and $t_{0.01}$=2.68, df 52) was found significant at 0.05 level of significance. The result indicates that the low attitude towards mathematics of experimental group- II performs significantly better than that of high attitude towards mathematics of control group.

Table-5 indicates that low attitude towards mathematics group with mean of 19.25 of experimental group-II exhibits higher mean gain scores than average attitude towards mathematics group with mean 15.84 of control group. The t-ratio for difference in mean gain scores of low attitude towards mathematics of experimental group-II and average attitude towards mathematics of control group was 3.46, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the low attitude towards mathematics of experimental group- II performs significantly better than that of average attitude towards mathematics of control group.

Table-5 indicates that low attitude towards mathematics group with mean of 19.25 of experimental group-II exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of low attitude towards mathematics of experimental group-II and of control group was 5.94, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the low attitude towards mathematics of experimental group- II performs significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that high attitude towards mathematics group with mean of 16.59 of control group exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of high and low attitude towards mathematics of control group was 3.21, which in comparison to the table value ($t_{0.01}$=2.68, df 52) was found significant at 0.01 level of significance. The result indicates that the high attitude towards mathematics of control group performs significantly better than that of low attitude towards mathematics of control group.

Table-5 indicates that average attitude towards mathematics group with mean of 15.84 of control group exhibits higher mean gain scores than low attitude towards mathematics group with mean 13.25 of control group. The t-ratio for difference in mean gain scores of average and low attitude towards mathematics of control group was 2.91, which in comparison to the table value ($t_{0.01}$=2.65, df 71) was found significant at 0.01 level of significance. The result indicates that the average attitude towards mathematics of control group performs significantly better than that of low attitude towards mathematics of control group.

Table-5 shows that the rest of combination groups i.e. high attitude towards mathematics of experimental group-I with high attitude towards mathematics of experimental group-II, average attitude towards mathematics of experimental group-I with low attitude towards mathematics of experimental group-II, low attitude towards mathematics of experimental group-I with low attitude towards mathematics of experimental group-II, low attitude towards mathematics of experimental group-I with high and average attitude towards mathematics of control group, high with average attitude towards mathematics of control group did not yield significant difference on self perceptions in mathematics even at 0.05 level of significance.

10. Discussion

The present study reveals that the self perceptions in mathematics of groups taught through radical and constructive learning approaches was more effective strategy than that of traditional teaching approaches. Hence, the null hypothesis **H_1**: There exists no significant difference between the groups taught through radical and social constructive learning approaches and conventional teaching approach on self perceptions in mathematics, was rejected.

It was concluded that radical and social constructive learning approach yielded better self perceptions scores in mathematics than traditional teaching approach. The result is supported by the finding of Mathew (2017) self-perception explains how better the students perform in their various school subjects offered to them like mathematics, science, language arts, social studies etc. Galia (2016) found that students who used the constructivist-based approach got significantly higher posttest scores than those taught using the lecture method, and some had improved perception and attitude towards calculus based on the written journals. Sridevi (2013) showed that constructivist teaching is more effective than conventional teaching in terms of perception of nature of science among 8th standard students. Saunders, Davis, Williams, and Williams (2004) found that both male and female students with more positive self-perceptions have stronger intentions to complete the current year of high school. Results of the study contradicted by the study of Lamar (2001) found no significant difference in the perceptions of male and female or higher and lower achieving students regarding constructivist pedagogy.

The findings of the present study also reveals that there exists significant difference between the groups having high, average and low attitude towards mathematics group with regard to self perceptions in mathematics scores. Hence, the null hypothesis **H_2**: There exists no significant difference between the groups having high, average and low scores attitude scores towards mathematics with regards to self perceptions, was rejected. It was concluded that high attitude towards mathematics group was higher than average and low attitude towards mathematics group with regard to self perceptions in mathematics scores. It was also concluded that average attitude towards mathematics group was better than low attitude towards mathematics group with respect to self perceptions in mathematics scores. The results of the study

supported by Sridevi (2013) found that constructivist approach was equally effective for both boys and girls in improving achievement and attitude towards science. Fareo (2011) showed exceptionality types of students with special needs had influence on their self-perception and sex of students with special needs had no significant influence on their self-perception. No suitable study found in contradiction to the result.

The present study reveals that that there exists significant difference in gain self perceptions in mathematics scores due to interaction effect of instructional approaches and attitude towards mathematics groups. Hence, the null hypothesis **H_3**: There exists no significant interaction effect of instructional approaches and attitude towards mathematics with regards to self perceptions, was rejected. Instructional approaches and attitude towards mathematics yielded significant difference in mean gain scores on self perceptions in mathematics. This result is supported by Cahill (2010) revealed a positive correlation between students' scholastic competence, self-perception scores and cognitive skills and academic achievement in reading, language arts, and mathematics. Murcia and Gimeno (2005) showed an effect of interaction between gender (males vs. females) and physical activity practice (practice vs. non-practice), indicating that males that did sport had higher scores in sport competence, attractive body, physical condition and physical strength than females that did sport and females that did not. No suitable study found in contradiction to result.

11. Findings

1. The self perceptions of groups taught through radical constructive learning approach and social constructive learning approach were found significantly higher than that of traditional teaching approach in mathematics. Further analysis revealed that:
   (i) The mean gain self perceptions scores of group taught through radical constructive learning approach were not found significantly higher than that of social constructive learning approach group.
   (ii) The mean gain self perceptions scores of group taught through radical constructive learning approach were found significantly higher than that of traditional teaching approach group.
   (iii) The mean gain self perceptions scores of group taught through social constructive learning approach were found significantly higher than that of traditional teaching approach group.
2. The self perceptions of high, average and low attitude towards mathematics groups were found significantly different from one another. Further analysis revealed that:
   (i) The mean gain self perceptions scores of high attitude towards mathematics group were found significantly higher than that of average and low attitude towards mathematics group.
   (ii) The mean gain self perceptions scores in mathematics of average attitude towards mathematics group were found significantly higher than that of low attitude towards mathematics group.
3. There was significant interaction effect of instructional approaches and attitude towards mathematics on self perceptions in mathematics. Further analysis revealed that:
   (i) The high attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of average and low attitude towards mathematics of radical constructive learning approach group.
   (ii) The high attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of average and low attitude towards mathematics of social constructive learning approach group.
   (iii) The high attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of high, average and low attitude towards mathematics of traditional teaching approach group.
   (iv) The average attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of low attitude towards mathematics of radical constructive learning approach group.
   (v) The average attitude towards mathematics of radical constructive learning approach group exhibited lower mean gain scores than that of high attitude towards mathematics of social constructive learning approach group.
   (vi) The average attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of average attitude towards mathematics of social constructive learning approach group.
   (vii) The average attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of high, average and low attitude towards mathematics of traditional teaching approach group.
   (viii) The low attitude towards mathematics of radical constructive learning approach group exhibited lower mean gain scores than that of high and average attitude towards mathematics of social constructive learning approach group.
   (ix) The low attitude towards mathematics of radical constructive learning approach group exhibited higher mean gain scores than that of low attitude towards mathematics of traditional teaching approach group.
   (x) The high attitude towards mathematics of social constructive learning approach group exhibited higher mean gain scores than that of average and low attitude towards mathematics of social constructive learning approach group.
   (xi) The high attitude towards mathematics of social constructive learning approach group exhibited higher mean gain scores than that of high, average and low attitude towards mathematics of traditional teaching approach group.
   (xii) The average attitude towards mathematics of social constructive learning approach group exhibited higher mean gain scores than that of low attitude

towards mathematics of social constructive learning approach group.

(xiii) The average attitude towards mathematics of social constructive learning approach group exhibited higher mean gain scores than that of high, average and low attitude towards mathematics of traditional teaching approach group.

(xiv) The low attitude towards mathematics of social constructive learning approach group exhibited higher mean gain scores than that of high, average and low attitude towards mathematics of traditional teaching approach group.

(xv) The high attitude towards mathematics of traditional teaching approach group exhibited higher mean gain scores than that of low attitude towards mathematics of traditional teaching approach group.

(xvi) The average attitude towards mathematics of traditional teaching approach group exhibited higher mean gain scores than that of low attitude towards mathematics of traditional teaching approach group.

(xvii) Rest of the combinations of instructional approaches and attitude towards mathematics group did not yield significant difference in mean gain self perceptions scores in mathematics.

12. Conclusion

In the present study the major focus of the investigator was on the self-perceptions in mathematics. The investigators tried to study the impact of radical and social constructive learning and traditional teaching approaches on the self-perception in mathematics in relation to their attitude towards mathematics. Above whole discussion states that learners taught through constructive learning approaches have better self-perceptions than that of traditional teaching group. It is also observed that learners with varying attitude towards mathematics have difference in their self-perceptions in mathematics. However, the findings suggest that teaching through radical and social constructive learning approaches prove to be better approaches for teaching mathematics at secondary school stage. Constructive learning approaches is beneficial for both teachers and parents to change the self-perceptions and many other affective outcomes in mathematics.

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