Effectiveness of Brain Based Learning on Self-Regulation Skills of Higher Secondary School Students

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Abstract:
The present research study is focused on to determine the effectiveness of brain-based learning on self-regulation skill of higher secondary school students. This study was executed as an experimental method and pretest-posttest control group design. The total population was stratified by the administration of Kolb's learning style inventory .The sample size consisted of 96 + 2 Science first year students who were selected randomly by applying stratified random sampling and were placed in two groups of control and experiment (each group, 48 students). The researcher taught the experimental group through lessons designed on the basis of brain based learning principles for 12 weeks. The self-regulation scale was used for collecting the data. The collected data were analyzed by using the statistical technique i.e. analysis of covariance (ANCOVA) test. The results of ANCOVA analysis test clearly indicated that the brain-based learning has effect on self-regulated learning skill and this impact lasts for 3 month. According to different researches, Brain-based Learning can be used as an intervention therapy for enhancing self-regulation skills of higher secondary students .

Key words: ***Effectiveness, Brain Based Learning, Self regulation skill, learning style, intervention***

1.0 INTRODUCTORY GLANCE OF THE STUDY

Learning is a psychological as well as biological or psychobiological entity. This includes the brain science. i.e. the chemical, structural and functional dimensions of what happens in the brain during learning (Taraj ,2012) as well as the mental and physical environment of a learner i.e. whether the learner regulate his/her self for balancing the emotion, planning , executing, evaluating the task successfully and rectifying with self analysis and self feedback. Most importantly whether the environment provided to the learner is threat free or not. According to Frederick Goodwin, president of the National Institute of Mental Health :", it was thought Previously, that our brain nerves are unalterable but in fact positive environments can create physical change in growing brain (Hoseini Iraj, 2010).

The human brain has many compartments with multi functions but the present system has pointed out and emphasizing a very small percentage of that. Technically speaking, the present schooling or system of learning emphasizes on a very narrow part of brain, present on the left side of cerebral cortex. The human brain is a complex system that is still used in school as a simple storing and information retrieval device (Hoiland,2005). According to Kerry (2010), the school learning concentrates on a narrow part of brain which is placed in left side of cerebral cortex and isolation of specific parts of the brain, has eliminated its systematic cohesion and

correlation. From the ancient Gurukul to today's constructivism the teaching method and strategies have been modified and restructured a lot, but very less method emphasized on the brain i.e. the functions of brain and the brain compatibility in regards to new information and learning. Currently many teachers continue to use teacher-centered instruction even though evidence is available to suggest a constructivist approach is more effective (Beauchman, 2005). The results of this study may have implications for using constructivist instructional method and theories of education.

2.0 THEORETICAL FRAMEWORK

The study uses the constructivist theory as foundation. Gardner's multiple intelligence theory is a constructivist theory (Gardner, 2006). According to Jensen,2008b, Gardner's theory of multiple intelligences is the base of brain based learning whereas behaviorists approach of Skinner and Pavlov are the bases of teacher centered instruction i.e. instruction for control group. The constructivist theoretical perspectives of education is the foundation for brain based instruction (Bush, 2006) .Brain based instruction uses orchestrated immersion as a central components of student learning (Jensen,2008b). Orchestrated immersion is using student knowledge as it applies to real life situations (Jensen, 2008b)

Gardner's theory identifies eight different intelligences: linguistic, logical-mathematical, spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist (Gardner, 2006). Linguistic intelligence occurs when a person processes words better than other forms of information; the person learns best from reading, lectures, taking notes, and discussions (Gardner, 2006). Logical-mathematical intelligence is the ability to learn best through numerical and logical formats (Gardner, 2006). These types of learner learn best from graphs, problem solving, algorithms, and they excel at abstract thinking (Gardner, 2006). People with spatial intelligence are good at visualizing, as well as solving puzzles and having a keen sense of direction (Gardner, 2006). Kinesthetic intelligence is an ability to learn best by movement or building things (Gardner, 2006). These learners tend to be successful in sports or activities requiring movement. Individuals with the ability to learn best through rhythms or sound have a musical intelligence (Gardner, 2006). Learner who can learn best by working with others in groups possesses interpersonal intelligence (Gardner, 2006). A person with intrapersonal intelligence learns best by having time alone to concentrate and analyze information (Gardner, 2006). The naturalist intelligence is defined as learning best when material is connected to the natural environment, this intelligence was added by Gardner in 1997 (Douglas et.al. 2008). The multiple intelligence theory suggests a person has a primary intelligence (Gardner, 2006). Brain-based instruction allows the use of multiple intelligences to work seamlessly with orchestrated immersion and active processing. Neuroscience has expanded since then and now brain theory encompasses a more holistic approach (Wilson, 2007). Brain-based instruction stems from the research of Gardner's multiple intelligence theory, as Gardner used brain-based evidence for his theory of multiple intelligences (Jensen, 2008b).

Brain-based instruction goes beyond the multiple intelligence theory; brain-based instruction includes the physical environment and reactions to learning to aid in increasing learning (Jensen, 2008b). Brain-based instruction has a focus on orchestrated immersion as one of three components, so students actively engage in learning (Wilmes, Harrington, Kohler-Evans, & Sumpter, 2008). Orchestrated immersion is the component of brain-based instruction containing Gardner's theory of multiple intelligences, as these activities create the appropriate environment for the multiple intelligences. Apart from orchestrated immersion the two other components of brain-based instruction are relaxed alertness and active processing. Marian Diamond has studied the relaxed alertness component of brain-based instruction (Wilson, 2007). Armstrong and Jensen have conducted studies more recently on all three components of brain-based instruction (Wilson, 2007). The controversy surrounding brain-based instruction is how the neurological information currently available translates to use in the classroom (Sternberg, 2008; Willingham, 2008). The current study uses this content specific theory as the theory relates to the constructivist theory and brain-based instruction. Historically, teacher-centered instruction has been the norm in most classrooms (Cuban, 2007). Teacher-centered instruction is an application of behaviorist theories (Gredler, 2008). The difference between these theories lies in the different roles of the student and teacher in the learning process. The behaviorists believe the teacher guides instruction and the students should be trained to sit quietly and listen (Gredler, 2008). While the constructivists believe that, the students should guide their own learning and the teacher's role is to facilitate the students in expanding their knowledge (Lattuca, 2006; Schunk, 2007). The implications may specifically address using the brain-based instructional method as an application of constructivist theory.

3.0 METHODOLOGY

3.1 Population and participants

The target population of the study consisted of all higher secondary school students. The accessible population of the study was all higher secondary students of Balasore district of Odisha. The researcher has purposively selected Rural Institute of Higher Studies (RIHS), Bhograi, Balasore as the research site of the study. 256 students had been enrolled in Class-XI (+2) of Science stream of RIHS. There were two sections (A & B) having 128 students in each section. The researcher had selected section B for the study by employing lottery method of simple random sampling technique. After verification of the attendance it was found that 96 students of section B had been attending the classes regularly. Finally, the researcher included all 96 students of section-B in the study after getting their consent for participation in the experiment.

In order to form two groups (control and experimental), all 96 students of Class-XI , section-B were taken. The researcher administered Kolb's Learning Style Inventory to ensure the equalization of groups with respect to learning styles. The performance of students on Kolb's Learning Style Inventory revealed that there were 22 Activist (A) learners, 24 Reflector (R) learners, 22 Pragmatist(P) learners, 20 Theorist (T) learners, 03 Activist & Theorist (A&T) learners, 03 Reflector & Theorist (R&T) learners, 01 Reflector learner and 01 Pragmatist (R&P) learner. Taking into consideration of different learning style among learners, the researcher has randomly assigned equally 11 activist learners, 12 reflective learners, 11 pragmatist learners, 10 theorist learners, 01 Activist & Theorist (A&T) learner, 01 Reflector & Theorist learner to each group. The remaining four learners one each from Activist & Theorist (A&T), Reflector & Theorist(R&T), Reflector & Pragmatist and Activist & Pragmatist(A&P) were randomly assigned 02 learners to each group. The details of the distribution learners into groups (Group A &B) on the basis of results obtained from Kolbe's Learning Style Inventory has been given in table 1.0

Table 1.0: Formation of Groups on the basis of Performance of Kolb's Learning Style Inventory

Sl No	**Category of learning style**	**Number of students**	**Formation of Groups**	
			Group A	**Group B**
01	Activist (A)	22	11	11
02	Reflector (R)	24	12	12
03	Pragmatist(P)	22	11	11
04	Theorist (T)	20	10	10
05	Activist & Theorist (A&T)	**03**	01	01
06	Reflector & Theorist(R&T)	**03**	01	01
07	Reflector &Pragmatist(R&P)	**01**	01 (A&T)	01 (A&P)
08	Activist & Pragmatist(A&P)	**01**	01 (R&T)	01 (R&P)
Total	8 Categories	96	48	48

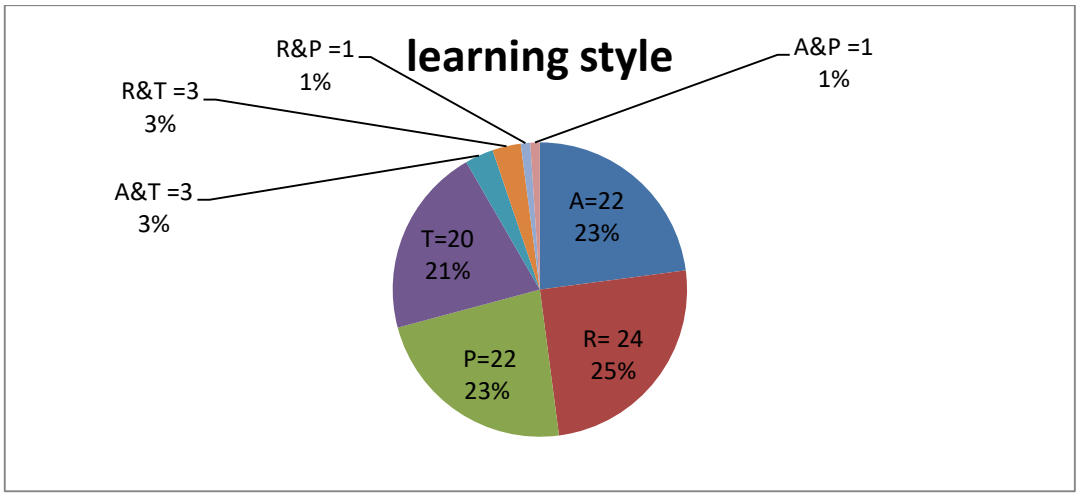


Fig: 1.0 Pie-chart showing different learning style in percentage

The researcher has selected Group A by using lottery method of simple random sampling techniques for experimental purpose. The Group B was taught through conventional method as control group.

3.2 Sample of the study

The random sampling technique was employed to select the sample. The sample for this study was comprised of 96 class XI students. The age ranges from 15 – 17 years. The medium of instruction was English.

Table 2.0: Sample of the study with respect to gender

Sl. No	Section	Group	Gender		No of students
			M	F	
01	B	Experimental	28	20	48
02	B	Control	29	19	48
Total			57	39	96

3.3 Tools for variables of the study

Variable includes in the study are Kolb's learning style inventory; self-regulation, achievement in science and reaction towards treatment. Descriptions of the tools which are used to collect data are mentioned below.

3.3.1 Kolb's learning style inventory

This inventory is designed to find out the preferred learning styles(s) of learner. Over the years, probably they may have developed learning habits/style(s). The test consists of 80 items spread over 5 different areas. There is no right and wrong responses as well as no time limits.

3.3.2 Self-regulation awareness tool

This tool was constructed by the researcher with the help of educational experts who are in the field of educational research, in order to measure the self-regulation among the students. Development of self-regulation occurs through learner's experiences, expression, understanding, and regulation of emotion from birth to adolescence. Self-regulation does not occur in isolation; neural, cognitive, and behavioral developments interact with emotional development in turn self-regulation. As their brain development is not full fledging, so it is not supporting them to control their emotion. Therefore self-regulation is a problem at this stage. After going through the literature review related to self-regulation, the investigator constructed the self- regulation tool with dimensions like:

Table 3.0: Dimensions of the self- regulation tool

Dimensions of self-regulation tool	Number of items
Metacognition.	05
Self –concept	04
Self-monitoring	04
Motivation	04
Cognitive strategy formation	04
Volition control strategies	03

3.4 Duration of the treatment

The researcher had done the study for 12 weeks. He approached to the institute principal and assures him that he will complete the portion whatever their teacher yet to finish within 12 weeks. The researcher interacts well with the biology teachers and observed four classes of them so as to teach the control group.

4.0 OBJECTIVES

Objectives are listed as follows:

1. To compare adjusted mean scores of Self-regulation Skill of Brain Based Learning and conventional Method Groups by taking Pre- Self-regulation Skill as covariate
2. To study the effect of Treatment, Gender and their interaction on Self-regulation Skill by taking Pre- Self-regulation Skill as covariate.

5.0 HYPOTHESES

1. There is no significant difference in mean scores of Self-regulation Skill of Brain Based Learning and conventional Method Groups by taking Pre- Self-regulation Skill as covariate.
2. There is no significant effect of Treatment, Gender and their interaction on Self-regulation Skill by taking Pre- Self-regulation Skill as covariate.

6.0 COMPARISON OF ADJUSTED MEAN SCORES OF SELF-REGULATION SKILL OF BRAIN BASED LEARNING AND CONVENTIONAL METHOD GROUPS BY TAKING PRE- SELF-REGULATION SKILL AS COVARIATE.

In order to find out mean difference between pre-test & post-test scores of Experimental and Control Group in terms of Self Regulation Skill, the investigator administered the standardized scale to assess. The requisite scores for finding the mean difference between the scores of Experimental and Control Group students were computed. The details has been given in table 4.3

Table No.4.0 Mean Score Difference in Self Regulation Skill between Experimental and Control Group after treatment.

Categories			Pre-test		Post test		
Variable	Groups	N	Mean	SD	Mean	SD	Gained mean
Self Regulation Skill	Experimental	48	83.58	18.92	99.27	9.97	15.69
	Control	48	83.33	20.72	92.73	10.76	9.4

It can be inferred from the table no 4.0 that the mean pre-test self regulation score of experimental and control group is 83.58, 83.33 and SD 18.58, 20.72 respectively. Also it can be seen that the mean post-test self regulation score of experimental and control group is 99.27, 92.73 and SD 9.97, 10.76 respectively. It can also be seen that

the mean gain score of self-regulation is 15.69 and 9.4 respectively. So it is cleared that the mean self-regulation score increased from pre-test to post-test.

In order to test whether the assumption of normality of scores holds good or not, test of normality was performed on self regulation. The result of the Shapiro- wilk test has been summarized below in the table No.4.1.

Table No.4.1: Test of normality of Self Regulation Skill

Level of Treatment	Shapiro- wilk			
	Statistics	df	Exact significance	Significane Level
Experimental	.984	48	.729	> 0.05
Control	.975	48	.398	> 0.05

From the table 4.4 it is clear that the value of the Shapiro – Wilk statistics for traditional/control group is 0.975 whose significance value with df = 48 is 0.389. This value is greater than 0.05 and thus is not significant at 0.05 level of significance. In the light of this the null hypothesis "The given distribution for self-regulation do not deviate significantly from normality" is not rejected. Similarly the value of statistics for experimental group or brain based learning (BBL) group is 0.984 whose exact significance value with df = 48 is 0.729. This value is greater than 0.05 and thus is not significant at 0.05 level of significance. In the light of this null hypothesis that "The given distribution for self regulation scores of experimental group do not deviate from normality is not rejected, thus it can be concluded that the self regulation scores for experimental and control group are distributed normally.

The second assumption to be tested was that of homogeneity of error variance, for which leven's test was applied using SPSS. The result have been summarized below in table no 4.2

Table No.4.2 Levene's test of equality of error variance

F	df1	df2	Exact significance	Significane Level
1.862	1	94	.176	> 0.05

From the table no 4.2 it is clear that the F- value is 1.862 whose significance value with df = 94 is 0.176 .this value is greater than 0.05 and hence is not significant at 0.05 level of significance. In the light of this that the null hypothesis that "The error variance of self regulation is not significantly differ across the groups" is not rejected .thus it can be concluded that the variance of achievement score is equal across the group.

Therefore the results of the test of normality and test of homogeneity of variance indicate that the assumption of ANCOVA hold good in the context of the given data, so the investigator is justified in proceeding with the use of one-way ANCOVA for data analysis of the objectives .

Table No.4.3 Summary of one – way ANCOVA of Self Regulation Skill scores by taking pre- Self Regulation Skill as covariate

Source of variation	**df**	**SS y.x**	**MSS y.x**	**F y.x**	**Exact significance**	**Significance Level**
Treatment	1	1019.705	1019.705	10.573	0.002	< 0.01
Error	93	8969.128	96.442			
Total	96					

**Significant at 0.01 level

From Table No.4.6 it is seen that the adjusted F-value for treatment is 10.573, whose significance value with df =(1, 93) is 0.002. This value is lesser than 0.01 and hence is significant at 0.01 level of significance. It indicates that the adjusted mean score of self regulation of student taught through Brain Based Learning (BBL) and conventional method differ significantly when pre- self regulation was taken as covariate. in the light of this the null hypothesis that "There is no significant difference in adjusted mean scores of self regulation of students

belongs to BBL group and traditional group while pre-self-regulation was taken as covariate is rejected . Further, it has been found that the adjusted mean scores of self regulation of students taught through BBL is 99.27 which is higher than the corresponding mean score 92.73 of student taught through traditional methods when their mean score were adjusted with respect to pre-self regulation . Therefore it may be concluded that the BBL was found to be significantly effective than the traditional method in enhancing self-regulation.

7.0 EFFECTIVENESS OF TREATMENT, GENDER AND THEIR INTERACTION ON SELF-REGULATION SKILL BY TAKING PRE- SELF-REGULATION SKILL AS COVARIATE

In order to test whether the assumption of normality of scores holds good or not, test of normality was performed on self-regulation of Experimental, control and male, Female respectively. The result of the Shapiro- Wilk test has been summarized below in the table No.5.1.

Table No.5.0 Test of normality of self-regulation scores for experimental and control group

Level of Treatment	Shapiro- Wilk			
	Statistics	df	Exact significance	Significance Level
Experimental	.984	48	.729	> 0.05
Control	.975	48	.398	> 0.05

From the table 5.0 it is clear that the value of the Shapiro – Wilk statistics for traditional/control group is 0.975 whose significance value with df = 48 is 0.398. This value is greater than 0.05 and thus is not significant at 0.05 level of significance. In the light of this the null hypothesis "The given distribution for self-regulation does not deviate significantly from normality" is not rejected. Similarly the value of statistics for experimental group or brain based learning (BBL) group is 0.984 whose exact significance value with df = 48 is 0.729. This value is greater than 0.05 and thus is not significant at 0.05 level of significance. In the light of this null hypothesis that "The given distribution for self-regulation scores of experimental group do not deviate from normality is not rejected, thus it can be concluded that the scores for self-regulation of experimental group and control group are distributed normally

Table No.5.1 Test of normality of self-regulation scores for male and female

Level of Treatment	Shapiro- Wilk			
	Statistics	df	Exact significance	Significance Level
Male	.974	39	.490	> 0.05
Female	.966	57	.113	> 0.05

From the table 5.2 it is clear that the value of the Shapiro – Wilk statistics for male is 0.974 whose significance value with df = 48 is 0.490. This value is greater than 0.05 and thus is not significant at 0.05 level of significance. In the light of this the null hypothesis "The given distribution for male self-regulation score does not deviate significantly from normality" is not rejected. Similarly the value of statistics for female self-regulation is 0.966 whose exact significance value with df = 48 is 0.113. This value is greater than 0.05 and thus is not significant at 0.05 level of significance. In the light of this null hypothesis that "The given distribution for self-regulation scores of female do not deviate from normality is not rejected ,thus it can be concluded that the self-regulation scores for male and female are distributed normally.

The second assumption to be tested was that of homogeneity of error variance, for which leaven's test was applied using SPSS. The result have been summarized below in table no 5.3

Table No.5.2 Levene's test of equality of error variance

F	df1	df2	Exact significance	Significance Level
.827	3	92	.482	> 0.05

From the table no 5.2 it is clear that the F- value is 0.827 whose significance value with df = 92 is 0.482. This value is greater than 0.05 and hence is not significant at 0.05 level of significance. In the light of this that the null hypothesis that "The error variance of self regulation is not significantly differ across the male and female students" is not rejected. Thus it can be concluded that the variance of self-regulation score is equal across the groups.

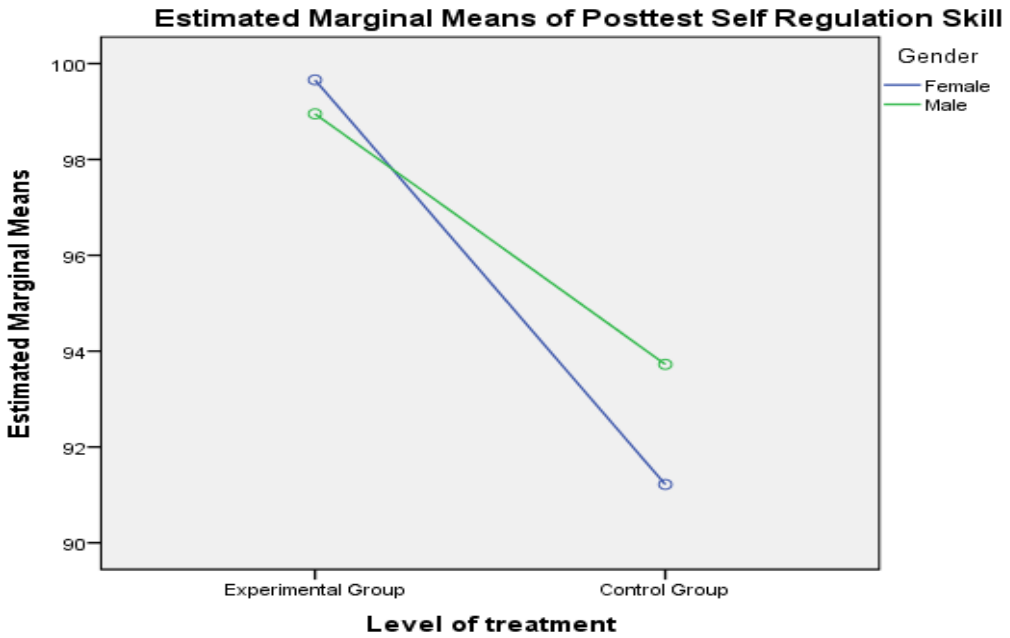
Therefore the results of the test of normality and test of homogeneity of variance indicate that the assumption of ANCOVA hold good in the context of the given data, so the investigator is justified in proceeding with the use of one-way ANCOVA for data analysis of the objective.

Table No.5.3 Summary of one – way ANCOVA of self-regulation scores by taking pre-self regulation as covariate

Source of variation	df	SS y.x	MSS y.x	F y.x	Exact significance	Significance Level
Treatment	1	52.613	1076.186	11.000	.001	< 0.01
Error	91	8902.652	97.831			
Total	96	895699.000				

**Significant at 0.01 level

From Table No.5.4 it is evident that the adjusted F-value for treatment is 11.000, whose significance value with df = (1, 91) is 0.001. This value is lesser than 0.01 and hence is significant at 0.01 level of significance. It indicates that the adjusted mean score of self regulation of male and female differ significantly. In the light of this the null hypothesis that "There is no significant difference in mean gain scores of self regulation of students belongs to male and female group is rejected. Hence it can be concluded that the self regulation of students is dependent of their gender.



From the above graph it is evident that the self-regulation of students is dependent of their gender and female shows higher self-regulation than male students.

8.0 FINDINGS

1. The Brain Based Learning strategy was found to be significantly superior to traditional method in terms of self regulation when pre-self regulation was taken as covariate.
2. The self-regulation of students was found to be dependent of their gender and female appears to be significantly higher self-regulation than male students

9.0 DISCUSSION AND CONCLUSION

The adjusted F-value for treatment is 10.573, whose significance value with df =(1, 93) is 0.002. This value is lesser than 0.01 and hence is significant at 0.01 level of significance. It indicates that the adjusted mean score of self regulation of student taught through Brain Based Learning (BBL) and conventional method differ significantly when pre- self regulation was taken as covariate. The Brain Based Learning strategy was found to be significantly superior to traditional method in terms of self regulation when pre-self regulation was taken as covariate. The effectiveness of BBL on self-regulation was found to be effective as well as superior to traditional method when group were made randomly. This finding is supported by Afsar Khalili Sadrabad, Soghra Ebrahimi Ghavam and Hamideh Radmanesh (2015) found that brain-based learning could also be effective on students' self-regulated learning, and leave lasting effects on self-regulated learning, Felicidad T Villavicencio, Allan B. I Bernardo (2013), They found self-regulation and the positive academic emotions of enjoyment and pride are positive predictors of achievement; and enjoyment and pride both moderate the relationship between self-regulation and achievement. Ann-Bailey Lipsett (2011) reported that Brain-Based Strategies and Classroom Interventions help to Promote Self-Regulation. Hence it can be concluded that brain based learning enhance the self regulation skill. The self-regulation skill also essential for academic outcome is supported by Jarvela & Jarvenoja, 2011; Zimmerman, 2008, that Self-regulation is essential to the learning process. It can help students create better learning habits and strengthen their study skills (Wolters, 2011), apply learning strategies to enhance academic outcomes (Harris, Friedlander, Sadler, Frizzelle, & Graham, 2005), monitor their performance (Harris et al., 2005), and evaluate their academic progress (De Bruin, Thiede & Camp, 2011).

The third objective of the study was to study the effect of Treatment, Gender and their interaction on Self-regulation Skill by taking Pre- Self-regulation Skill as covariate. On analysis it was found that the self-regulation of students was found to be dependent of their gender.

Both males and females were benefited from the brain based learning in terms of self regulation in comparison to conventional Method when groups were matched statistically i.e. the adjusted F-value for treatment is 11.000, whose significance value with df = (1, 91) is 0.001. This value is lesser than 0.01 and hence is significant at 0.01 level of significance. It indicates that the adjusted mean score of self regulation of male and female differ significantly. This finding indicates that Gender may be kept in mind while developing brain based learning (BBL) package on developing self regulation skill. The brain based learning (BBL) package may not same for both males and females in respect of content, sequence, examples, etc. There was no gender bias in developing this brain based learning (BBL) package. The BBL package contains the same content is presented in the print form in books. The books are same for males and females. Not only this, the Methods of Teaching are not different for males and females. Further, the content of BBL package with different strategies and examples were to the level of both males and females. They were able to understand the subject matter. The freedom given was same for males and females. Both males and females asked questions to teacher that was replied to the satisfaction of both males and females. This might be the reason for this finding. From the discussion it may be concluded that the brain-based learning approach is helpful in developing self regulation skills among the adolescence. At the same time it is not a panacea for all learning, but it can be used to develop strategies that are based on the current available research.

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