Impact of Multiple Intelligence Based Intervention on Cognitive Abilities of Students

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ABSTRACT

As an enlightening process, the principal and global intent of education is to enhance students' cognitive abilities. Cognitive abilities induce progressive attainment and retention of learning skills that enable children to apply the attained information. Cognitive abilities can be improved by providing the right training to children. An in-depth longitudinal study was conducted to analyze the impact of educational intervention based on Gardner's multiple intelligence on the cognitive abilities of the respondents. Cluster sampling was followed to extract a sample including 3500 school going boys and girls aged between 11-14 years in India. The sample was primarily categorized into experimental and control groups. Both the groups were assessed in terms of their intelligence quotient, focus factor, decision making ability, creative quotient, cognitive capacity and estimation level thrice during the timeline of 12 months. Standardized cognitive ability assessment and multiple intelligence assessment were administered on them. Experimental group availed intervention whereas the control group was excluded from intervention. Intervention was provided in form of task-sheets based on the age and respective dominant multiple intelligence of each student. Eventually, a significant surge was notified in the cognitive abilities of experimental group while there was no such noticeable change in the cognitive abilities of control group. Therefore, it was concluded that the cognitive abilities of the children can be enhanced drastically if the educational instructions are imparted through their respective dominant intelligence. Hence, the educational system can become highly productive to bestow inevitable improvement in the development of cognitive abilities among students.

Introduction

Cognition is the entire thinking process. There are five core cognitive functions that influence learning skills. These are intelligence quotient, focus factor, decision making ability, creative quotient and cognitive capacity. Intelligence is the ability of a human brain to understand, comprehend and respond to the situations in an effective and efficient way. Focus factor is an indicator for collective focus and concentration in accomplishing assigned task to the

brain. It is one of the most prominent factors to achieve success. Decision making ability is a measurement of speed of decision making ability and response time to accomplish assigned tasks. Creative quotient is the capacity of generating ideas that can in some way be applied to the world. Cognitive capacity is the overall efficiency of your Brain. Higher the cognitive capacity better is the learner's efficiency, to store, process and retrieve information. Estimation level refers to the extent the child estimates himself. The research study was designed to cater to the needs of every individual seeking education. The content was designed, developed and delivered through educationists, experts in child development and academicians in a pre defined scientific technology. Tasksheets for intervention were based on the eight intelligences as defined by Gardner. Linguistic Intelligence is one of the most traditionally emphasized intelligences in Indian schools. Logical intelligence is the ability to analyze problems logically, work effectively with mathematical operations, and investigate issues using the scientific method. Musical intelligence is the ability to perform, compose, and appreciate musical patterns, including changes in pitch, tone, and rhythm. Kinesthetic intelligence is the ability to use the body for expression. Spatial intelligence is the ability to recognize, use, and interpret images and patterns and to reproduce objects in three dimensions. Interpersonal intelligence is the ability to understand intentions, motivations, and desires of others. Intrapersonal intelligence is the ability to understand oneself, and to interpret and appreciate one's own feelings and motivations. Naturalist intelligence is the ability to recognize and appreciate our relationship with the natural world. Dunn (1988) found that when the students are taught through their perceptual strengths and preferences, the output is highly effective. Campbell and Ramey (1994) revealed that early intervention has a positive impact on intellectual and academic achievement. Wallace (1995) conducted a research study and noticed that students perform better if the teaching process involves their learning styles. In a similar study, Jasmine (1996) found that teaching with multiple intelligences can help in improvement of their performance and abilities. Reiff (1996) has recorded that multiple intelligences based teaching and learning processes help in bridging home and school life by enhancing the capacities of students. Ellingson et al. (1997) also noticed that the student motivation increased through the use of personalized instructional and curricular adaptations. Fogarty (1997) conducted a research study and found that the problem based learning and other curriculum models for the multiple intelligences classroom motivate students to perform better. Mettetal et al. (1997)had also inferred that the students showed an accepting attitude toward a multiple intelligences curriculum and that their performance, intellectual abilities and behaviour improve when the students are imparted education through teaching style corresponding to their natural intelligence. Likewise, Kuzniewski et al. (1998) established through the empirical data, that the abilities of students improved when they were taught using their natural learning style. Gardner (2000) in his book, 'Intelligence reframed' has emphasized that each individual has the abilities which can be identified and fostered by teaching and educating them by the methodology based on their natural intelligences. Naglieri and Johnson (2000) found the effectiveness of a cognitive strategy intervention in improving scholastic achievement. Silver et al. (2000) highlighted that the

integration of learning styles and multiple intelligences can improve the performance and build up new capabilities among the students. Teele and Teele (2000) endorsed the concept of multiple intelligences based teaching to help students explore themselves. Craft (2001) analysed the impact of creativity in education and found positive correlation. Grigoriadou et al. (2001) developed a personalized instruction and found a highly positive relation of the system on students' abilities. Similarly Haynes (2001) emphasized the importance of teaching according to students' learning styles. Carter (2002) also found that personalized training methods improve cognitive abilities. McCandliss et al. (2003) highlighted the importance of planned intervention and focusing attention for improving their performance. Nolen (2003) recorded the importance of multiple intelligence for every classroom in order to enhance students' skills and abilities. Similar findings were suggested by Stanford (2003), Sternberg and Grigorenko (2004). In a study carried by Dunbar-Hall (2006), it was inferred that educating children as per their learning styles and dominant multiple intelligence improves their abilities and grasping power. The importance of multiple intelligences has been well defined by Gardner (2008), McClellan and Conti (2008), Armstrong (2009) and Chen et al. (2009). Moreover, Cassidy et al. (2016) and Meltzer (2018) found that intervention increased general intelligence and scholastic aptitude. Barros et al. (2019) found that the perfect and realistic self estimation is important for success. Huang et al. (2019) and Rasheed and Wahid (2019) inferred that learning styles matter extremely to motivating learners for better outputs. In the light of the reviewed studies, it was important to ascertain the importance of intervention based on multiple intelligences on cognitive abilities.

Methodology

The purpose of the study was to analyze the impact of educational intervention based on Gardner's multiple intelligence on the cognitive abilities of the respondents. The present research study was a longitudinal study. Sample was extracted in two stages following the cluster sampling. In all, 3500 school going students aged between 11-14 years from India were selected.

1 • Rapport Building and Consent of respondents
2 • Administration of pre intervention test and assessment (Assessment)
3 • Intervention -1 (6 months)
4 • Administration of first tracker test (Tracker Test-1)
5 • Intervention -2 (6 months)
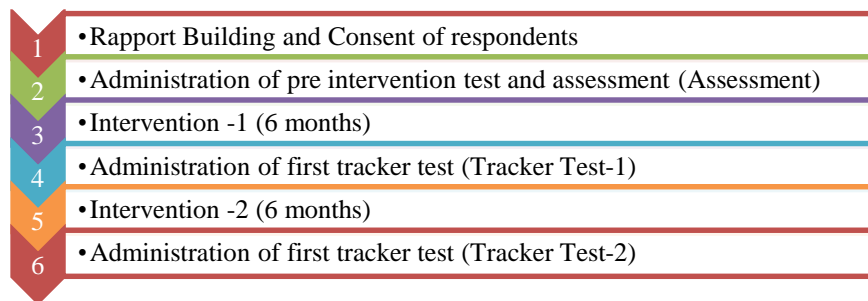6 • Administration of first tracker test (Tracker Test-2)

Fig.1: Intervention Programme for Experimental Group

The sample was categorized into experimental and control groups. Both the groups were assessed in terms of their intelligence quotient, focus factor, decision making ability, creative quotient, cognitive capacity and estimation level thrice during the timeline of 12 months. Standardized cognitive ability assessment and multiple intelligence assessment were administered on them. Experimental group availed intervention whereas the control group was excluded from intervention. Intervention was provided in form of task-sheets based on the age and respective dominant multiple intelligence of each student. The cognitive abilities and natural learning style were assessed by using Cognalysis, a standardized assessment developed by the authors. Proper timeline and procedure was followed during the intervention programme as evident from figure 1 and figure 2. Figure 1 shows the intervention programme for respondents in the experimental group while figure 2 demonstrates the programme for respondents in control group. In the first stage of the programme, rapport was built with the all the respondents. In the second step, pre intervention test and assessment was administered on all the respondents after taking their consent. The researchers hypothesize that there is a positive relationship between of educational intervention based on Gardner's multiple intelligence and the cognitive abilities of the respondents in experimental group.

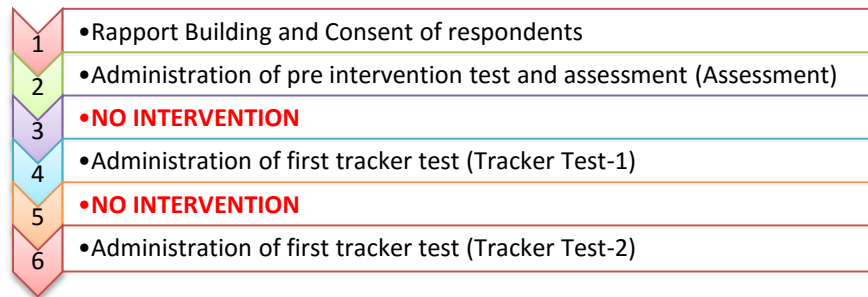|	
1	•Rapport Building and Consent of respondents
2	•Administration of pre intervention test and assessment (Assessment)
3	•NO INTERVENTION
4	•Administration of first tracker test (Tracker Test-1)
5	•NO INTERVENTION
6	•Administration of first tracker test (Tracker Test-2)

Fig.2: Programme for Control Group

The entire process was explained to the respondents. In the third step, the respondents in the experimental group were given customized tasksheets for six months. Instructions were given to attempt two tasksheets daily on regular basis. These tasksheets were different for students with different dominant multiple intelligence as assessed in step 2. But the subjects in the control group were not given any such tasksheets. After these six months, tracker test-1 was conducted on respondents of both the experimental as well as the control group. After this, subjects in experimental group were given tasksheets for next six months while no intervention was given to control group. Later tracker test-2 was conducted on all the respondents.

Results and Discussion

Once the data was collected, it was analyzed for drawing the relevant inferences. SPSS software was used for descriptive and inferential data analysis. The mean value of IQ1 in experimental group was 114.9 which rose to 119.11 after first intervention. The difference was found to be statistically significant with t-value of 39.5. Later, after the second intervention, the intelligence quotient further rose to 127.99. The difference was statistically significant with t-value of 67.46.

1.1 Comparing intelligence quotient before and after intervention

	Table 1: Intelligence Quotient before and after intervention									
	Experimental Group					Control Group				
	Mean	SD	SEM	t-value	Level of Sig	Mean	SD	SEM	t-value	Level of Sig
IQ-1	114.9	3.14	0.08	39.5	Significant	115.9	3.14	0.08	1.93	Not Significant
IQ-2	119.11	3.16	0.08			116.11	3.16	0.08		
IQ-2	119.11	3.16	0.08	67.46	Significant	116.11	3.16	0.08	0.04	Not Significant
IQ-3	127.99	4.51	0.1			115.94	4.5	0.1		
IQ-1	114.6	3.14	0.08	99.5	Significant	115.9	3.14	0.08	0.34	Not Significant
IQ-3	127.99	4.51	0.1			115.94	4.5	0.1		
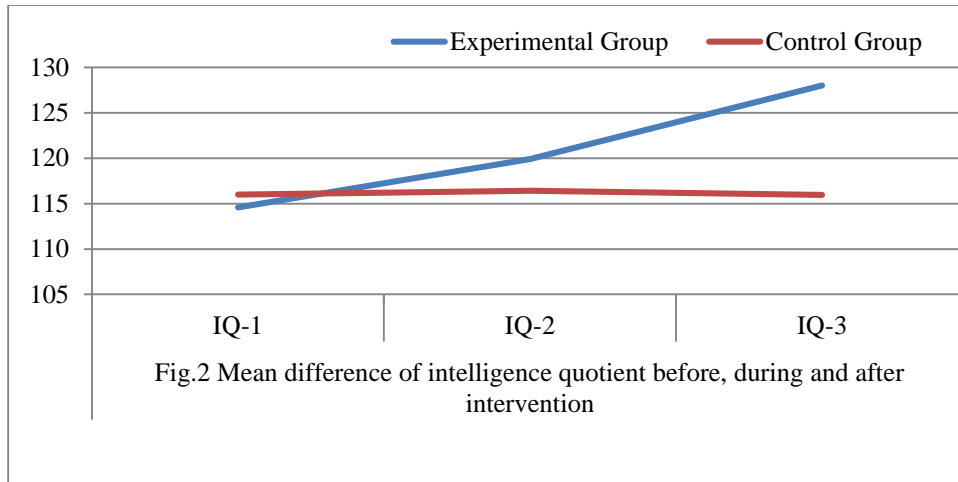
Fig.2 Mean difference of intelligence quotient before, during and after intervention
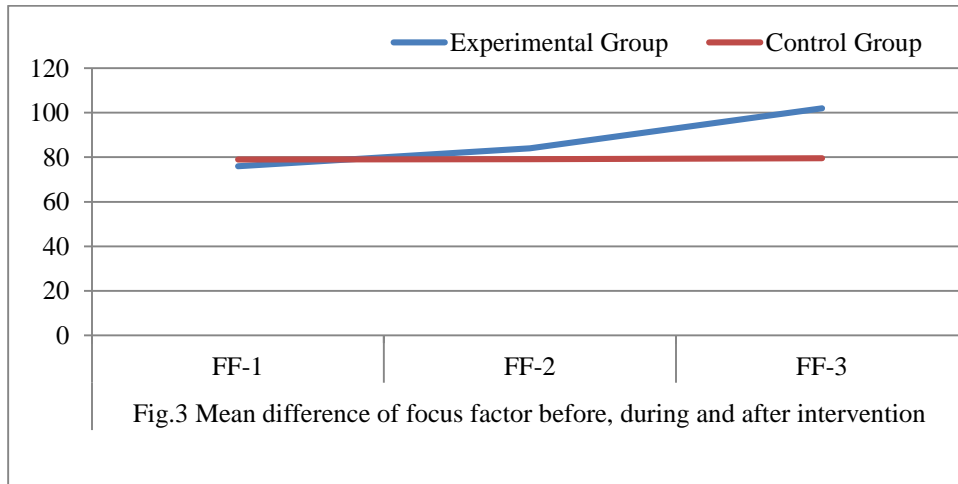
Moreover, when the mean value in test-1 was compared with that of test-3, the difference was found to be statistically significant and the t value was 99.5. In case of control group, no such significant difference could be found in any case. Similar findings were suggested by Blackwell et al. (2007), Diamond et al. (2007), Douglas et al. (2008), Petty (2009) and Cassidy et al. (2011).

1.2 Comparing focus factor before and after intervention

		Experimental Group					Control Group			
Table 2: Focus Factor before and after intervention										
	Mean	SD	SEM	t-value	Level of Sig	Mean	SD	SEM	t-value	Level of Sig
FF-1	75.9	6.05	0.14	34.91	Significant	79	6.05	0.1	0.89	Not Significant
FF-2	83.96	7.27	0.17			79.2	7.2	0.17		
FF-2	83.96	7.27	0.17	59.51	Significant	79.2	7.2	0.17	1.3	Not Significant

F F -3	102	10 .3	0.2 4			79. 6	10 .3	0.2 4		
F F -1	75. 9	6. 05	0.1 4	90.5	Signific ant	79	6. 05	0.1	1.95	Not Significan t
F F -3	102	10 .3	0.2 4			79. 6	10 .3	0.2 4		

Fig.3 Mean difference of focus factor before, during and after intervention

The mean value of FF1 in experimental group was 75.9 which rose to 83.96 after first intervention. The difference was found to be statistically significant with t-value of 34.91. Later, after the second intervention, the focus factor further rose to 102. The difference was statistically significant with t-value of 59.51. Moreover, when the mean value in test-1 was compared with that of test-3, the difference was found to be statistically significant and the t value was 90.5. On the contrary, insignificant changes were found in the focus factor of respondents in the control group. The studies conducted by Chiesa et al. (2011) and Delgoshaei and Delavari (2012) also corroborated the findings of the present study.

1.3 Comparing decision making ability before and after intervention

	Experimental Group					Control Group				
	Mean	SD	SEM	t-value	Level of Sig	Mean	SD	SEM	t-value	Level of Sig
DMA-1	0.35	0.14	0.003	20.72	Significant	0.44	0.142	0.0035	1.81	Not Significant
DMA-2	0.44	0.14	0.003			0.45	0.143	0.0034		
DMA-2	0.44	0.14	0.003	49.11	Significant	0.45	0.143	0.0034	1.6	Not Significant
DMA-3	0.688	0.142	0.003			0.46	0.142	0.144		
DMA-1	0.35	0.14	0.003	69.29	Significant	0.44	0.142	0.0035	1.72	Not Significant
DMA-3	0.688	0.142	0.003			0.46	0.142	0.144		

Table 3: Decision Making Ability before and after intervention

The mean value of DMA1 in experimental group was 0.35 which rose to 0.44 after first intervention. The difference was found to be statistically significant with t-value of 20.72. Later, after the second intervention, the decision making ability further rose to 0.688. The difference was statistically significant with t-value of 49.11. As the mean value in test-1 was compared with that of test-3, the difference was found to be statistically significant and the t value was 69.29. In contrast, insignificant changes were found in case of their control group counterparts. Morewedge et al. (2015) found the similar results
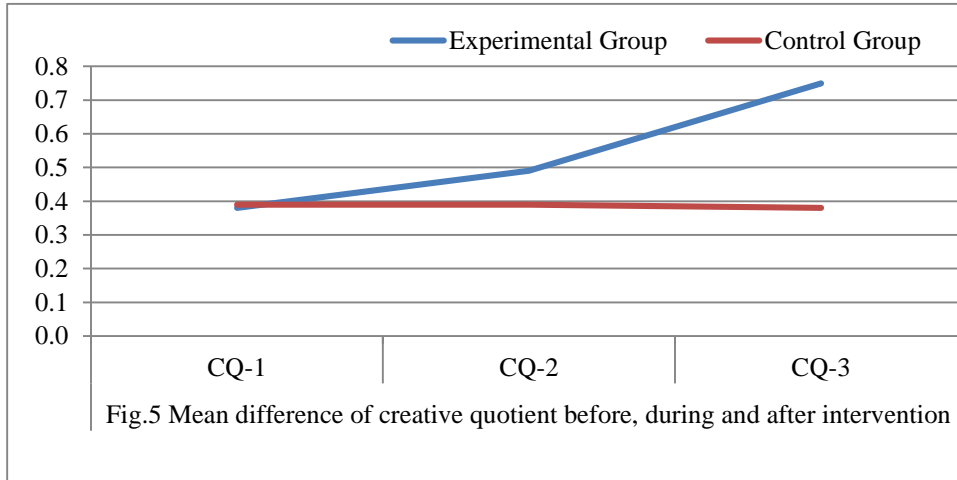
Fig.4 Mean difference of decision making ability before, during and after intervention
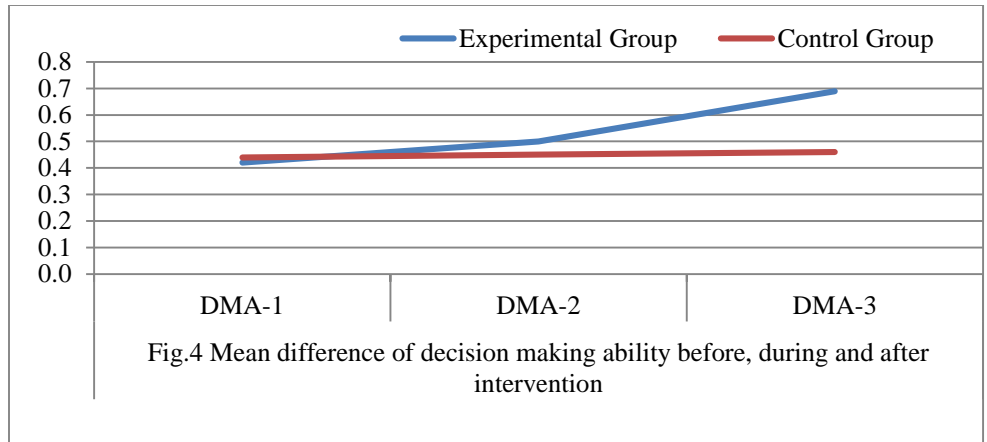
1.4 Comparing creative quotient before and after intervention

<table>
<thead>
<tr><th colspan="11">Table 4: Creative Quotient before and after intervention</th></tr>
<tr><th></th><th colspan="5">Experimental Group</th><th colspan="5">Control Group</th></tr>
<tr><th></th><th>Mean</th><th>SD</th><th>SEM</th><th>t-value</th><th>Level of Sig</th><th>Mean</th><th>SD</th><th>SEM</th><th>t-value</th><th>Level of Sig</th></tr>
</thead>
<tbody>
<tr><td>CQ-1</td><td>0.382</td><td>0.146</td><td>0.003</td><td rowspan="2">21.65</td><td rowspan="2">Significant</td><td>0.39</td><td>0.14</td><td>0.003</td><td rowspan="2">0.5</td><td rowspan="2">Not Significant</td></tr>
<tr><td>CQ-2</td><td>0.489</td><td>0.14</td><td>0.003</td><td>0.389</td><td>0.14</td><td>0.003</td></tr>
<tr><td>CQ-2</td><td>0.489</td><td>0.14</td><td>0.003</td><td rowspan="2">51.8</td><td rowspan="2">Significant</td><td>0.389</td><td>0.14</td><td>0.003</td><td rowspan="2">1.6</td><td rowspan="2">Not Significant</td></tr>
<tr><td>CQ-3</td><td>0.75</td><td>0.14</td><td>0.003</td><td>0.38</td><td>0.14</td><td>0.003</td></tr>
<tr><td>CQ-1</td><td>0.382</td><td>0.146</td><td>0.003</td><td>74.73</td><td>Significant</td><td>0.39</td><td>0.14</td><td>0.003</td><td>1.95</td><td>Not</td></tr>
</tbody>
</table>

	Mean	SD	SEM				Mean	SD	SEM		Level of Sig
CQ-3	0.75	0.14	0.003				0.38	0.14	0.003		Significant

Fig.5 Mean difference of creative quotient before, during and after intervention
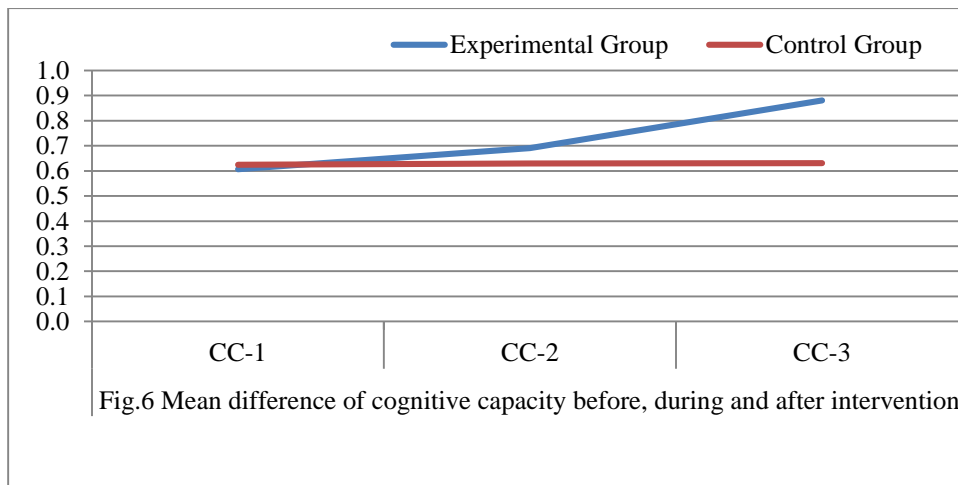
The mean value of CQ1 in experimental group was 0.382 which rose to 0.489 after first intervention. The difference was found to be statistically significant with t-value of 21.65. Later, after the second intervention, the creative quotient further rose to 0.75. The difference was statistically significant with t-value of 51.8. Moreover, when the mean value in test-1 was compared with that of test-3, the difference was found to be statistically significant and the t value was 74.73. However, insignificant changes were found in the creative quotient of students in control group. Similar findings were suggested by Hu et al. (2013).

1.5 Comparing cognitive capacity before and after intervention

Table 5: Cognitive Capacity before and after intervention											
	Experimental Group					Control Group					
	Mean	SD	SEM	t-value	Level of Sig	Mean	SD	SEM	t-value	Level of Sig	
CC-1	0.61	0.145	0.0035	16.99	Significant	0.62	0.145	0.0035	0.92	Not Significant	

CC-2	0.69	0.143	0.0034			0.63	0.143	0.0034		
CC-2	0.69	0.143	0.0034		Significant	0.63	0.143	0.0034		Not Significant
CC-3	0.88	0.142	0.0034	40.33		0.63	0.142	0.0034	0.86	
CC-1	0.61	0.145	0.0035		Significant	0.62	0.145	0.0035		Not Significant
CC-3	0.88	0.142	0.0034	56.45		0.63	0.142	0.0034	1.77	

Fig.6 Mean difference of cognitive capacity before, during and after intervention

The mean value of CC1 in experimental group was 0.61 which rose to 0.69 after first intervention. The difference was found to be statistically significant with t-value of 16.99. Later, after the second intervention, the cognitive capacity further rose to 0.88. The difference was statistically significant with t-value of 40.33. Moreover, when the mean value in test-1 was compared with that of test-3, the difference was found to be statistically significant and the t value was 56.45. However, insignificant changes were found in the cognitive capacity of respondents in control group. The findings were similar to that inferred by Kerry (2015).

1.6 Comparing estimation level before and after intervention

Table 6: Estimation Level before and after intervention										
	Experimental Group					Control Group				
	Mean	SD	SEM	t-value	Level of Sig	Mean	SD	SEM	t-value	Level of Sig
EL-1	50.12	2.02	0.05	0.67	Not Significant	51	2.02	0.05	0.71	Not Significant
EL-2	50.13	1.99	0.05			51.19	1.99	0.05		
EL-2	50.13	1.99	0.05	1.89	Not Significant	51.19	1.99	0.05	0.58	Not Significant
EL-3	50.1	1.97	0.05			51.21	1.99	0.05		
EL-1	50.12	2.02	0.05	1.95	Not Significant	51	2.02	0.05	1.96	Not Significant
EL-3	50.1	1.97	0.05			51.21	1.99	0.05		

Fig.7 Mean difference of estimation level before, during and after intervention
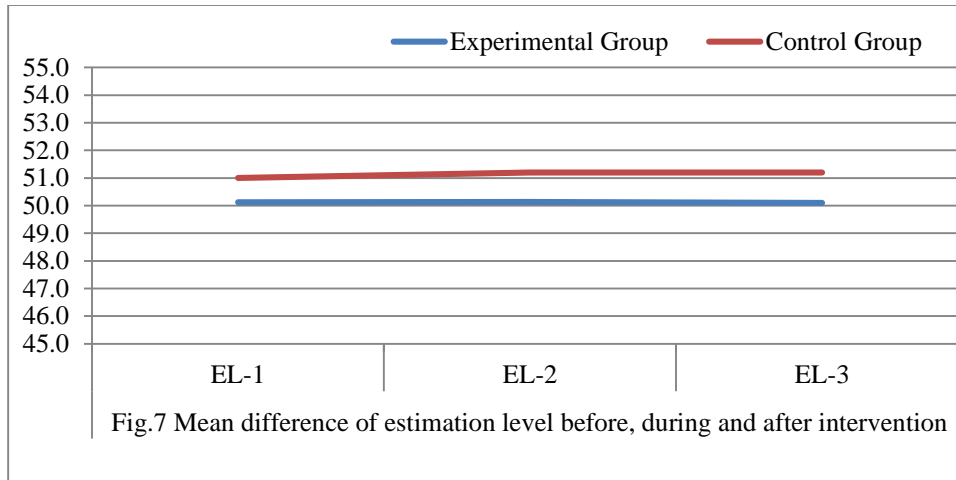
The mean value of EL1 in experimental group was 50.12 which rose to 50.13 after first intervention. The difference was found to be statistically non-significant with t-value of 0.67. Later, after the second intervention, the estimation level dipped to 50.1. The difference was insignificant with t-value of 1.89. Moreover, when the mean value in test-1 was compared with that of test-3, the difference was found to be insignificant and the t value was 1.95. Similar trend was notified among subjects in control group.

Conclusion

Education is a tool that aids in overall development of every child. Multiple intelligence based teaching ensures holistic development of children. A personalized approach to multiple intelligence based instructions can have a direct impact on students' learning. Students' performance rise if they are engaged in activities linked to their natural interest, strengths and interests based on Gardner's multiple intelligence through the programmed instructions as per child's learning nature, In this sense, teachers can utilize the individual strengths of students for better learning. Students are benefited from choosing how they learn. Learning and cognition can be developed using natural learning style as it can cater to the diverse learning needs of all students. After the analysis of the data, it was found that if the students are taught according to their inherent primary learning style, they can learn in an efficient manner and the performance is higher as compared to the system where they are taught in the same traditional way. Hypothesis was thus proved that with the regular intervention based on multiple intelligences, their intelligence quotient, focus factor, decision making ability, creative quotient, and cognitive capacity boomed dramatically. Hence, the present research study underlines the effectiveness of teaching learning process that corresponds to each student's natural learning style.

Limitations and Further Research Implications

The study was however limited to the cognitive aspects. The socio-demographic data was not collected due to unwillingness of the respondents and their parents. The further research study can be carried to correlate the data to the socio-demography of respondents.

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