

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

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ABSTRACT

Cognitive development refers to the development and effectiveness of mental processes. Cognitive development is very important as it is the foundation of abilities and skills of life. It is the basis of thinking abilities. Education is basically meant to enable the students to understand the information in the desired manner and eventually to implement this gained knowledge wisely according to the situations faced by them. Cognitive abilities are the core abilities of our brain which are required to think, read, understand, learn, recite, reason, and attend. Cumulatively, they assimilate incoming information and pass it into the bank of knowledge utilized at school and usual life. Together, each of the minute and major cognitive skills plays a significant role in processing novel information. In this context, the present longitudinal study was conducted on a sample of 474 students, aged 16 years, in order to analyse the impact of the regular intervention of customized education and personalized activities based on the natural learning style of the students on their cognitive development and academic achievement. It was found that if the students are taught according to their respective learning nature, they will learn much easily and develop their interest in studies. Every child is unique, carrying his own learning nature and capability. The regular intervention of customized education led to the increase in the cognitive abilities as well as academic achievement. It was notified that if the students are taught according to their respective learning nature, they will grasp much easily and develop their interest in studies.

Keywords: *Cognitive development, Academic achievement, Customized education, Natural learning style*

Cognition improves education and both of these aspects in life go hand in hand. It is clear that every child has a unique personality and hence is his learning style. In the schools, generally all children are taught using the same method. However, if the leaning potential of each child is to be explored and utilized, it is very important for the educators to understand and accept the learning nature of students. According to Furnham et al. (2003), Cognitive

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Received: January 22, 2019; Revision Received: February 27, 2019; Accepted: March 8, 2019

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

science educational technology has emerged to pave the way towards success irrespective of the child's apparent achievements. Piaget (1971) has explained cognition as the utmost vital parameter which can lead every child towards success. It refers to any mental activity that leads to the development of meaning. As mentioned by Klein (2003) cognitive processes use existing knowledge and generate new knowledge. Woodman et al. (2003) concur that cognition is the entire thinking process primarily including intelligence quotient, focus factor, decision making ability, creative quotient, memory, reasoning, multiple intelligences and natural abilities. Success requires a focused mind, high decision making ability, creativity and early grooming on natural abilities. (Brown Wright, 2004) Cognitive Ability is the capacity of the human brain to perform higher mental processes like thinking, remembering, understanding and problem solving. Cognitive abilities help a human brain to acquire knowledge and process that knowledge, so that it can be employed effectively in a practical world. It is also the ability to think and understand. It includes sensing, remembering and deducing. Cognitive processes use existing knowledge and generate new knowledge that leads to intelligence. Frederick (2005) and Hillman et al. (2014) explain that if the body perceives, reacts, evaluates, understands things properly it means that the person is intelligent. Cognitive ability plays an important role in predicting academic achievement. Cognition, a wide term to refer for cognitive and academic performance, is a mental function involved in acquiring knowledge and comprehension. A high cognition has been identified as a positive marker of health. Likewise variables associated with cognition have been used to assess psychological health of school aged individuals. Specifically, adolescence is a critical stage for cognition, and cognition in adolescents may be an important predictor of adult health. For example, poor cognition during adolescence has been associated with higher morbidity and mortality, anxiety disorders, depression, psychological distress and coronary heart disease later in life. High cognition is linked to positive psychological-related variables such as self-esteem and self-concept. A healthy lifestyle during adolescence may be crucial for better cognition. However, the foundations of cognitive development are laid during childhood. Intelligence is the ability of a human brain to understand, comprehend and respond to the situations in an effective and efficient way. IQ is a measurement of knowledge tested against time and age. It is a ratio of mental age against chronological age and time. IQ cannot be a constant factor and varies in either direction as we grow older. Focus factor is an indicator for collective attention, focus and concentration in accomplishing assigned tasks. It is one of the most prominent factors to achieve success. If focus factor is not high, even a high IQ might not be beneficial. It is a ratio of accuracy against age and time. DMA is a measurement of speed of decision making ability and response time to accomplish assigned tasks. It is considered to be a backbone factor to achieve success. It is a ratio of application of knowledge against age and time. According to Gardner (1983), an individual's learning style refers to the preferential way in which the student absorbs, processes, comprehends and retains information. There are nine different intelligences which are identified. Multiple intelligence level gives us an important insight about our natural strengths. The multiple intelligence theory claims that all humans have nine intelligences, to a lesser or greater extent, and that we each have a different intelligence profile as mentioned by Davis (2004) and Janssen et al. (2014), this profile is based on our genetics and experiences, and it makes us unique from others. There are eight intelligences Linguistic intelligence is the ability to use spoken and written language effectively to express oneself. Lawyers, writers, and speakers tend to have high linguistic intelligence. Logical-mathematical intelligence is the ability to analyze problems logically, work effectively with mathematical operations, and investigate issues using the scientific method. Finding patterns and deductive reasoning are other capabilities associated with this intelligence. People working in the scientific and

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

mathematical communities tend to be high in this type of intelligence. Musical intelligence is the ability to perform, compose, and appreciate musical patterns, including changes in pitch, tone, and rhythm. Successful musicians, composers, and people involved in music production have high levels of musical intelligence. Bodily-kinesthetic intelligence is the ability to use the body for expression. People high in this intelligence use their physical coordination to master problems. Professional dancers and athletes are good examples of this. Spatial intelligence is the ability to recognize, use, and interpret images and patterns and to reproduce objects in three dimensions. Successful architects, sculptors and designers are likely to have high spatial intelligence. Interpersonal intelligence is the ability to understand intentions, motivations, and desires of others. This intelligence allows individuals to work well with others. Professions like therapy, teaching, and sales attract individuals with high interpersonal intelligence. Intrapersonal intelligence is the ability to understand oneself, and to interpret and appreciate one's own feelings and motivations. Therapists, actors, caregivers, and writers are all people who can bring high levels of personal awareness to their work. Naturalist intelligence is the ability to recognize and appreciate our relationship with the natural world. Astronomers, biologists, and zoologists are examples of professions with a high level of naturalist intelligence. There are numerous studies that suggest positive associations between cognition and academic achievement. The study conducted by Cattell (1950) has laid down sufficient evidence to imply that there is a positive influence of cognition as well as brain structure and function on academic achievement. Ample research work has portrayed that the children with high IQ and cognitive abilities have better academic achievement than the children with average IQ and lower cognition. Seashore et al. (1950) have also confirmed the same and concluded that the children with high IQ and higher cognitive abilities have better grasping power, retention, recall and higher understandability as compared to an average child. The result of the study shows that the high IQ child will score better than the low IQ child. Low IQ child will most probably be a slow learner whereas a child with high IQ has a higher probability of being a fast learner. Cognitive ability predicts academic achievement which has also been established by a study conducted by Guilford (1959 and 1967). The results of this study support that children with higher cognitive abilities excel in academics. Similarly, Rosenthal and Jacobson (1968), Bowers (1969) and Cattell (1971) made investigations of cognitive style, learning style and study skills as predictors of academic achievement of prospective teachers and found that examination mastery along with cognitive style and imaginative style was found to be a good predictor of academic achievement. Similar studies had been carried on by Guilford and Hoepfner (1971), Furnham et al. (2005), Hodge (2005), Donnelly et al. (2016) and Bala et al. (2017) affirmed the relationship between cognitive style, intelligence quotient and academic achievement of high school students and recorded a significant correlation between cognitive style and academic achievement. In other significant studies conducted by Adey and Shayer (2006), Fuchs et al. (2006), Gunzelmann and Connell (2006), Neisser (2014) and Acharya and Sengupta (2015), it was found that cognition and intelligence are related to education and academic achievement of school students. The results further reported that there was a significant relationship between cognition, intelligence and academic achievement among school students; there existed a significant difference between boys and girls in terms of cognitive abilities ; proportionally, there existed significant difference between them in terms of academic achievement. It is inevitable that students having high intelligence quotient would have better performance in academics. Kirby et al. (1977) and Douglas et al. (2008) also found intellectual and cognitive development are significantly related to each other and that higher intelligence foster scholastic achievement. In another study conducted by Das and Cummins (1978), the association between intelligence and academic achievement was

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

established and it was noticed that the IQ scores of students were proportional to their academic scores. Neisser (1979) and Zahra et al. (2010) have also supported the similar findings.

METHODOLOGY

The research study was conducted on a sample of 474 students. Cognitive Ability Scale was used to assess the dynamic intelligence quotient (DIQ), focus factor (FF), decision making ability (DMA) and creative quotient (CQ). Multiple intelligence scale was used to assess the primary learning style. Besides, report cards were accessed to find academic test marks (ATM).

Table 1: Distribution of sample (n=474)

Gender	N	Place	n	Group	
				Experimental	Control
M	241	Pb	138	67	71
		Chd	103	54	49
F	233	Pb	143	69	74
		Chd	90	48	42

Table 2: Procedure

	Experimental Group	Control Group
Stage 1	Rapport Building	
Stage 2	Consent of respondents and socio-demographic data collection	
Stage 3	Administration of pre intervention test and assessment (TA-1)	
Stage 4	Intervention Quarter-1	No Intervention
Stage 5	Administration of first tracker test (TA-2)	
Stage 6	Intervention Quarter-2	No Intervention
Stage 7	Administration of first tracker test (TA-3)	
Stage 8	Intervention Quarter-3	No Intervention
Stage 9	Administration of first tracker test (TA-4)	
Stage 10	Intervention Quarter-4	No Intervention
Stage 11	Administration of post intervention test and assessment (TA-5)	

The tools are the key to assess and evaluate the variables under study. In the present research study, socio demographic data sheet, cognitive ability assessment and multiple intelligence scale were used to get the primary quantitative data for further analysis.

RESULTS

When IQ in all tests among males was compared, statistically significant difference was seen in IQ 4 and IQ 5 between males of experiment and control group in Chandigarh as well as Punjab along with IQ 3 in Punjab. Absolutely the same trend was witnessed among females. The mean value ranged from 94 to 119.7 in experiment group while it ranged from 93.87 to 104.2 in control group. The mean value of experiment group was higher than the control group in all the tests.

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

Table 3: Details of IQ of 16 year old respondents

16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD	
Exp. and Control Group, Male						Gender wise, Experiment					Area wise, Male					
IQ1	Ch	Ex	54	95.48	10.70	Ch	M	54	95.48	10.70	Ex	Ch	54	95.48	10.70	
		Co	49	95.78	11.24		F	48	93.84	12.94		Ch	67	94.00	11.78	
	Pb	Ex	67	94.00	11.78	Pb	M	67	94.00	11.78		Co	Ch	49	95.78	11.24
		Co	71	93.87	10.88		F	69	95.65	13.45			Pb	71	93.87	10.88
IQ2	Ch	Ex	54	100.3	11.25	Ch	M	54	100.3	11.25	Ex	Ch	54	100.3	11.25	
		Co	49	98.48	11.18		F	48	98.63	13.60		Ch	67	98.80	12.38	
	Pb	Ex	67	98.80	12.38	Pb	M	67	98.80	12.38		Co	Ch	49	98.48	11.18
		Co	71	96.42	10.88		F	69	100.5	14.14			Pb	71	96.42	10.88
IQ3	Ch	Ex	54	105.4	11.82	Ch	M	54	105.4	11.82	Ex	Ch	54	105.4	11.82	
		Co	49	101.1	11.28		F	48	103.6	14.29		Pb	67	103.8	13.01	
	Pb	Ex	67	103.8*	13.01	Pb	M	67	103.8	13.01		Co	Ch	49	101.1	11.28
		Co	71	98.98	11.04		F	69	105.6	14.86			Pb	71	98.98	11.04
IQ4	Ch	Ex	54	114.0*	13.36	Ch	M	54	114.0	13.36	Ex	Ch	54	114.0	13.36	
		Co	49	102.3	11.58		F	48	110.5	16.00		Pb	67	112.5	14.47	
	Pb	Ex	67	112.5*	14.47	Pb	M	67	112.5	14.47		Co	Ch	49	102.3	11.58
		Co	71	99.90	11.32		F	69	112.7	17.28			Pb	71	99.90	11.32
IQ5	Ch	Ex	54	119.7*	14.00	Ch	M	54	119.7	14.00	Ex	Ch	54	119.7	14.00	
		Co	49	104.2	11.85		F	48	115.8	16.87		Pb	67	118.2	15.31	
	Pb	Ex	67	118.2*	15.31	Pb	M	67	118.2	15.31		Co	Ch	49	104.2	11.85
		Co	71	101.9	11.46		F	69	117.9	18.26			Pb	71	101.9	11.46
Exp. and Control Group, Female						Gender wise, Control					Area wise, Female					
IQ1	Ch	Ex	48	93.84	12.94	Ch	M	49	95.78	11.24	Ex	Ch	48	93.84	12.94	
		Co	42	95.05	11.58		F	42	95.05	11.58		Pb	69	95.65	13.45	
	Pb	Ex	69	95.65	13.45	Pb	M	71	93.87	10.88		Co	Ch	42	95.05	11.58
		Co	74	94.31	12.09		F	74	94.31	12.09			Pb	74	94.31	12.09
IQ2	Ch	Ex	48	98.63	13.60	Ch	M	49	98.48	11.18	Ex	Ch	48	98.63	13.60	
		Co	42	97.48	11.84		F	42	97.48	11.84		Pb	69	100.5	14.14	
	Pb	Ex	69	100.5	14.14	Pb	M	71	96.42	10.88		Co	Ch	42	97.48	11.84
		Co	74	96.83	12.12		F	74	96.83	12.12			Pb	74	96.83	12.12
IQ3	Ch	Ex	48	103.6	14.29	Ch	M	49	101.1	11.28	Ex	Ch	48	103.6	14.29	
		Co	42	99.91	12.24		F	42	99.91	12.24		Pb	69	105.6	14.86	
	Pb	Ex	69	105.6*	14.86	Pb	M	71	98.98	11.04		Co	Ch	42	99.91	12.24
		Co	74	99.37	12.31		F	74	99.37	12.31			Pb	74	99.37	12.31
IQ4	Ch	Ex	48	110.5*	16.00	Ch	M	49	102.3	11.58	Ex	Ch	48	110.5	16.00	
		Co	42	101.2	12.45		F	42	101.2	12.45		Pb	69	112.7	17.28	
	Pb	Ex	69	112.7*	17.28	Pb	M	71	99.90	11.32		Co	Ch	42	101.2	12.45
		Co	74	100.6	12.55		F	74	100.6	12.55			Pb	74	100.6	12.55
IQ5	Ch	Ex	48	115.8*	16.87	Ch	M	49	104.2	11.85	Ex	Ch	48	115.8	16.87	
		Co	42	102.7	12.68		F	42	102.7	12.68		Pb	69	117.9	18.26	
	Pb	Ex	69	117.9*	18.26	Pb	M	71	101.9	11.46		Co	Ch	42	102.7	12.68
		Co	74	102.2	12.83		F	74	102.2	12.83			Pb	74	102.2	12.83

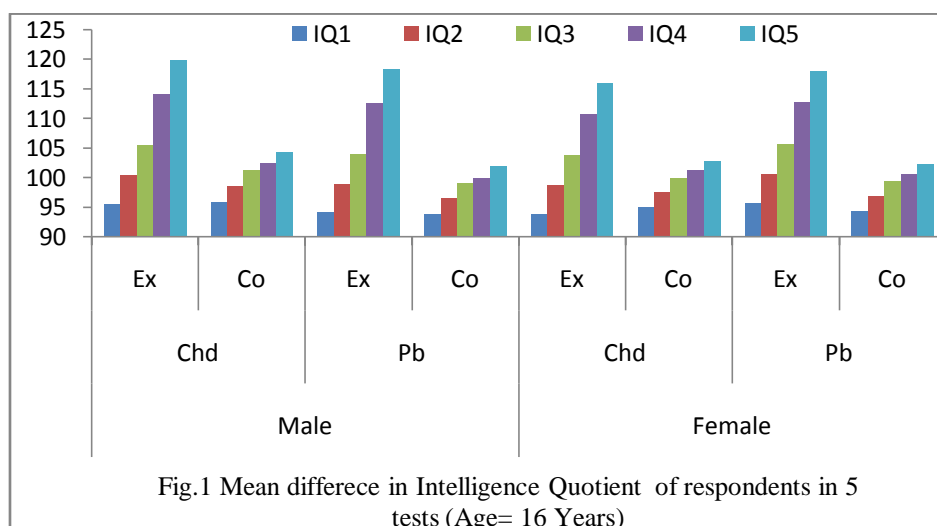
*Statistically significant differences

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

Among females, the mean value ranged from 93.84 to 117.9 in experiment group while it ranged from 94.31 to 102.7 in control group. The mean value of experiment group was lower than the control group in all the tests. When the IQ in all tests of respondents in experiment group was compared gender wise, insignificant difference was found between males and females in case of experiment group as well as control group. Females had lower values as compared to males. The mean values among males ranged from 94 to 119.7 and among females ranged from 93.84 to 117.9. In control group, females had higher values as compared to males. The mean values among males ranged from 93.87 to 104.2 and among females ranged from 94.31 to 102.7. When comparison was made between males of Chandigarh and Punjab, insignificant difference was found between their IQ in experiment as well as control group in all the tests. Similarly, no significant difference was found among females except in case of IQ 2 between females of Chandigarh and Punjab in experiment group. The mean of IQ varied from 95.48 to 119.7 in Chandigarh while in Punjab it varied from 93.87 to 118.2. In case of females, the mean of IQ varied from 93.84 to 115.8 in Chandigarh while in Punjab it varied from 94.31 to 117.9.

Table 4: Comparison of IQ among 16 year old respondents

Male								
Place	Chandigarh				Punjab			
Group	Ex		Co		Ex		Co	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
IQ1	95.48*	10.70	95.79	11.24	94.00*	11.78	93.88	10.88
IQ2	100.3*	11.25	98.49	11.18	98.80*	12.38	96.43	10.88
IQ3	105.4*	11.82	101.19	11.28	103.8*	13.01	98.99	11.04
IQ4	114.0*	13.36	102.34	11.58	112.5*	14.47	99.91	11.32
IQ5	119.7*	14.00	104.29	11.85	118.2*	15.31	101.91	11.46
Female								
IQ1	93.84*	12.94	95.06	11.58	95.65*	13.45	94.31	12.09
IQ2	98.63*	13.60	97.48	11.84	100.5*	14.14	96.84	12.12
IQ3	103.6*	14.29	99.92	12.24	105.6*	14.86	99.38	12.31
IQ4	110.5*	16.00	101.22	12.45	112.7*	17.28	100.63	12.55
IQ5	115.8*	16.87	102.77	12.68	117.9*	18.26	102.28	12.83



Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

There was significant rise in the IQ of 16 years old male respondents of experiment groups in Chandigarh and Punjab. The mean value in Chandigarh increased from 95.49 to 119.8. In Punjab, the mean value rose from 94.01 to 118.2. Similarly, among females, significant increase was recorded. The mean value increased from 93.84 to 115.8 in experiment group of Chandigarh and it rose from 95.65 to 118 in Punjab. In contrast, insignificant changes were witnessed among their control group counterparts.

Table 5: Details of FF of 16 year old respondents

16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD				
Exp. and Control Group, Male						Gender wise, Experiment					Area wise, Male								
FF1	Ch	Ex	54	46.35	15.43	Ch	M	54	46.35	15.43	Ex	Ch	54	46.35	15.43				
			Co	49	45.66		15.61	F	48	48.01			15.46	Pb	67	42.97	14.25		
		Ex	67	42.97	14.25		Pb	M	67	42.97*		14.25	Co	Ch	49	45.66*	15.61		
	Co	71	40.23	13.01	F	69		49.62	13.98	Pb	71	40.23			13.01				
	Pb	Ex	54	48.72	16.22	Ch		M	54	48.72	16.22	Ex		Ch	54	48.72	16.22		
			Co	49	48.36		16.04	F	48	50.46	16.25		Pb		67	45.16	14.97		
Ex		67	45.16	14.97	Pb		M	67	45.16*	14.97	Co		Ch	49	48.36*	16.04			
		Co	71	42.78			13.52	F	69	52.15				14.69	Pb	71	42.78	13.52	
FF2	Ch	Ex	54	51.20		17.05	Ch	M	54	51.20		17.05	Ex	Ch	54	51.20	17.05		
			Co	49		51.04		16.55	F	48		53.03			17.08	Pb	67	47.47	15.74
		Pb	Ex	67	47.47	15.74		Pb	M	67	47.47*	15.74		Co	Ch	49	51.04	16.55	
	Co			71	45.32	14.13	F		69	54.81	15.44	Pb	71			45.32	14.13		
	Pb		Ex	54	55.23	18.22	Ch		M	54	55.23	18.22	Ex		Ch	54	55.23	18.22	
		Co		49	51.67	16.87			F	48	56.65	18.29				Pb	67	51.31	16.69
Ex		67	51.31*	16.69	Pb	M			67	51.31*	16.69	Co			Ch	49	51.67*	16.87	
		Co	71	45.78		14.40			F	69	58.62					17.00	Pb	71	45.78
FF3	Ch	Ex	54	57.93		18.86		Ch	M	54	57.93			18.86	Ex	Ch	54	57.93	18.86
			Co	49		52.66			17.23	F	48			59.30			19.08	Pb	67
		Pb	Ex	67	53.85*	17.34	Pb		M	67	53.85*	17.34	Co	Ch		49	52.66	17.23	
	Co			71	46.69	14.68			F	69	61.34	17.83				Pb	71	46.69	14.68
	Pb		Ex	48	48.01	15.46			Ch	M	49	45.66		15.61		Ex	Ch	48	48.01
		Co		42	47.35	12.70				F	42	47.35		12.70				Pb	69
Ex		69	49.62	13.98	Pb	M		71		40.23*	13.01	Co		Ch	42		47.35	12.70	
		Co	74	48.56		12.92		F		74	48.56				12.92		Pb	74	48.56
FF4	Ch	Ex	48	50.46		16.25	Ch	M		49	48.36		16.04	Ex	Ch		48	50.46	16.25
			Co	42		49.77		13.38		F	42		49.77				13.38	Pb	69
		Pb	Ex	69		52.15		14.69	Pb	M	71		42.78*		13.52	Co	Ch	42	49.77
	Co			74		51.09		13.17		F	74		51.09		13.17			Pb	74
	Pb		Ex	48	53.03	17.08		Ch		M	49	51.04	16.55		Ex		Ch	48	53.03
		Co		42	52.16	14.19				F	42	52.16	14.19					Pb	69
Ex		69	54.81	15.44	Pb	M	71			45.32*	14.13	Co	Ch	42			52.16	14.19	
		Co	74	53.59		13.57	F			74	53.59			13.57			Pb	74	53.59
Pb	Ex	48	56.65	18.29		Ch	M		49	51.67	16.87		Ex	Ch		48	56.65	18.29	
		Co	42	52.86			14.48		F	42	52.86					14.48	Pb	69	58.62
	Ex	69	58.62	17.00			Pb	M	71	45.32*	14.13			Co	Ch	42	52.16	14.19	
		Co	74	53.59				13.57	F	74	53.59					13.57	Pb	74	53.59
Ex	48	56.65	18.29	Pb	M			49	51.67	16.87	Ex	Ch			48	56.65	18.29		
	Co	42	52.86		14.48			F	42	52.86					14.48	Pb	69	58.62	17.00

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

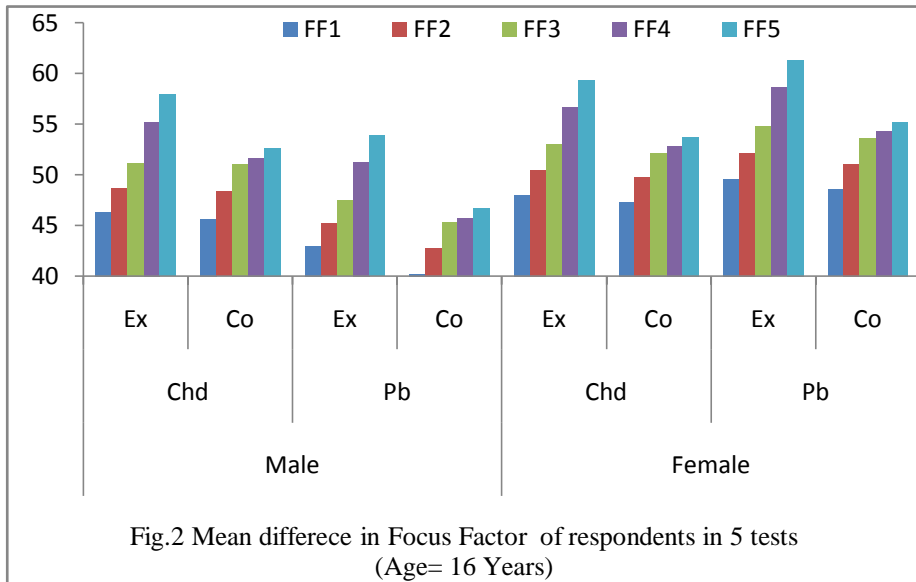
16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD
FF5	Pb	Co	69	58.62	17.00	Pb	M	71	45.78*	14.40	Co	Ch	42	52.86	14.48
		Ex	74	54.29	13.84		F	74	54.29	13.84		Pb	74	54.29	13.84
	Ch	Co	48	59.30	19.08	Ch	M	49	52.66	17.23	Ex	Ch	48	59.30	19.08
		Ex	42	53.70	14.80		F	42	53.70	14.80		Pb	69	61.34	17.83
	Pb	Co	69	61.34*	17.83	Pb	M	71	46.69*	14.68	Co	Ch	42	53.70	14.80
		Ex	74	55.18	14.08		F	74	55.18	14.08		Pb	74	55.18	14.08

When FF in all tests among males was compared, statistically significant difference was seen in FF 4 and FF 5 between males of experiment and control group in Punjab. Among females, significant difference was recorded in FF 5 between males of experiment and control group in Punjab. The mean value ranged from 42.97 to 57.93 in experiment group while it ranged from 40.23 to 52.66 in control group. The mean value of experiment group was higher than the control group in all the tests. Among females, the mean value ranged from 48.01 to 61.34 in experiment group while it ranged from 47.35 to 55.18 in control group. The mean value of experiment group was higher than the control group in all the tests. When the FF in all tests of respondents in experiment group was compared gender wise, significant difference was found between males and females of Punjab in case of experiment group as well as control group. Females had higher values as compared to males. The mean values among males ranged from 42.97 to 57.93 and among females ranged from 48.01 to 61.34. In control group, females had higher values as compared to males. The mean values among males ranged from 40.23 to 52.66 and among females ranged from 47.35 to 55.18. When comparison was made between males of Chandigarh and Punjab, insignificant difference was found between their FF in respondents of control group in FF 1, FF 2 and FF 4 but in case of their female counterparts, insignificant difference was observed in all the tests. The mean of FF varied from 45.66 to 57.93 in Chandigarh while in Punjab it varied from 40.23 to 53.85. In case of females, the mean of FF varied from 47.35 to 59.3 in Chandigarh while in Punjab it varied from 48.56 to 61.34.

Table 6: Comparison of FF among 16 year old respondents

Male								
Place	Chandigarh				Punjab			
Group	Ex		Co		Ex		Co	
FF	Mean	SD	Mean	SD	Mean	SD	Mean	SD
FF1	46.35*	15.43	45.66	15.61	42.97*	14.25	40.23	13.01
FF2	48.72*	16.22	48.36	16.04	45.16*	14.97	42.78	13.52
FF3	51.20*	17.05	51.05	16.55	47.47*	15.74	45.32	14.13
FF4	55.23*	18.22	51.67	16.87	51.31*	16.69	45.78	14.40
FF5	57.93*	18.86	52.66	17.23	53.85*	17.34	46.70	14.68
Female								
FF1	48.01*	15.46	47.35	12.70	49.62*	13.98	48.57	12.92
FF2	50.46*	16.25	49.78	13.38	52.15*	14.69	51.10	13.17
FF3	53.03*	17.08	52.16	14.19	54.81*	15.44	53.59	13.57
FF4	56.65*	18.29	52.87	14.48	58.62*	17.00	54.29	13.84
FF5	59.30*	19.08	53.70	14.80	61.34*	17.83	55.18	14.08

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students



There was significant rise in the FF of male respondents of experiment groups in Chandigarh and Punjab. The mean value in Chandigarh increased from 46.36 to 57.93. In Punjab, the mean value rose from 42.97 to 53.85. Similarly, among females, significant increase was recorded. The mean value increased from 48.01 to 59.31 in experiment group of Chandigarh and it rose from 49.62 to 61.35 in Punjab. In contrast, insignificant changes were witnessed among their control group counterparts.

Table 7: Details of DMA of 16 year old respondents

16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD
Exp. and Control Group, Male						Gender wise, Experiment					Area wise, Male				
DMA1	Ch	Ex	54	0.21	0.08	Ch	M	54	0.21	0.08	Ex	Ch	54	0.21	0.08
		Co	49	0.21	0.08		F	48	0.22	0.09			Ex	Pb	67
	Pb	Ex	67	0.19	0.08	Pb	M	67	0.19*	0.08	Co	Ch	49	0.21*	0.08
		Co	71	0.18	0.07		F	69	0.23	0.08			Co	Pb	71
DMA2	Ch	Ex	54	0.35*	0.14	Ch	M	54	0.35	0.14	Ex	Ch	54	0.35	0.14
		Co	49	0.24	0.09		F	48	0.36	0.14			Ex	Pb	67
	Pb	Ex	67	0.32*	0.13	Pb	M	67	0.32*	0.13	Co	Ch	49	0.24	0.09
		Co	71	0.21	0.08		F	69	0.38	0.13			Co	Pb	71
DMA3	Ch	Ex	54	0.39*	0.15	Ch	M	54	0.39	0.15	Ex	Ch	54	0.39	0.15
		Co	49	0.25	0.10		F	48	0.41	0.15			Ex	Pb	67
	Pb	Ex	67	0.36*	0.14	Pb	M	67	0.36*	0.14	Co	Ch	49	0.25	0.10
		Co	71	0.22	0.08		F	69	0.42	0.14			Co	Pb	71
DMA4	Ch	Ex	54	0.42*	0.16	Ch	M	54	0.42	0.16	Ex	Ch	54	0.42	0.16
		Co	49	0.26	0.10		F	48	0.44	0.16			Ex	Pb	67
	Pb	Ex	67	0.39*	0.15	Pb	M	67	0.39*	0.15	Co	Ch	49	0.26*	0.10
		Co	71	0.22	0.08		F	69	0.45	0.15			Co	Pb	71
DMA5	Ch	Ex	54	0.45*	0.17	Ch	M	54	0.45	0.17	Ex	Ch	54	0.45	0.17
		Co	49	0.26	0.10		F	48	0.46	0.17			Ex	Pb	67
	Pb	Ex	67	0.41*	0.15	Pb	M	67	0.41*	0.15	Co	Ch	49	0.26*	0.10
		Co	71	0.23	0.08		F	69	0.47	0.16			Co	Pb	71

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

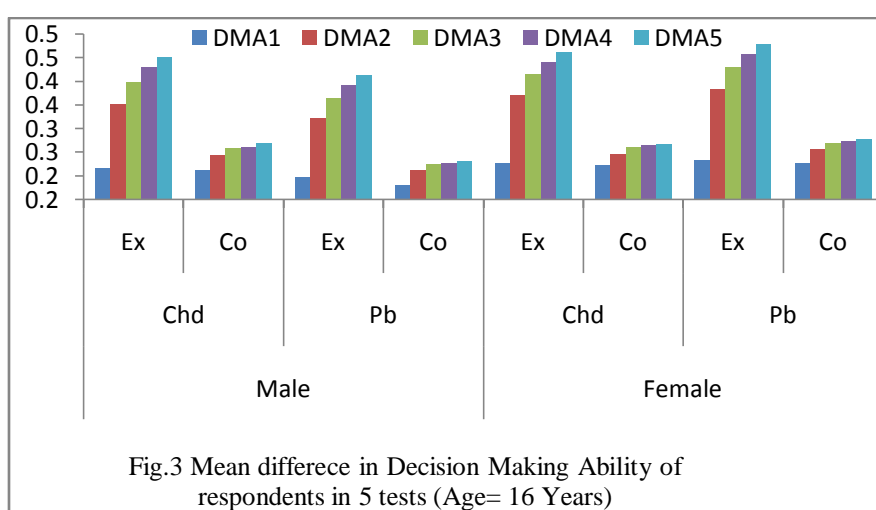
16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD
Exp. and Control Group, Female						Gender wise, Control					Area wise, Female				
DMA1	Ch	Ex	48	0.22	0.09	Ch	M	49	0.21	0.08	Ex	Ch	48	0.22	0.09
		Co	42	0.22	0.07		F	42	0.22	0.07		Pb	69	0.23	0.08
	Pb	Ex	69	0.23	0.08	Pb	M	71	0.18*	0.07	Co	Ch	42	0.22	0.07
		Co	74	0.22	0.07		F	74	0.22	0.07		Pb	74	0.22	0.07
DMA2	Ch	Ex	48	0.36*	0.14	Ch	M	49	0.24	0.09	Ex	Ch	48	0.36	0.14
		Co	42	0.24	0.08		F	42	0.24	0.08		Pb	69	0.38	0.13
	Pb	Ex	69	0.38*	0.13	Pb	M	71	0.21*	0.08	Co	Ch	42	0.24	0.08
		Co	74	0.25	0.08		F	74	0.25	0.08		Pb	74	0.25	0.08
DMA3	Ch	Ex	48	0.41*	0.15	Ch	M	49	0.25	0.10	Ex	Ch	48	0.41	0.15
		Co	42	0.26	0.09		F	42	0.26	0.09		Pb	69	0.42	0.14
	Pb	Ex	69	0.42*	0.14	Pb	M	71	0.22*	0.08	Co	Ch	42	0.26	0.09
		Co	74	0.26	0.09		F	74	0.26	0.09		Pb	74	0.26	0.09
DMA4	Ch	Ex	48	0.44*	0.16	Ch	M	49	0.26	0.10	Ex	Ch	48	0.44	0.16
		Co	42	0.26	0.09		F	42	0.26	0.09		Pb	69	0.45	0.15
	Pb	Ex	69	0.45*	0.15	Pb	M	71	0.22*	0.08	Co	Ch	42	0.26	0.09
		Co	74	0.27	0.09		F	74	0.27	0.09		Pb	74	0.27	0.09
DMA5	Ch	Ex	48	0.46*	0.17	Ch	M	49	0.26	0.10	Ex	Ch	48	0.46	0.17
		Co	42	0.26	0.09		F	42	0.26	0.09		Pb	69	0.47	0.16
	Pb	Ex	69	0.47*	0.16	Pb	M	71	0.23*	0.08	Co	Ch	42	0.26	0.09
		Co	74	0.27	0.09		F	74	0.27	0.09		Pb	74	0.27	0.09

When DMA in all tests among males was compared, statistically significant difference was seen in DMA 2, DMA 3, DMA 4 and DMA 5 between males of experiment and control group in Chandigarh as well as Punjab. Absolutely the same trend was witnessed among females. The mean value ranged from 0.19 to 0.45 in experiment group while it ranged from 0.18 to 0.26 in control group. The mean value of experiment group was higher than the control group in all the tests. Among females, the mean value ranged from 0.22 to 0.47 in experiment group while it ranged from 0.22 to 0.27 in control group. The mean value of experiment group was lower than the control group in all the tests. When the DMA in all tests of respondents in experiment group was compared gender wise, significant difference was found between males and females in case of experiment group as well as control group in Punjab while in case of Chandigarh, in both the groups, insignificant differences were recorded. Females had higher values as compared to males. The mean values among males ranged from 0.19 to 0.45 and among females ranged from 0.22 to 0.47. In control group, females had higher values as compared to males. The mean values among males ranged from 0.18 to 0.26 and among females ranged from 0.22 to 0.27. When comparison was made between males of Chandigarh and Punjab, significant difference was found between their DMA 1, DMA 4 and DMA 5 in control group among males as well as females. The mean of DMA varied from 0.21 to 0.45 in Chandigarh while in Punjab it varied from 0.18 to 0.41. In case of females, the mean of DMA varied from 0.22 to 0.46 in Chandigarh while in Punjab it varied from 0.22 to 0.47.

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

Table 8: Comparison of DMA among 16 year old respondents

Male								
Place	Chandigarh				Punjab			
Group	Ex		Co		Ex		Co	
DMA	Mean	SD	Mean	SD	Mean	SD	Mean	SD
DMA1	0.21*	0.08	0.21	0.08	0.19*	0.08	0.18	0.07
DMA2	0.35*	0.14	0.24	0.09	0.32*	0.13	0.21	0.08
DMA3	0.39*	0.15	0.26	0.10	0.36*	0.14	0.23	0.08
DMA4	0.42*	0.16	0.26	0.10	0.39*	0.15	0.23	0.08
DMA5	0.45*	0.17	0.27	0.10	0.41*	0.15	0.23	0.08
Female								
DMA1	0.22*	0.09	0.22	0.07	0.23*	0.08	0.23	0.07
DMA2	0.36*	0.14	0.25	0.08	0.38*	0.13	0.26	0.08
DMA3	0.41*	0.15	0.26	0.09	0.42*	0.14	0.27	0.09
DMA4	0.44*	0.16	0.26	0.09	0.45*	0.15	0.27	0.09
DMA5	0.46*	0.17	0.27	0.09	0.47*	0.16	0.28	0.09



There was significant rise in the DMA of male respondents of experiment groups in Chandigarh and Punjab. The mean value in Chandigarh increased from 0.22 to 0.45. In Punjab, the mean value rose from 0.2 to 0.41. Similarly, among females, significant increase was recorded. The mean value increased from 0.23 to 0.46 in experiment group of Chandigarh and it rose from 0.23 to 0.48 in Punjab. In contrast, insignificant changes were witnessed among their control group counterparts.

Table 9: Details of CQ of 16 year old respondents

16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD
Exp. and Control Group, Male						Gender wise, Experiment				Area wise, Male					
CQ1	Ch	Ex	54	0.52*	0.07	Ch	M	54	0.52*	0.07	Ex	Ch	54	0.52*	0.07
		Co	49	0.39	0.05		F	48	0.55	0.07		Pb	67	0.54	0.08
	Pb	Ex	67	0.54*	0.08	Pb	M	67	0.54	0.08	Co	Ch	49	0.39	0.05
		Co	71	0.37	0.05		F	69	0.55	0.07		Pb	71	0.37	0.05

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

16	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD
CQ2	Ch	Ex	54	0.63*	0.09	Ch	M	54	0.63*	0.09	Ex	Ch	54	0.63	0.09
		Co	49	0.43	0.06		F	48	0.67	0.09		Pb	67	0.66	0.09
	Pb	Ex	67	0.66*	0.09	Pb	M	67	0.66	0.09	Co	Ch	49	0.43	0.06
		Co	71	0.42	0.06		F	69	0.67	0.08		Pb	71	0.42	0.06
CQ3	Ch	Ex	54	0.67*	0.10	Ch	M	54	0.67*	0.10	Ex	Ch	54	0.67	0.10
		Co	49	0.46	0.06		F	48	0.71	0.09		Pb	67	0.70	0.10
	Pb	Ex	67	0.70*	0.10	Pb	M	67	0.70	0.10	Co	Ch	49	0.46	0.06
		Co	71	0.44	0.06		F	69	0.71	0.09		Pb	71	0.44	0.06
CQ4	Ch	Ex	54	0.71*	0.10	Ch	M	54	0.71*	0.10	Ex	Ch	54	0.71	0.10
		Co	49	0.49	0.07		F	48	0.75	0.10		Pb	67	0.74	0.10
	Pb	Ex	67	0.74*	0.10	Pb	M	67	0.74	0.10	Co	Ch	49	0.49	0.07
		Co	71	0.47	0.07		F	69	0.75	0.09		Pb	71	0.47	0.07
CQ5	Ch	Ex	54	0.77*	0.11	Ch	M	54	0.77*	0.11	Ex	Ch	54	0.77	0.11
		Co	49	0.53	0.08		F	48	0.82	0.10		Pb	67	0.81	0.11
	Pb	Ex	67	0.81*	0.11	Pb	M	67	0.81	0.11	Co	Ch	49	0.53	0.08
		Co	71	0.52	0.08		F	69	0.82	0.10		Pb	71	0.52	0.08
Exp. and Control Group, Female						Gender wise, Control						Area wise, Female			
CQ1	Ch	Ex	48	0.55*	0.07	Ch	M	49	0.39	0.05	Ex	Ch	48	0.55	0.07
		Co	42	0.39	0.06		F	42	0.39	0.06		Pb	69	0.55	0.07
	Pb	Ex	69	0.55*	0.07	Pb	M	71	0.37*	0.05	Co	Ch	42	0.39	0.06
		Co	74	0.40	0.05		F	74	0.40	0.05		Pb	74	0.40	0.05
CQ2	Ch	Ex	48	0.67*	0.09	Ch	M	49	0.43	0.06	Ex	Ch	48	0.67	0.09
		Co	42	0.44	0.06		F	42	0.44	0.06		Pb	69	0.67	0.08
	Pb	Ex	69	0.67*	0.08	Pb	M	71	0.42*	0.06	Co	Ch	42	0.44	0.06
		Co	74	0.44	0.05		F	74	0.44	0.05		Pb	74	0.44	0.05
CQ3	Ch	Ex	48	0.71*	0.09	Ch	M	49	0.46	0.06	Ex	Ch	48	0.71	0.09
		Co	42	0.47	0.07		F	42	0.47	0.07		Pb	69	0.71	0.09
	Pb	Ex	69	0.71*	0.09	Pb	M	71	0.44*	0.06	Co	Ch	42	0.47	0.07
		Co	74	0.47	0.06		F	74	0.47	0.06		Pb	74	0.47	0.06
CQ4	Ch	Ex	48	0.75*	0.10	Ch	M	49	0.49	0.07	Ex	Ch	48	0.75	0.10
		Co	42	0.50	0.07		F	42	0.50	0.07		Pb	69	0.75	0.09
	Pb	Ex	69	0.75*	0.09	Pb	M	71	0.47*	0.07	Co	Ch	42	0.50	0.07
		Co	74	0.50	0.06		F	74	0.50	0.06		Pb	74	0.50	0.06
CQ5	Ch	Ex	48	0.82*	0.10	Ch	M	49	0.53	0.08	Ex	Ch	48	0.82	0.10
		Co	42	0.55	0.08		F	42	0.55	0.08		Pb	69	0.82	0.10
	Pb	Ex	69	0.82*	0.10	Pb	M	71	0.52*	0.08	Co	Ch	42	0.55	0.08
		Co	74	0.55	0.07		F	74	0.55	0.07		Pb	74	0.55	0.07

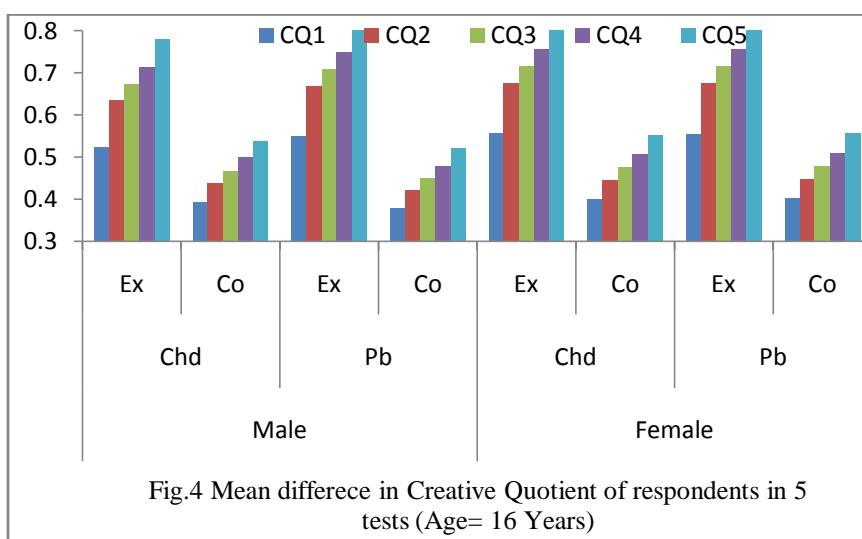
Among males, there were significant differences found between the CQ of experiment and control group in Chandigarh as well as Punjab. The same trend was witnessed in case of females. The mean value ranged from 0.52 to 0.81 in experiment group while it ranged from 0.37 to 0.53 in control group. The mean value of experiment group was higher than the control group in all the tests. Among females, the mean value ranged from 0.55 to 0.82 in experiment group while it ranged from 0.39 to 0.55 in control group. The mean value of experiment group was higher than the control group in all the tests. When the CQ of

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

respondents in experiment group was compared gender wise, significant differences were recorded between males and females of Chandigarh while in case of control group, the differences were significant in Punjab. Females had higher values as compared to males. The mean values among males ranged from 0.52 to 0.81 and among females ranged from 0.55 to 0.82. In control group, females had higher values as compared to males. The mean values among males ranged from 0.37 to 0.53 and among females ranged from 0.39 to 0.55. When comparison was made between males of Chandigarh and Punjab, insignificant difference was found between their CQ in experiment as well as control group in all the tests. Similarly, no significant difference was found among females. The mean of CQ varied from 0.39 to 0.77 in Chandigarh while in Punjab it varied from 0.37 to 0.81. In case of females, the mean of CQ varied from 0.39 to 0.82 in Chandigarh while in Punjab it varied from 0.4 to 0.82.

Table 10: Comparison of CQ among 16 year old respondents

Male								
Place	Chandigarh				Punjab			
Group	Ex		Co		Ex		Co	
CQ	Mean	SD	Mean	SD	Mean	SD	Mean	SD
CQ1	0.52*	0.07	0.39	0.05	0.54*	0.08	0.38	0.05
CQ2	0.63*	0.09	0.44	0.06	0.66*	0.09	0.42	0.06
CQ3	0.67*	0.10	0.47	0.06	0.70*	0.10	0.45	0.06
CQ4	0.71*	0.10	0.50	0.07	0.74*	0.10	0.48	0.07
CQ5	0.77*	0.11	0.54	0.08	0.81*	0.11	0.52	0.08
Female								
CQ1	0.55*	0.07	0.40	0.06	0.55*	0.07	0.40	0.05
CQ2	0.67*	0.09	0.45	0.06	0.67*	0.08	0.45	0.05
CQ3	0.71*	0.09	0.48	0.07	0.71*	0.09	0.48	0.06
CQ4	0.75*	0.10	0.51	0.07	0.75*	0.09	0.51	0.06
CQ5	0.82*	0.10	0.55	0.08	0.82*	0.10	0.55	0.07



There was significant rise in the CQ of male respondents of experiment groups in Chandigarh and Punjab. The mean value in Chandigarh increased from 0.52 to 0.78. In Punjab, the mean

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

value rose from 0.55 to 0.82. Similarly, among females, significant increase was recorded. The mean value increased from 0.56 to 0.83 in experiment group of Chandigarh and it rose from 0.55 to 0.83 in Punjab. In contrast, insignificant changes were witnessed among their control group counterparts.

Table 11: Details of marks of 16 year old respondents

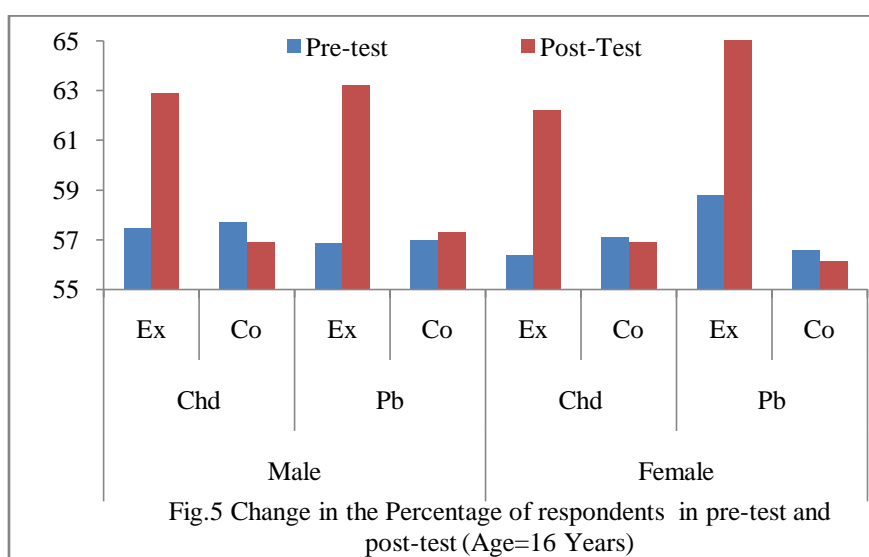
I6	Place	Gp	N	Mean	SD	Place	M/F	N	Mean	SD	Gp	Place	N	Mean	SD
Exp. and Control Group, Male						Gender wise, Experiment					Area wise, Female				
M1	Ch	Ex	54	57.48	5.84	Ch	M	54	57.48	5.84	Ex	Ch	54	57.48	5.84
		Co	49	57.68	6.03		F	48	56.38	6.95		Pb	67	56.87	6.41
	Pb	Ex	67	56.87	6.41	Pb	M	67	56.87	6.41	Co	Ch	49	57.68	6.03
		Co	71	56.98	6.19		F	69	58.78	7.19		Pb	71	56.98	6.19
M2	Ch	Ex	54	62.88*	8.47	Ch	M	54	62.88	8.47	Ex	Ch	54	62.88	8.47
		Co	49	56.88	8.94		F	48	62.19	9.16		Pb	67	63.21	8.68
	Pb	Ex	67	63.21*	8.68	Pb	M	67	63.21*	8.68	Co	Ch	49	56.88	8.94
		Co	71	57.31	8.14		F	69	69.62	10.14		Pb	71	57.31	8.14
Exp. and Control Group, Female						Gender wise, Control					Area wise, Male				
M1	Ch	Ex	48	56.38	6.95	Ch	M	49	57.68	6.03	Ex	Ch	48	56.38	6.95
		Co	42	57.11	6.62		F	42	57.11	6.62		Pb	69	58.78	7.19
	Pb	Ex	69	58.78	7.19	Pb	M	71	56.98	6.19	Co	Ch	42	57.11	6.62
		Co	74	56.56	6.65		F	74	56.56	6.65		Pb	74	56.56	6.65
M2	Ch	Ex	48	62.19*	9.16	Ch	M	49	56.88	8.94	Ex	Ch	48	62.19*	9.16
		Co	42	56.90	8.59		F	42	56.90	8.59		Pb	69	69.62	10.14
	Pb	Ex	69	69.62*	10.14	Pb	M	71	57.31	8.14	Co	Ch	42	56.90	8.59
		Co	74	56.12	8.39		F	74	56.12	8.39		Pb	74	56.12	8.39

There were insignificant differences found between the M 1 in Chandigarh and Punjab among male respondents. But in case of M 2, there was significant difference. The same trend was notified among females. The mean value ranged from 56.87 to 63.21 in experiment group while it ranged from 56.88 to 57.68 in control group. The mean value of experiment group was lower than the control group in both the tests. Among females, the mean value ranged from 56.38 to 69.62 in experiment group while it ranged from 56.12 to 57.11 in control group. The mean value of experiment group was higher than the control group in both the tests. When the marks of respondents in experiment group were compared gender wise, it was found that there existed significant differences between M 2 of males and Punjab. However, in other cases, the difference was insignificant. Females had lower values as compared to males. The mean values among males ranged from 56.87 to 63.21 and among females ranged from 56.38 to 69.62. In control group, females had lower values as compared to males. The mean values among males ranged from 56.88 to 57.68 and among females ranged from 56.12 to 57.11. There were insignificant differences between marks of respondents when compared area wise. However, significant difference was found between the marks of males in Chandigarh and Punjab among females in experiment group. The mean of marks varied from 56.88 to 62.88 in Chandigarh while in Punjab it varied from 56.87 to 63.21. In case of females, the mean of marks varied from 56.38 to 62.19 in Chandigarh while in Punjab it varied from 56.12 to 69.62.

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

Table 12: Comparison of marks among 16 year old respondents

Male								
Place	Chandigarh				Punjab			
Group	Ex		Co		Ex		Co	
Marks	Mean	SD	Mean	SD	Mean	SD	Mean	SD
M1	57.48*	5.84	57.69	6.03	56.87*	6.41	56.99	6.19
M2	62.88*	8.47	56.89	8.94	63.21*	8.68	57.31	8.14
Female								
Marks	Mean	SD	Mean	SD	Mean	SD	Mean	SD
M1	56.38*	6.95	57.12	6.62	58.78*	7.19	56.57	6.65
M2	62.19*	9.16	56.90	8.59	69.62*	10.14	56.12	8.39



There was significant rise in the marks of male respondents of experiment groups in Chandigarh and Punjab. The mean value in Chandigarh increased from 57.48 to 62.88. In Punjab, the mean value rose from 56.87 to 63.21. Similarly, among females, significant increase was recorded. The mean value increased from 56.38 to 62.19 in experiment group of Chandigarh and it rose from 58.78 to 69.62 in Punjab. In contrast, insignificant changes were witnessed among their control group counterparts.

CONCLUSION

To recapitulate, it was found that when students are taught according to their inherent primary learning style, they can learn in an effective manner and the performance is higher as compared to the system where they are taught in the same traditional way. It was further observed that with the regular intervention of customized education, the interest of the students was developed in studies. The intelligence quotient, focus factor, decision making ability, creative quotient and academic marks increased dramatically after the successful consummation of intervention programme. Hence, the present research study underlines the effectiveness of teaching learning process that corresponds to each student’s natural learning style. It was proved through the study that there was minimal change in the cognitive ability as well as academic achievement of the students who were not given any kind of intervention. However, when the students were imparted education based on their natural learning style, vibrant changes could be witnessed. In a nutshell, if same content is delivered in the different

Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

ways in which the students are receptive, there can be enhancement in their cognitive abilities as well as academic scores.

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Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students

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Acknowledgements

The authors profoundly appreciate all the people who have successfully contributed in ensuring this paper is in place. Their contributions are acknowledged however their names cannot be able to be mentioned.

Conflict of Interest

The authors carefully declare this paper to bear not conflict of interests

How to cite this article: Marwaha, S, Sinha, A.K, & Sahani, R (2019). Amalgamation of Education and Natural Learning Style Impacts Cognitive Development and Academic Achievement among 16 Year Old Students. *International Journal of Indian Psychology*, 7(1), 632-648. DIP:18.01.071/20190701, DOI:10.25215/0701.071