Article

SAGE Open
October-December 2015: 1–12

DOI: 10.1177/2158244015611452
sgo.sagepub.com
SAGE

Information Processing and Creative Thinking Abilities of Residential and Non-Residential School Children: A Pilot Study

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Abstract

This study attempts to assess and compare the residential and non-residential schoolchildren in information-processing skills and creative thinking abilities. A sample of 80 children from Classes 5 and 7 were selected from two types of schools, residential/ashram (02) and non-residential/formal schools (02) in Bolpur subdivision of West Bengal in India where the medium of instruction is Bengali language/mother-tongue. All the children were individually administered the PASS (Planning, Attention, Simultaneous, Successive), Stroop, Matching Familiar Figure Test (MFFT-20), and creative thinking tasks. The residential school children were found to perform better both in information processing and creative thinking tasks. The developmental trend could not be clearly observed due to small sample size, but with increasing age, children were using better processing strategies. Due to ashram environment, creative pedagogy, and various co-curricular activities, the residential school children were found to be more creative than their formal school counterparts. Moreover, some significant positive correlations were found among information processing skills and creative thinking dimensions.

Keywords

information processing, creative thinking, residential, non-residential, schoolchildren

Introduction

To quote a few traditional researchers, Neisser (1967) defined the concept cognition as a study of how people encode, structure, store, retrieve, use, or otherwise learn knowledge. Atkinson and Shiffrin (1968) in their human information processing model have viewed that learning and memory processes are discontinuous and multi-staged, and any new information before being stored are manipulated by our information processing/memory system. Their famous stage theory model identified three types of memory based on its processing stages that is, sensory memory, short-term/working memory, and long-term memory. The "Levels of Processing" theory developed by Craik and Lockhart (1972) disagreed with the three-stage serial processing model of Atkinson and Shiffrin and stated that any information from the environment is being processed at multiple levels simultaneously depending on its characteristics, attention, and meaningfulness. New information need not have to go through a specific order of processing nor any prescribed channel. However, the more deeply the information is being processed/learned, the more it would be retained in our memory system (Kearsley, 2001). Similarly, the more connections, elaborations being made to any single idea, stimuli, or concept, the more likely it would be remembered better (Huitt, 2003). The advocates of "Dual-Coding Theory" (Clark & Paivio, 1991) suggested for two processing modes such as verbal and non-verbal processings; for example, mental images and verbal entities, chunks or prepositions are being processed by different systems. Furthermore, there are three separate types of processing and interaction between these two systems such as representational, referential, and associative processing. The "Schema theory of Information Processing and Memory" developed by Rumelhart (1980) proposes that information is stored in multiple locations throughout the brain in the form of networks of connections; thus, units of memory are connections rather than any concrete representation of previous information. The developmental perspective of information processing as proposed by Flavell, Miller, and Miller (2002) emphasizes that increased

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processing capacity, speed, and efficiency takes place as a result of biological maturation, knowledge development, modifications of connections in neural networks, repeated self-organization, and meta-cognition. As the child becomes more competent in structuring and organizing information and uses his experience more often, he will be using the metacognitive strategies more spontaneously and frequently (Flavell et al., 2002). Sternberg's (1988) theory of "Successful Intelligence" based on information-processing approach suggests that intelligence is comprised of three kinds of information processing components: meta-components, performance components, and knowledge acquisition components; all these work together to facilitate learning and cognitive development. Developmental changes take place as a result of feedback, self-monitoring, social interaction, and automization. Later on, Sternberg has also added the concepts of practical intelligence and creative intelligence in his theory. Kogan (1983) in his model refers to information processing as individuals' variations in modes of perceiving, remembering, thinking, and so on, or as different ways of apprehending, storing, transforming, and utilizing information. Das, Naglieri, and Kirby (1994) in their "PASS Theory" (Planning, Attention, Simultaneous, Successive) have analyzed information processing as an act of cognitive processes, which indicate how the individual approaches a task or problem, the strategies, and plans he uses to reach a solution. Much closer to their definition, Halpern (1996) articulated this concept as critical thinking and defined this as "the use of cognitive skills or strategies that increase the probability of a desirable outcome" (p. 5). Burden and Byrd (1994) classified critical thinking as a higher-order cognitive activity that requires a set of cognitive skills such as reasoning, intellectual curiosity, sense of responsibility, perseverance, reflective thinking, and so on.

Thus, the above discussion on some of the core information processing research revealed that the human cognition/thinking is to be understood through an account of the representation of the information and of processes that manipulate this information. So far as the hierarchies of cognitive processes and multi-dimensional functioning of human cognition/intellect, Bloom, Englehart, Furst, Hill, and Krathwohl's (1965) "Taxonomy of cognitive Domain," Guilford's (1971) "Analysis of Intelligence," and Anderson and Krathwohl's (2000) "Revised Bloom Taxonomy" are considered to be path-breaking works in integrating all, from simple to higher-order thinking processes, for successful problem solving in the field of education. Bloom et al. had proposed a six-level-based "Taxonomy of Educational objectives" based on the learning hierarchy, that is, knowledge, comprehension, application, analysis, synthesis, and evaluation. Later on, other researchers have modified and revised the model as knowledge, comprehension, application, analysis, evaluation, and creativity, after proposing that evaluation is less difficult than synthesis and both incorporate different types of processing (Anderson & Krathwohl, 2000; Huitt, 2003). However, there was a consensus among researchers that even though both synthesis and evaluation are based on the ability to analyze, compare, contrast the parts of the whole, and understand their interrelationships, the type of thinking/cognitive processing involved in synthesis is often called "Creative thinking," and in evaluation, it is called "Critical thinking."

Thus, creative thinking/creativity is considered to be the highest level of cognitive process, which automatically includes all other lower cognitive processes while enacting a creative thought. Guilford (1967, 1971) had reported that "divergent thinking" is much closer to creativity, which includes four basic components such as fluency, flexibility, originality, and elaboration. Torrance (1965) defined creativity as the process of forming different ideas or hypothesis, testing these hypotheses, evaluating its effectiveness, and communicating the outcomes and its utilities. Later on, Torrance, Orlow, and Safter (1990) identified a set of creative attributes/thinking abilities such as fluency, flexibility, originality, elaboration, abstractness of the title, resistance to closure, emotional expressiveness, articulateness action, expressiveness, synthesis, internal as well as unusual visualization, braking the boundaries, humor, fantasy, richness, colorfulness of imagery, and so on, for being truly creative or engaged in creative act. Gardner (1985) has interpreted creativity as a complex construct and most likely/commonly is being expressed through a broad range of intelligence, including linguistic, musical, mathematical, spatial, kinesthetic, interpersonal, and intrapersonal. Wright (1987) reported about some home environment factors such as respect for the child, the stimulation of independence, and enriched learning environment encourage creativity among children. Weisberg (1999) proposed that creativity involves essentially ordinary cognitive processes yielding extraordinary products. He attempted to show that the insights depend on subjects using conventional cognitive processes (such as analogical transfer) applied to knowledge already stored in memory. Longley, Zytkow, Simon, and Bradshow (1987) made a similar claim about the ordinary nature of creative thinking. Cultural background was also found to have an impact on creativity (Baker, Rudd, & Domeroy, 2000; Sharma & Naruka, 1983; Torrance, 1981). Researchers have pointed out that besides personal attributes, some key educational factors play key role in the development of creativity among students, that is, teacher's teaching style (exercise, tactical strategic training; Jausovoc, 1988), students' learning styles (Isaacs, 1987), critical thinking, knowledge motivation, and creative response style being transacted in the educational setting. Most importantly, students' intrinsic motivation and motivation to excel in every field/work often lead to creative excellence (Sternberg & Luppart, 1991; Torrance, 1997).

However, the literature review on creativity research has primarily categorized these into four parts, that is, four p's/factors such as person, process, product, and press/place. Empirical research have been done on each of these aspects,

thus accumulating huge amount of work. The first category of "person" relates to the cognitive abilities, biological traits, and psycho-physical traits of creative people. The second category, "process," refers to mental processes or stages of creative thinking that backs up creative work. The third one, "product," means creative output/product, which can be measured/evaluated through its novelty, originality, authenticity, fluency, elaboration, effectiveness, and utility. The fourth category is "press," which refers to the enriched environment context, which boosts the creative thinking and actions among individuals (Beghetto, Kozbelt, & Runco, 2010). Feldhusen (2002) reported that the phenomenon creativity has been extensively and successfully researched at higher level in case of talented adults and less explicitly in case of children or common man. Thus, children can be given a secondary role at the periphery of creative expression known as "low range creativity" or "creative spontaneity" (Feldman in Sawyer et al., 2003). Researchers have also acknowledged that there are different types of creative contribution. For example, Gardner (1994) has described different types of creative contributions individuals can make, such as (a) solving a well-defined problem, (b) devising and encompassing theory, (c) creating a "frozen work," (d) performing a ritualized work, and (e) rendering a "high-stake" performance. Similarly, according to Taylor (1959), there were five typologies for creativity, that is, expressive, productive, inventive, innovative, and emergentive. Expressive type is the spontaneous creativity often seen among children through their play and drawings. Productive creativity is being demonstrated by scientists and artists. Inventive creativity may be described as problem solving or updating the existing technology. Innovative creativity manifests in reinventing an existing system/organism/object through the utilization of conceptual skills. Emergentive creativity is the creation of entirely new paradigm/opening/discovery/hybrid product, and so on. Thus, from the above discussion, we can apparently conclude that creativity would express itself in different forms depending on the right combination of particular set of abilities, skills, personality traits, and environment.

Moreover, creativity being a cognitive act involves certain processes to reach at the output/product. It is also evident from the above literature that very few attempts have been made to relate these two significant cognitive components, that is, intelligence/information processing and creativity, and what sort of relationship they share with each other. The review of research findings on these two concepts reveals that the pattern of relationship between these two is positive but not linear in nature. That is, to be creative, a person must possess certain minimum (optimum) level of intelligence (such as grasping power, analytical skills, or ability for integrating various components etc.), but highly intelligent persons may not be equally creative. As we know, creativity being a cognitive act also involves different ways of thinking, that is, flexibility, originality, openness, fluency, elaboration, and so on, through which new solutions to various problems are arrived at. But here, the question is how the creative people process the information when they are engaged in a creative act. Do they process these in a different way or like any other normal/average individual? Is there any specialty about creative thinking or is it just as other cognitive processes such as memory, reasoning, problem solving, and so on. Out of various information processing models that have emerged out of cognitive-processing approach to assess intelligence, the author found that only in Sternberg's (1999) model of "Successful Intelligence" the component of creative intelligence has been incorporated. He and his associates found that the best predictor of creative aspects of thinking seemed to be the efficiency with which an individual is able to transition between conventional and unconventional ways of thinking. The other information processing models such as Das et al.'s (1994) PASS, Cairns and Cammock's (1978) "Reflection–Impulsivity" model, and Gardner's (1993) 'Multiple intelligences" model describe different modes of information processing such as different ways of apprehending, storing, transforming, and utilizing the information. At this point of discussion, it strikes to the present researcher whether the creative individuals process the information in a similar fashion as normal ones or in a different mode. What is their specialty if it exists? This instigated the present author to take up this study.

Moreover, there is a growing realization among the intellectual mass that creativity is no more a privilege for a handful of people/the chosen few, but it is the basic human endowment present among all, in different measures. Creative potentiality is often not recognized systematically and nurtured properly. The failure generally begins in the school at an early stage and continues throughout life. In this context, Piaget's and Vygotsky's theories have great relevance in understanding the children's (developmental) psychology, that is, the process of learning to think and thinking to learn.

Piaget (1896-1980) advocates learning as construction, and his theory encourages hands-on learning. Piaget believed that through assimilation and accommodation processes, the individuals try to adapt themselves in the new environment and maintain equilibrium/cognitive harmony. Whereas, Vygotsky (1962, 1978) believed that the learner constructed his or her knowledge by interacting with others in the society. Thus, social interaction plays an important role in student learning, and his theory advocates for gradual changes in learning and development through increasing social contacts, language, and social interactions. His philosophy was

> what is learnt must be taught by the teachers, who should explain, model and use guided practices in the classroom. Allowing the students to think aloud and work through their assigned tasks are effective instruction strategies at elementary and middle school levels. (Vygotsky, 2004, pp. 9-97)

According to Piaget (1896-1980) in this context, the most important aim of education is not to train individuals who

repeat the previous generations, but to train inventors who are creative and possess the skill of producing new things (Anwar, Shamim-Ur-Rasool, & Haq, 2012). Edward and David (1982) have emphasized that both creative and critical thinking should be involved in the teaching–learning process and curricula, through the context, activities, and assessment in school subjects, especially math and science. Thus, it is being felt by the educationists that the creative ability should be detected very early in life, so that it can be nurtured properly to reach the culminating point. The National Policy on Education (NPE; 1986/1992), National Council of Educational Research and Training (NCERT; 1986, India), National Curriculum Framework (NCF; 2005), and several other commissions have all along advocated for the need to develop both the creative and critical thinking among the schoolchildren through inducing spontaneity, curiosity, original thinking, independent analysis, courage to ask questions, scientific temper, and so on. The child-centered approach as articulated by NPE (India) also emphasizes the development of creative thinking and problem-solving abilities to make the teaching–learning process more successful and innovative in nature. It would also enhance the skill of "learning to learn" among the children, and for this, it is very urgent to know how they process the information collected from the environment. Even though numerous studies have been conducted on various dimensions of creative ability and cognitive-processing skills, rare attempts have been made to relate these two components in an educational set up, especially at the elementary education level. Nowadays, creativity is increasingly gaining importance across the fields, from school education to professional world and corporate sectors as well. Even though researchers have found that creative thinking can contribute significantly to the acquisition of information and educational skills (Gotoh, 2004; Krulik & Rudnik, 1999), the empirical findings on the relationship between creativity and intelligence/academic achievement are still inconclusive. This has prompted the researcher to explore the answers to these following questions.

Research Questions

Research Question 1: Is there any difference among residential/ashram and non-residential/formal schoolchildren in information processing and creative thinking skills?
Research Question 2: Would there be any developmental trend among the schoolchildren?
Research Question 3: What would be the pattern of relationship between information processing and creative thinking abilities?

Method

Sample

A sample of 80 school-going children (sharing the similar demographic characteristics), 40 each from Classes 5 and 7 have been selected from two types of schools, that is, residential/ashram schools and non-residential/formal schools. The two schools, Pathabhavan and Siksha–Satra of Visva–Bharati University at Santiniketan in West Bengal, India were the two ashram schools and the other two schools called Srinanda High School and Vivekanda Vidyapith under the West Bengal board (WB) of secondary education were taken as the non-residential/formal schools. All these schools were Bengali/mother-tongue medium schools located in the Bolpur subdivision of Birbhum district in West Bengal, India. The samples were drawn from Classes 5 and 7 of these four schools through stratified-random (sampling) technique.

Tools/Tasks Used

The following tools such as Das, Naglieri, and Kirby's PASS processing tasks, Matching Familiar Figure Test **(**MFFT-20) task, Stroop task, and Baquer Mehdi's creative thinking tasks were used in this study.

a. *Planned connection task*: In this planning task, each subject is required to connect all the numbers in the worksheet as quickly as possible. There are two conditions where in Condition 1, the subject has to connect 1 to 2, 2 to 3, numbers only, and in Condition 2, he or she has to connect both numbers and letters such as 1 to A, A to 2, 2 to B, and B to 3 likewise.
b. *Visual search*: This is also a planning task, where the subject's task is to point out the object, number, or letter in the response-field background that matches the target located in the centre box. Each item consists of two searches presented in a single page. For each subtask (item page), the subject's score is the time taken by him or her. The items are of high and low density and auto and control search in nature. In auto-search items, the target figures are different from that of background figures, whereas in control search, both are of same class.
c. *Selective attention*: This is an attention task of PASS model. There are two types of cards in this task, one for name matching, and the other for picture matching. The score would be given according to the subjects' accuracy in matching the picture and the name.
d. *Raven's Coloured Progressive Matrices* (RCPM): This is a non-verbal reasoning task consisting of 36 matrices or designs, each having a part removed from it. The subject's task is to decide the missing part, and insert it from six possible alternatives given there. As the child is required to simultaneously evaluate and search all the alternatives to find out the correct one, Das et al. (1994) have used this test in their model (PASS) as a good measure of simultaneous processing. The scores would be given to the correct responses made by the subjects.
e. *Figure copying*: This has also been used as a measure of simultaneous processing. The task requires the subject to copy 15 geometrical figures that are visible to him or

her. Each drawing is scored as 0, 1, or 2 according to the degree of accuracy of reproduction of figures.

f. *Digit Span*: The test is similar to Wechsler Intelligence Scale for Children–Revised (WISC-R; Wechsler, 1974) "Digit Span Forward" subtest that has been used here as a successive processing task. The subject is required to recall a series of digits, keeping the order/sequence of these digits intact. Each correct score would be counted for the recall of correct digit with its respective order/position of presentation.

g. *Serial recall*: This is another successive processing task used by Das et al. in the PASS model. Here, the subject's task is to recall a series of words, with their respective position/order intact.

h. *Matching Familiar Figure Test* (MFFT-20 by Cairns & Cammock, 1978): This test measures the information processing style of the subjects such as reflective or impulsive processing style. The subject has to find out the exact figure (replica) of the target figure (given on the top) out of six alternatives. The experimenter records latency to the first response, total number of errors for each item, and the order in which these are made. The subject could get maximum five chances to select the correct answer. Number of errors and time taken would be recorded by the experimenter.

i. *Stroop Colour–Word Interference Task*: This task has been used to measure the amount of cognitive interference. The time taken by the subject to complete each task and the number of errors committed by him or her were recorded.

j. Baquer Mehdi's (1973) *Creative Thinking Test*: In this task, there are some incomplete figures, lines, and shapes, which one has to take as the base and then draw a novel and interesting picture out of his imagination and give an appropriate title to explain it.

Design

This is a quasi-experimental design having two independent variables, such as types of school and grade/class, and again having two levels such as (a) ashram/residential and formal/non-residential schools and (b) Classes 5 and 7. Thus, it is a 2 × 2 factorial design study. In the present study, 10 assessment tools/tasks were used, and in total, there were 31 dependent measures.

Procedure

All the tools and tasks were individually administered on all the subjects ($N = 80$) in the sample. The collected data were further analyzed through various statistical tests.

Data Analyses and Interpretation

The collected data were analyzed using descriptive statistical techniques such as mean (X), standard deviation (σ), *t* tests, and Pearson Product Moment correlation (*r*). In the following section, both the quantitative and qualitative interpretations are given (see Tables 1 and 2).

As the findings reveal, the ashram school children performed better in various dimensions of creative thinking test, that is, originality, elaboration, and flexibility. Ashram schoolchildren also outperformed their non-residential counterparts in almost all the information processing tasks. The developmental trend could not be clearly observed in case of creative ability, due to small sample size, but it appears that children are using better processing strategies with increasing age. Due to small sample constraint, the *t* test could not be done individually in case of all 31 dependent variables. The total scores and grand means were taken to compare the ashram and non-ashram schoolchildren on broad measures, that is, total information processing and creative measures (see Tables 3 and 4).

Table 3 shows the correlations among all the information processing and creative thinking measures (31) as found in case of Grade 5 children. Besides the interrelationships within the same group of measures such as information processing or creative thinking measures, some other significant positive correlations have been observed such as between selective attention and creativity–elaboration measures ($r = .313$*), simultaneous processing (RCPM) and creativity–originality measures ($r = .490$*** and .398***), simultaneous processing (RCPM) and creativity–flexibility measures ($r = .323$*). Table 4 presents the correlation (*r*) values as found in case of all the Grade 8 children. Here, also besides the inter-correlations among various information processing measures and creative thinking measures separately, some of the significant positive correlations are observed between arousal/attention measure and creativity–originality measure ($r = .342$* and .341*); simultaneous processing (RCPM) and creativity–originality measures ($r = .326$*, .429***, and .559***); simultaneous processing (RCPM) and creative-elaboration ($r = .350$* and .348*); simultaneous processing (RCPM) and creativity–flexibility measures ($r = .391$* and .501***); simultaneous processing (figure copying) and creativity–originality measures ($r = .530$*** and .411***); the successive processing (Digit Span) with creativity–elaboration measure ($r = .317$*); and successive processing (Serial recall) with creativity–originality ($r = .350$*) measure; Another significant factor observed here was that the planning measures were negatively correlated to creative ability measures. Thus, with regard to the relationship between information processing skills and creative abilities, the major findings are

- a. The arousal/attention dimension of information processing is found to be significantly and positively related to originality and elaboration dimensions of creative thinking,
- b. The simultaneous processing ability is significantly and positively correlated to three dimensions such as originality, elaboration, and flexibility of creative thinking, and

Table 1. Showing the Mean and Standard Deviation Values of Ashram and Non-Ashram Schoolchildren.

		Non-ashram school Class 5		Non-ashram school Class 7		Ashram school Class 5		Ashram school Class 7	
Sl. no.	Variables	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1.	Plan connection (time)	249.50	139.75	560.55	195.06	247.65	85.27	355.00	71.45
2.	Plan connection (error)	2.25	2.00	2.60	4.30	1.20	1.32	1.10	2.29
3.	Auto search (time)	21.30	9.42	36.95	6.61	17.25	6.95	29.10	7.28
4.	Control search (time)	35.05	13.10	118.40	58.40	80.25	13.57	56.85	16.44
5.	Auto/control search (error)	0.00	0.00	0.30	1.13	0.00	0.00	0.15	0.49
6.	Selective attention (time)	158.63	65.78	278.30	119.57	133.45	28.56	169.20	57.32
7.	Selective attention (score)	21.50	7.47	29.25	4.68	37.10	1.89	39.55	9.44
8.	RCPM (time)	268.35	112.64	623.75	205.32	245.65	110.14	356.70	84.21
9.	RCPM (response)	18.20	5.62	20.60	3.33	23.05	4.75	25.65	3.60
10.	Figure copying (time)	830.10	257.95	1100.2	670.02	658.95	116.21	815.60	297.47
11.	Figure copying (Score)	16.80	5.38	18.70	5.62	23.75	4.36	26.60	3.83
12.	Digit Span (score)	58.00	13.02	61.80	6.49	69.00	14.03	74.80	7.11
13.	Serial recall (score)	53.35	6.14	56.80	3.39	59.35	1.57	64.55	3.72
14.	MFFT-20 (time)	278.80	165.52	306.80	75.02	269.80	86.26	301.15	113.14
15.	MFFT-20 (error)	19.60	9.88	18.85	9.95	19.90	6.03	19.15	7.15
16.	Stroop Task (time)	94.90	30.38	121.55	26.97	86.30	21.35	99.90	18.61
17.	Stroop Task (error)	5.30	3.18	13.35	3.51	3.90	2.10	7.00	3.06
18.	Activity I: Elaboration—non-verbal	4.05	1.00	4.50	1.10	5.10	1.29	5.35	1.50
19.	Activity I: Elaboration—verbal	3.60	0.99	3.95	1.00	5.10	1.25	5.25	1.36
20.	Activity I: Originality—non-verbal	4.10	1.74	4.35	1.31	5.25	1.33	5.45	2.08
21.	Activity I: Originality—verbal	0.40	0.99	0.60	0.50	1.45	0.83	1.60	0.88
22.	Activity II: Elaboration—non-verbal	9.05	1.67	9.00	2.20	10.50	1.10	10.85	1.31
23.	Activity II: Elaboration—verbal	9.60	1.54	9.65	1.87	10.75	0.97	11.05	1.23
24.	Activity II: Originality—non-verbal	13.50	4.35	14.50	4.80	20.30	5.10	24.35	4.30
25.	Activity II: Originality—verbal	1.10	1.59	1.45	1.05	1.15	1.57	1.75	0.64
26.	Activity III: Elaboration—non-verbal	13.35	2.64	13.25	2.92	14.50	2.04	15.35	2.23
27.	Activity III: Elaboration—verbal	12.25	2.84	13.35	2.60	14.40	2.93	15.50	2.59
28.	Activity III: Originality—non-verbal	33.45	3.05	33.60	4.13	35.55	3.90	36.05	4.24
29.	Activity III: Originality—verbal	1.40	0.00	1.43	0.00	2.05	0.50	2.54	1.00
30.	Activity III: Flexibility—non-verbal	10.45	2.89	10.60	2.45	12.60	2.04	13.30	2.60
31.	Activity III: Flexibility—verbal	10.55	2.28	10.65	2.62	13.55	2.93	15.55	2.78

Note. RCPM = Raven's Coloured Progressive Matrices; MFFT = Matching Familiar Figure Test.

- c. The successive processing ability, also is found to be significantly and positively correlated to both the originality and elaboration dimensions of creative ability.

However, one more significant result is that the planning skills are negatively related to all the three, that is, originality, elaboration, and flexibility dimensions of creative ability (as evident in Table 4, $r = -.350$*,$-.361$*, $-.391$*, $-.327$*, $-.326$*, $-.347$*, $-.392$*, $-.313$*, and Table 3, $r = -.374$*, $-.351$*, $-.344$*,).

Discussion

As the findings show (both Tables 1 and 2), the ashram/residential schoolchildren performed significantly better than the formal/non-residential schoolchildren in all the information processing and creative thinking tasks. Due to small sample size in this pilot study, the researcher couldnot make a comparison among various subgroups. Hence, the *t* test was done to compare the main groups such as school types and class, where in each case, the $N = 40$. Even though there are 31 dependent variables in Table 1, the total scores and grand means were taken for *t* test to compare the ashram and formal schoolchildren on total information processing and creative measures. However, from Table 1, it is very much evident that the ashram schoolchildren's (both Classes 5 and 7) mean scores are higher in all the dimensions of information processing, that is, selective attention, simultaneous processing, successive processing, planning skills, as well as both the verbal and non-verbal dimensions of creative thinking, that is originality, elaboration, and flexibility. This implies

Table 2. Showing the *t* Values.

Variables	Between groups	*t* values
Information processing skills	Students of ashram and non-ashram schools (irrespective of grades)	6.47**
Creativity	Students of ashram and non-ashram schools (irrespective of grades)	4.48**
Creativity	Class 5 ashram school and Class 7 ashram schoolchildren	2.75***
Creativity	Class 5 formal school and Class 7 formal schoolchildren	0.68
Information processing skills	Class 5 ashram school and Class 7 ashram schoolchildren	1.97*
Information processing skills	Class 5 formal school and Class 7 formal schoolchildren	2.28*

Note. α (level of significance) at .05 level = 1.960. α (level of significance) at .01 level = 2.576.
*Significant at .05 level.
**Significant at .01 level.

that the ashram schoolchildren are fully utilizing their information processing skills and creative thinking abilities. The researcher also observed that even though both the Visva–Bharati (VB) ashram schools and WB formal schools had adopted the CCE (Continuous and Comprehensive-Evaluation) patterns, the Tagore philosophy-based VB-ashram school environments were more enriched, stimulating, natural, and stress-free in comparison to formal schools located in a more crowded semi-urban area (in Bolpur town). The teachers in both types of schools were well trained and following the guidelines of CCE pattern. However, the infrastructure and curricula followed in VB-ashram schools were more enriched and innovative, which encouraged both the ashram schoolchildren and teachers to engage themselves in various solo and group activities, which were often missing in WB formal schools. Moreover, the VB-ashram schoolteachers were more motivated to engage the children in various curricular and extra-curricular activities than their formal school counterparts, as they were taking pride in being a part of VB-ashram culture. Most of the teachers had themselves been the students of VB schools.

The researcher wants to point out here that the VB-ashram/residential school environments (2 schools) are completely different from any other residential school with respect to academic, socio-cultural, philosophical, as well as physical atmosphere. VB (residential) schools and ashram environment provide enough opportunity for freedom of thought, imagination, and creative expression. Probably, this has encouraged the spirit of creative thinking and problem-solving ability of ashram schoolchildren. Moreover, this finding could be asserted from the fact that the ashram schools (VB) have got an unique curriculum and method of teaching that incorporate various extra-curricular activities such as drawing, painting, dance, music, one-act-play, recitation, poetic sessions, discussion on current social problems, horticulture, plantation, pottery making, weaving, cloth printing, making toys, artistic pieces from papers and leaves, and so on. The children learn from naturalistic observation and by doing themselves. The teachers emphasize on self-learning and formative and qualitative evaluation. The children attend weekly programs such as "*Kabi Sabha*," "*Sahitya Charcha*," "*Darshan* Class," and so on, and their knowledge, skills, and creative thoughts are being evaluated instantly when they are actually performing it. The whole school environment (campus, curriculum, and culture) has been attuned to Rabindranath Tagore's philosophy of naturalistic education. Thus, it is observed that this "ashramic" education nourishes some basic skills and competencies among its children that develop the sensitivity in perceiving a problem, analyzing and defining it in details, eagerness to look for more information, searching for alternative solutions and unusual ideas, seeking new relationships among various components, using a reflective strategy for self-evaluation before taking the final decision, willingness to accept conflicting ideas, intuitive thinking, and so on. Possibly, these could be the reasons why ashram schoolchildren invariably performed better in all the dependent measures (i.e., information-processing skills and creative thinking abilities).

As far as the second research question is concerned, it is found that even though some developmental trend had been found in case of information-processing skills and creative abilities of ashram schoolchildren only, it could not be firmly established, due to small sample size. In this regard, few empirical studies showed that both extrinsic and intrinsic motivation can co-exist in the classroom situations (Corpus & Wormington, 2011), which can drive forward the process of creativity (Amabile & Hennessey, 2009). Often, cultural differences might influence creativity (Erez & Nouri, 2010). A recent study has also supported the view that learning environment positively affect the thinking style of children and encourage them to generate more creative ideas and activities (Alghafri & Ismail, 2014). In the present study, it is observed that the formal schoolchildren were not exposed to any such stimulating/creative environment or such tasks. However, the present researcher feels that effective curricula and pedagogy, enriched and collaborative environment, flexible, and open-ended learning can boost the thinking skills among children.

With regard to the third research question, the relationship between information processing and creative thinking abilities, it is found that (see Tables 3 and 4, Figure 1) attention and successive processing skills correlate significantly and

Table 3. Showing the *r* Values of Grade 5 (*N* = 40).

Correlations	Plan connection (time)	Plan connection (error)	Auto search (time)	Control search (time)	Auto/ control search (error)	Selective attention (time)	Selective attention (score)	RCPM (time)	RCPM (response)	Figure copying (time)	Figure copying (score)	Digit Span (score)	Serial recall (score)	MFFT-20 (time)	MFFT-20 (error)	Stroop task (time)	Stroop task (error)	Activity I: Elaboration—non-verbal	Activity I: Elaboration—verbal	Activity I: Originality—non-verbal	Activity I: Originality—verbal	Activity II: Elaboration—non-verbal	Activity II: Elaboration—verbal	Activity II: Originality—non-verbal	Activity II: Originality—verbal	Activity III: Elaboration—non-verbal	Activity III: Elaboration—verbal	Activity III: Originality—non-verbal	Activity III: Originality—verbal	Activity III: Flexibility—non-verbal	Activity III: Flexibility—verbal
Plan connection (time)	1.000																														
Plan connection (error)	.882**	1.000																													
Auto search (time)	.845**	.800**	1.000																												
Control search (time)	.770**	.776**	.749**	1.000																											
Auto/control search (error)	.450**	.512**	.375*	.593**	1.000																										
Selective attention (time)	.433**	.422**	.498**	.353*	.208	1.000																									
Selective attention (Score)	−.320	−.385	−.484	−.251	−.221	−.405	1.000																								
RCPM (time)	.644**	.653**	.760**	.681**	.209	−.495	−.354	1.000																							
RCPM (response)	−.741	−.688	−.858	−.668	−.271	−.443	.493**	−.728	1.000																						
Figure copying (time)	−.014	−.058	−.005	−.068	−.075	.449**	.008	.033	−.088	1.000																					
Figure copying (score)	.254	.224	.242	.255	.103	−.143	.124	.178	−.229	−.355	1.000																				
Digit Span (score)	−.271	−.348	−.287	−.246	−.260	−.106	.655**	−.162	.247	.224	.055	1.000																			
Serial recall (score)	−.076	−.216	−.009	−.161	−.351	−.048	.365*	.026	−.111	.239	.125	.515**	1.000																		
MFFT-20 (time)	.316*	.394**	.515**	.285	.200	.250	−.427	.303	−.360	.026	−.084	−.401	−.084	1.000																	
MFFT-20 (error)	.762**	.701**	.759**	.704**	.288	.486**	−.406	.768**	−.829	.013	.366*	−.139	.019	.165	1.000																
Stroop Task (time)	.261	.180	.326*	.159	.044	.568**	−.321	.446**	−.409	.259	−.103	−.087	.000	.000	.404**	1.000															
Stroop Task (error)	.723**	.632**	.68**	.645**	.250	.493**	−.402	.724**	−.682	.216	.016	−.195	−.109	.051	.666**	.640**	1.000														
Activity I: Elaboration—non-verbal	−.008	.074	−.042	.049	.308*	−.271	.139	.150	.046	−.243	.102	−.176	−.124	.123	−.164	−.276	−.296	1.000													
Activity I: Elaboration—verbal	−.113	−.065	−.130	−.219	−.082	−.343	.094	−.246	.106	−.136	−.185	−.192	−.106	.209	−.285	−.293	.370*	.724**	1.000												
Activity I: Originality—non-verbal	−.374	−.290	−.520	−.307	.013	−.027	.189	−.276	.490**	−.086	−.328	.085	−.166	−.302	−.414	.013	−.260	.155	.016	1.000											
Activity I: Originality—verbal	−.240	−.222	−.195	−.312	−.186	−.338	−.020	−.217	.279	−.265	−.122	−.209	−.038	.192	−.284	−.254	−.393	.388*	.562**	.139	1.000										
Activity II: Elaboration—non-verbal	.000	.074	.043	−.127	−.031	.002	.084	.012	−.004	−.027	.076	.033	.094	.076	−.026	.247	−.009	−.270	.190	.099	.142	1.000									
Activity II: Elaboration—verbal	.055	.120	.101	−.190	−.109	.124	.125	−.133	.008	.094	−.104	.007	.195	.095	−.098	−.061	.110	.150	.236	−.021	.123	.509**	1.000								
Activity II: Originality—non-verbal	−.189	−.033	−.189	−.161	.042	−.077	.121	−.114	.060	.069	.094	.063	.052	−.091	−.136	.100	−.103	.394**	.250	.230	.152	.600**	.237	1.000							
Activity II: Originality—verbal	−.105	−.038	−.156	−.268	−.109	.052	.040	−.202	.113	.089	−.178	.087	.082	.134	−.229	.208	−.093	−.035	.099	.066	.002	.435**	.262	.334*	1.000						
Activity III Elaboration—non-verbal	−.300	−.269	−.269	−.344	−.100	−.238	.313*	−.203	.234	.070	−.235	.076	.009	−.200	−.300	−.097	−.259	.291	.416**	.086	.239	.379*	.493**	.278	.062	1.000					
Activity III: Elaboration—verbal	.040	−.010	.112	−.008	−.102	−.038	.303	.116	.097	.124	−.029	.242	.153	−.014	−.078	−.151	.050	.176	.281	−.150	−.048	.168	.243	−.170	−.196	.431**	1.000				
Activity III: Originality—non-verbal	−.044	.046	.070	−.041	.177	.013	.205	−.060	.149	.004	.116	.136	.037	.007	−.035	.011	−.160	.251	.201	.040	.016	.298	.312	.374*	.004	.197	.034	1.000			
Activity II: Originality—verbal	−.504	−.446	−.541	−.437	−.110	−.377	.263	−.468	.398	−.079	−.312	.054	.029	−.088	−.472	−.369	−.595	.416**	.471**	.170	.312	.062	.093	.171	.188	.378*	−.072	.171	1.000		
Activity III: Flexibility—non-verbal	−.175	−.165	−.083	−.192	−.015	−.283	−.062	−.151	.095	−.055	−.062	−.274	−.109	.107	−.199	−.124	−.168	.263	.368*	−.153	.138	.318*	.275	.119	.075	.267	.217	.097	.205	1.000	
Activity III: Flexibility—verbal	−.351	.307*	−.293	−.339	−.056	−.398	.131	−.287	.323*	−.100	−.114	.074	−.105	−.008	.300	−.275	−.417	.396**	.453**	−.080	.195	.321	.033	.110	.035	.369*	.429**	.216	.474**	.678**	1.000
N	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Note. *r* = correlation. Table value of *r* at α .01 = .393 and α at .05 = .304. *df* = 38. RCPM = Raven's Coloured Progressive Matrices; MFFT = Matching Familiar Figure Test.
*Significant at .05 level. **Significant at .01 level.

Table 4. Showing the '*r*' Values of Grade 8 (*N* = 40).

Correlations	Plan connection (time)	Plan connection (error)	Auto search (time)	Control search (time)	Auto/ control search (error)	Selective attention (time)	Selective attention (score)	RCPM (time)	RCPM (response)	Figure copying (time)	Figure copying (score)	Digit Span (score)	Serial recall (score)	MFFT-20 (time)	MFFT-20 (error)	Stroop task (time)	Stroop Task (error)	Activity I: Elaboration—non-verbal	Activity I: Elaboration—verbal	Activity I: Originality—non-verbal	Activity I: Originality—verbal	Activity II: Elaboration—non-verbal	Activity II: Elaboration—verbal	Activity II: Originality—non-verbal	Activity II: Originality—verbal	Activity III: Elaboration—non-verbal	Activity III: Elaboration—verbal	Activity III: Originality—non-verbal	Activity III: Originality—verbal	Activity III: Flexibility—non-verbal	Activity III: Flexibility—verbal
Plan connection (time)	1.000																														
Plan connection (error)	.239	1.000																													
Auto search (time)	.606**	.369**	1.000																												
Control search (time)	.553**	.438**	.749**	1.000																											
Auto/control search (error)	.029	.343*	.083	.257	1.000																										
Selective attention (time)	.666**	.188	.398**	.459**	−.084	1.000																									
Selective attention (score)	−.325	−.573	−.249	−.269	−.151	−.397	1.000																								
RCPM (time)	.546**	.359*	.679**	.764**	−.062	−.477	−.221	1.000																							
RCPM (response)	−.474	−.672	−.658	−.656	−.289	−.182	.441**	−.629	1.000																						
Figure copying (time)	.269	.335*	.232	.282	−.055	.143	−.182	.187	−.289	1.000																					
Figure copying (score)	−.062	−.538	−.230	−.345	−.160	.050	.140	−.246	.366*	−.477	1.000																				
Digit Span (score)	−.326	−.286	−.092	−.146	−.129	−.320	.328*	−.071	.236	−.374	.164	1.000																			
Serial recall (score)	−.222	−.436	−.158	−.245	−.157	−.208	.530**	−.115	.236	−.317	.282	.267	1.000																		
MFFT-20 (time)	.215	−.160	.141	.185	−.138	.149	.147	.315*	.033	.055	−.106	.092	.245	1.000																	
MFFT-20 (error)	.382*	.559**	.687**	.615**	.396**	.179	−.501	.368*	−.755	.094	−.197	−.181	−.243	−.167	1.000																
Stroop Task (time)	.449**	−.036	.389*	.312*	.097	.319*	−.104	.231	−.185	−.123	.128	.014	−.177	.174	.348*	1.000															
Stroop Task (error)	.264	−.500	.371*	.407**	.137	.163	−.209	.148	−.469	.048	−.350	−.033	−.235	−.233	.554**	.051	1.000														
Activity I: Elaboration—non-verbal	−.323	−.204	−.242	−.285	−.265	−.286	.043	−.248	.297	−.228	.164	.317*	.230	.175	−.239	−.057	−.231	1.000													
Activity I: Elaboration—Verbal	−.187	.050	−.120	−.093	−.183	−.134	−.154	−.148	.181	−.079	−.112	.068	−.056	.186	−.073	.094	−.042	.706**	1.000												
Activity I: Originality—non-verbal	−.269	−.283	−.327	−.231	−.004	−.325	.223	−.310	.326*	.061	.146	.062	.350	.063	−.113	−.232	−.189	.293	.087	1.000											
Activity I: Originality—verbal	−.262	−.226	−.326	−.392	−.238	−.305	.342*	−.302	.429**	−.031	.119	.293	.307*	.329*	−.342	−.202	−.272	.572**	.398**	.527**	1.000										
Activity II: Elaboration—non-verbal	−.307	−.303	−.187	−.265	−.268	−.277	.334*	−.183	.350*	−.205	.170	.005	.111	−.244	−.295	−.179	−.186	.028	.104	.138	.106	1.000									
Activity II: Elaboration—verbal	−.350	−.306	−.197	−.313	−.204	−.188	.262	−.278	.348*	−.234	.272	−.001	.209	−.362	−.217	−.186	−.031	−.009	.014	.182	−.009	.814**	1.000							
Activity II: Originality—non-verbal	−.170	−.487	−.417	−.413	−.211	−.002	.341*	−.380	.559**	−.322	.530**	.131	.253	−.184	−.457	−.086	−.276	.096	.169	−.028	.096	.358*	.365*	1.000							
Activity II: Originality—verbal	−.234	−.251	−.055	−.181	−.122	−.243	.212	−.168	.178	−.181	.103	.016	−.025	−.090	−.022	.144	−.118	.109	.124	.071	.156	.345*	.349*	.182	1.000						
Activity III: Elaboration—non-verbal	−.259	−.254	−.266	−.242	.008	−.149	.133	−.230	.253	−.141	.195	.023	.152	.088	−.243	−.045	−.451	.132	.029	.285	.285	.213	.165	.104	.399**	1.000					
Activity III: Elaboration—verbal	−.075	−.133	−.143	−.175	.084	−.137	.169	.260	.122	.017	.171	.001	.078	.016	−.102	.032	−.279	.081	−.093	.273	.275	.063	.095	.043	.267	.801**	1.000				
Activity III: Originality—non-verbal	.065	−.148	−.172	−.110	.208	.220	.109	−.084	.206	−.454	.411**	−.062	.205	.006	−.185	−.021	−.073	−.010	−.255	−.005	−.138	−.084	.028	.301	−.250	−.056	.013	1.000			
Activity II: Originality—verbal	−.140	−.167	−.004	−.099	−.130	−.181	.207	−.202	.270	−.021	−.231	−.014	−.099	.052	−.171	.082	−.135	.171	.101	.143	.335*	.262	.197	−.127	.500**	.441**	.464**	−.08	1.000		
Activity III: Flexibility—non-verbal	−.166	−.361	−.347	−.161	.104	−.168	.188	−.165	.391	−.281	.196	.031	.120	−.012	−.229	.059	−.525	.048	−.087	.298	.163	.239	−.028	.301	.176	.365*	.222	.261	.273	1.000	
Activity III: Flexibility—verbal	−.251	−.391	−.429	−.231	−.201	−.201	.242	−.307	.501**	−.239	.091	.019	.098	.028	−.344	−.002	−.547	.053	−.088	.298	.236	.250	.050	.253	.238	.473**	.357*	.257	.492**	.928**	1.000
N	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Note. *r* = correlation. Table value of *r* at α .01 = .393 and α at .05 = .304. *df* = 38. RCPM = Raven's Coloured Progressive Matrices; MFFT = Matching Familiar Figure Test.
*Significant at .05 level. **Significant at .01 level.

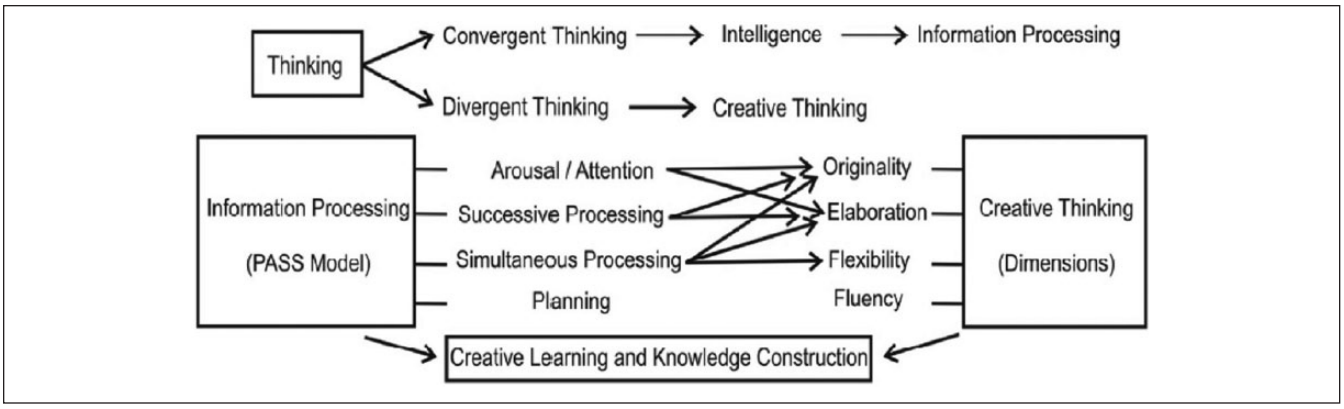

Figure 1. Relationship between information processing and creative thinking.
Note. PASS = Planning, Attention, Simultaneous, Successive.

positively with the originality and elaboration dimensions of creative thinking; simultaneous processing skill is found to correlate significantly and positively with all the three major dimensions of creative ability, that is, originality, elaboration, and flexibility. Thus, it implies that the effective use of attention, successive, and simultaneous processing strategies help the children in perceiving, analyzing, and synthesizing the information in a more creative manner that boost their original ideas, innovative thoughts, and could bring better flexibility, variety, elaboration, and clarity in creative thinking process.

So far as the relationship of creativity with other cognitive processes is concerned, a recent study by Anwar et al. (2012) revealed that at school level, high achievers are not significantly different from low achievers in terms of creative thinking abilities. In this study, the creative abilities of secondary schoolchildren did not correlate with their achievement scores. Hence, the relationship between creativity and academic intelligence has again become debatable. However, these researchers found the gender and urban locations to be the significant influencing factors in children's creative thinking abilities. Another study has also confirmed that school contexts and classroom environment influence the creative abilities of children, and for understanding the pattern of relationship between children's motivation and creative abilities, we need to study different types of schools and its learning environment (Amin & Regander, 2011). From these findings, we can assume that creative thinking is a significant component of (human) higher-order thinking process, and in case of children, it remains in a very primitive, fluid form; it requires a combination of other ingredients such as right environment, skills, personality attributes, as well as nourishment/training for getting manifested into a more crystallized form of creative product/outcome. Hence, for drawing a conclusion, more number of empirical research studies are required in creativity training and applications field. The classroom instructions designed to promote creative thinking can also increase the probability of academic success among the low achievers. The current-age researchers have also advocated for teaching the thinking skills to primary-level schoolchildren and that strategic teaching, critical, and creative thinking should be well integrated in the school curriculum (Alghafri & Ismail, 2014). Here, Sternberg's theory of successful intelligence can be taken as a reference point where it has been elaborately discussed how intelligence can be successfully utilized for creativity and every individual should strive to acquire/develop the creative intelligence.

Conclusion and Future Work

Thus, from this pilot study (with a small sample size), the researcher could assume that the information-processing skills such as attention, successive and simultaneous processing are the pre-requisites for conceptualizing the original idea, elaborating it, using it more flexibly for different purposes, and working on the different dimensions of creative thinking, which resemble divergent thinking. However, when the individual would actually proceed toward creative act or manifestation of this creative thoughts/potentials, he has to converge his ideas into one selected topic/plan/blue print; thus, ultimately, both intelligence and creativity or divergent and convergent thinking merge into one point, venturing toward creative product/innovative practices/creative intelligence, the ultimate goal of smart learning and higher cognition. Moreover, educational experts have also recommended for a holistic approach called "manifold thinking," based on the proper integration of creative, critical, reflective, and caring thinking (Valtanen, Berki, Kampylis, & Thedorakopoulou, 2008). The school education should be a platform of know-what, know-how, and know-why to foster students' creative thinking in a constructive environment (with multi sensory and collaborative learning experiences).

So far as the validity of this research findings are concerned, the researcher wants to clarify its limitations due to which it cannot be generalized. It was just a small attempt to satisfy the intellectual curiosity. Even though the topic is very interesting, there is a dearth of empirical studies in this direction.

The findings of the present study could not be generalized because of small sample size, and one single state (West Bengal) from which the sample has been drawn. To get a better picture of the pattern of relationship among various information processing and creative thinking abilities, more number of empirical works are needed. Similarly, more number of ashram/residential schools should be studied to find out the right inputs for creative learning environments. Even though our curricula advocates for encouraging critical and creative thinking among children, in reality, whether our formal schools do seriously care about this or not, should also be investigated. However, till today, VB-ashram school has been the ideal learning environment for creative thinking, but how the other residential, that is, the mushrooming international schools are different from these should also be studied.

Implications

From the above discussion, it can be suggested that to stimulate the creative thinking and enhance the information-processing skills among our children, we need to introduce certain reforms in our school education system, such as (a) curriculum to be based on problem-solving approach, (b) emphasis to be given on using effective processing strategies during learning, (c) to encourage self-learning and problem-based learning, (d) creating avenues for innovative ideas and original contributions, (e) flexibility and openness in teaching–learning process and pedagogy, (f) adopting brainstorming technique in the instructional process to encourage creative thoughts, and (g) encouraging the use of metacognitive strategies for self-evaluation and knowledge construction. Prominent researchers and educationists have already recommended for creativity-fostering strategies at primary education level, which are equally oriented toward conducive environment (CE), creative process (CP), and creative student (CS; Kampylis, Saariluoma, & Berki, 2011).

At the end of this discussion, researcher wants to conclude that the educator must design the instruction, prepare specific curriculum, and create a stimulating and flexible learning environment, where children's thinking styles will be promoted through better communication, interaction, collaboration, and hands-on activities, which would foster all kinds of cognitive-processing abilities.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research and/or authorship of this article.

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