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Influence of psychological variables on divergent thinking in adolescents: A cross-sectional study

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Abstract

Divergent thinking (DT) is a thought process wherein many original ideas are conceptualized and unique suggestions are proffered to identify the best possible solution to a problem; it is an important component of creativity. The present study endeavors to examine the level of DT in school students and the primary factors influencing DT with the help of assessment tests such as Standard Progressive Matrices (SPM), the Emotional Intelligence Scale (EIS test), and Sharma's Divergent Production Abilities Test (DPA). A cross-sectional study is done using quantitative methodology and probability sampling techniques. The participants of the study are [n = 192 (boys = 106, girls = 86)] school students in the age range of 11–14 years, and the study area is Tiruppur district in Tamil Nadu. Results indicate that DT and EI are negatively correlated with each other, and there is no relationship between DT and intelligence quotient (IQ). Gender differences in DT are identified, with males scoring higher than females on assessment tests. There is no significant difference between the influences of demographic factors like geographical area, economic status, age, birth order, and hand preference on DT. The study's major conclusion about education is that students at CBSE schools do better than those at private and government-run schools. The performance of government school students is rather poor when compared to CBSE and private schools. This indicates that government school students require proper training, timely assistance, and innovative teaching methods, which lead to the enhancement of DT and creativity.

Keywords: Adolescents, Boards of education, Creativity, Divergent thinking, Emotional intelligence, Intelligence, Schools, Students.

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1. Introduction

Guilford [1] was the one who first introduced the concept of DT. It is considered an essential part of creative thinking and is fundamental to the development of higher-order thinking skills [2]. DT is known as thinking outside the box because

it helps produce unique ideas and generate many unconventional solutions to problems. This creative process may not always lead directly to the optimal solution, but it significantly boosts the probability of discovering novel solutions by enabling many possibilities. Although people who suggest generating and exploring new ideas may have exciting perspectives to creatively meet a challenge, this does not guarantee they will be innovative in their day-to-day activities or capable of always generating fresh alternatives and unconventional solutions to problems [3]. Researchers have expressed a lot of interest in DT because it provides a great deal of information about the transformation of original ideas into creative processes and innovative products [3]. Creativity is measured through divergent and convergent thinking, which have different cognitive processes. Even though DT is a crucial factor in creativity, it is not synonymous with creativity [4]. It can help in developing the potential for creative problem-solving [5]. In research studies examining capacity for creativity, originality, and innovative thinking ability, DT tests are probably the most popular method of assessing the creative potential of the participants [6]. Therefore, it is an essential part of obtaining better educational outcomes after an assessment of creative potential and helps boost academic performance by promoting creativity in the classroom. Four fundamental components of these DT tests are: fluency (generating more ideas), flexibility (producing ideas in numerous categories), originality (offering unique ideas), and elaboration (suggesting abstract ideas). Divergent thinking tests aim to generate alternative uses for common objects and familiar things in real-life situations. The essential ability and capacity to think creatively and solve problems by exploring many novel ideas and unique solutions are estimated by divergent thinking test scores [7]. In DT tests, individuals may exhibit a high degree of originality and creativity in their responses to various activities. For instance, when presented with the target item "brick," a participant who lacks prior knowledge or exposure to this common object may generate a multitude of imaginative and innovative alternative uses for it. Divergent assessments exhibit a stronger correlation with practical manifestation of creative behaviors, such as securing patents, authoring novels, composing plays, and founding start-ups or professional organizations [8].

In all realms of a person's life, from the personal and professional to the social and cultural, the ability to think creatively is a valuable skill that can be hugely rewarding [9]. Divergent thinking techniques are used in educational and organizational settings to boost innovation and ingenuity through the generation of multiple creative ideas [3]. The traditional Indian education system primarily focuses on rote learning and encourages committing information to memory; these fall under conventional convergent thinking (CT) and not DT, which conversely actively encourages inquiry, exploration of cause and effect, experimentation, and practical application for obtaining many viable answers to a challenging problem [10]. CT focuses on logically determining the correct solution to the problem, often a single and familiar one, in a standardized and stereotypical manner.

DT is considered an essential skill as it enables students to adopt novel approaches to existing issues and offer creative solutions to specific challenges [11]. With the growing awareness of the significant contribution of DT to creative thought processes and problem-solving in today's modern era, which requires quick action for speedy resolution of challenges, researchers give more importance to brainstorming and identifying and selecting alternative solutions with DT, and many insightful research articles have been published in the field of DT. Research suggests that the natural capacity for divergent thinking is at its peak during childhood, and young children have a high creative potential for DT with the natural ability to view many perspectives, explore varying alternatives, infuse fresh thoughts, and generate creative ideas to address challenges during most stages of their childhood [12]. According to previous research, instructors may have opportunities to foster and promote diverse thinking abilities and creative ideation in students beyond childhood by using supplementary digital tools such as tablets and other electronic gadgets in the search for potential solutions to the problems and challenges of the modern age [13].

The current educational system is rather conventional, inflexible, outdated, highly regulated, and does not prepare students to meet tomorrow's challenges or equip them with essential work skills and competencies in preparation for the workforce of the future. Wagner claimed, "The students who are most likely to succeed in the future are not the ones who merely know how to perform well in today's educational system — they acquire good grades and test scores and earn degrees. Real competencies will be significantly more important than academic certificates for success in the contemporary world". Developing the ability to think critically and creatively, communicate effectively and efficiently in a straightforward manner, and solve problems after exploring all possible solution pathways are all essential life skills that the educational system should help young people acquire. Youngsters must focus on continual growth and improvement after they have identified their interests, discovered their passion, and found their purpose in life [14]. The skills and talents of the current generation of students can only be nurtured through the adoption of a growth mindset in a classroom that focuses on experiential learning through questioning and encourages free and frank intellectual discussions. It is the responsibility of educators and concerned stakeholders to inculcate in students the values of hard work, determination, persistence, resilience, and the humility to confess ignorance, as well as the understanding that not every question has a correct response and that some may never have one. The presence of demanding syllabus and a highly structured curriculum pose significant obstacles, as educators' face constraints in adequately addressing all content within the designated time frame. The lack of time results in experience of stress due to excessive work demands and the lack of creative thinking. The free expression of innate creativity in students should be actively encouraged so they can be better prepared to tackle issues that will arise in the course of their careers in the future. By fostering the critical skill of creativity, students gain the ability and self-sufficiency to resolve problems using their imagination and ingenuity. DT, or the capacity to think imaginatively and explore new possibilities, is perceived as one of the indispensable skills of the twenty-first century that students need to master to succeed in an increasingly digital world and keep pace with rapid technological advancements [15].

Intelligence, as a desired trait, has been studied for more than a century as a significant predictor of educational and professional success [16]. Creativity and intelligence are two closely related essential traits of ability that explain why some people are more likely than others to come up with new ideas or easy answers to challenges, problems, tasks, or difficult situations [17]. While intelligence aids people in solving issues logically, creativity enables people to think about things in fresh, innovative ways and promotes the growth and development of society through the translation of revolutionary ideas into reality. In the past 60 years, academic research has focused far more on intelligence than creativity [18]. However, the interconnectedness of creativity and intelligence continues to remain unclear [19]. A good understanding of one's own mental framework and discernment of the feelings and emotions of others helps establish successful communication channels with people. This ability is known as emotional intelligence. In other words, it is a collection of knowledge and social and emotional skills that influence the capacity of a person to respond to environmental needs. Suliman and Al-Shaikh [20]. Wolfradt, et al. [21] discovered a favorable relationship between creative performance and a person's impression of creativity. Based on their study, Murphy and Janeke [22] reported a positive relationship between creative performance and EI. Thus, people with higher EI may favor more complicated and original thought processes.

By consciously honing their divergent thinking skills, students can generate fresh ideas, gain new insights, offer creative output, and solve complex problems with ease. They must therefore focus their efforts on improving their mental abilities by learning and expanding their intellectual capacity. Teachers play a crucial and indispensable role as mentors in fostering and promoting divergent thinking in students, helping them to find feasible solutions to their difficulties by first obtaining a holistic understanding of the issue at hand. Moreover, the process of divergent thinking stimulates neural activity in the brain, facilitating the formation of nerve cell. Consequently, this enhances the individual's capacity to discern the interconnections among diverse concepts and generate appropriate solutions to carefully analyzed problems. By stimulating the thought process of students, they are encouraged and urged to tap the reservoir of creative potential latent in each of them.

It is indeed a truism that students need to be taught not only "what to think but also how to think" if they are to be performers and achievers. In keeping with the innumerable demands of the current century, students need to possess the ability to think in many different ways. It is essential for them to be genuinely interested in learning as much as possible about the world around them, seeking answers without fear of making mistakes. In this study, an attempt is made to examine how IQ and EI influence DT. Such studies have immense relevance as they are crucial in gaining insights into enabling the holistic education and empowerment of students, who must gain the confidence to apply their talents, skills, and abilities to make new discoveries, conduct path-breaking research studies, efficiently solve problems that they encounter, and possess the capacity to have a broad understanding of all aspects of any challenge.

2. Methodology

2.1. Study Design

The present study is based on a survey of 192 students, aged between 11 and 14, pursuing their studies in various boards of education in schools located in the Tiruppur district of the South Indian state of Tamil Nadu. A simple random sampling design is adopted in this study, and the selection of students is based on the lottery method with replacement (students have equal opportunity to participate in the study irrespective of their previous selection). Inferential and descriptive statistical techniques are deployed to analyze the data in SPSS 26 (Statistical Package for Social Sciences).

2.2. Procedure

The researcher presents a brief outline of the scope and nature of the study before collecting the data from the selected students. All the participants have the liberty to freely voice their doubts and solicit answers to their queries at any point during the period of the research study. On being approached, the researcher has a duty to provide satisfactory answers to the students. From the group of students who evince interest in being part of the study, a random selection is made based on the lottery method. Later, the researcher explains the procedures to be followed for filling out the informed consent form, questionnaire, and response sheet. After obtaining the informed consent of the respondents, the data collection procedure is initiated. The questionnaires have no time limit except for the divergent production ability test, and there are no rights or wrong answers. Participants can choose their responses based on their opinions, and it is requested that they do not omit any statements. The researcher assures them that absolute confidentiality of their personal information will be maintained and that the study will be used only for academic and publication purposes.

2.3. Tools and Measures

IQ is measured by standard progressive matrices containing SETS-A, B, C, D, and E; each set contains 12 pictures and totals 60 pictures with options 1 to 6 and 8 [23]. The Emotional Intelligence Scale is used to measure students' EQ levels. It has 31 statements measuring aspects such as understanding emotions, understanding motivation, empathy, and handling emotions. It follows a yes-or-no type of questionnaire pattern [24]. Sharma's Divergent Production Abilities Test (DPA) is utilized in the study to identify the level of DT. This test measures DT on the basis of fluency, flexibility, originality, and elaboration. It has six parts: word production, uses of things, similarities, sentence construction, titles, and solutions. Fluency is measured by the number of ideas generated, and flexibility is measured by the number of categories produced in the list. Originality is scored based on unusual ideas generated by the 'If' response, wherein the responses that fall under 1% receive 5 marks, 2% of responses are given 3 marks, 3% of the responses are allotted 2 marks, 4% of the responses are assigned 1 mark, and 5% of the responses are given zero marks. Elaboration is measured by assessing the detailed answers provided. Finally, all the scores are added to obtain the total scores of all the students [25]. In addition, demographic details

like age, gender, geographical area, economic status, etc. are also collected from students and analyzed using Excel tools and Statistical Package for the Social Sciences (SPSS) software (26).

3. Results

The study focuses on exploring the factors influencing divergent thinking among school students belonging to various schools following different educational boards like the government-run State Board and the Central Board of Secondary Education (CBSE). The primary focus of this study is to analyze the impact of emotional intelligence, intelligence, and demographic characteristics on divergent thinking.

Table 1.
Depicts the demographic details of the respondents.

Characteristics	N= 192 total (%)
Gender	
Male	106 (55.2%)
Female	86 (44.8%)
Standard	
7 th	152 (79.2%)
8 th	40 (20.8%)
Age	
11-12 years	106(55.2%)
13-14 years	86 (44.8%)
Board of the school	
CBSE	73 (38%)
Matriculation	55 (28.6%)
State government	64 (33.3%)
Economic status	
Low	45 (23.4%)
Middle	130(67.7%)
High	17 (8.9%)
Birth-order	
First	90 (46.9%)
Second	90 (46.9%)
Third	10 (5.2%)
Fourth	2 (1%)
Handedness	
Right hand	177 (92.2%)
Left hand	15 (9.3%)
Geographical area	
Urban	49 (25.5%)
Semi-Urban	93 (48.4%)
Rural	50 (26%)

According to the data presented in [Table 1](#), it is observed that there is high proportion of male students in the 7th grade and the age group of 11-12 years, as compared to the 8th grade and the age group of 13-14 years. Additionally, the number of female students is comparatively lower in the aforementioned grade and age groups. There are fewer respondents from government-run state boards and matriculation boards than CBSE board schools. The majority of the students are first and second born with regard to their birth order and are predominately from middle-class economic backgrounds, as compared to the third and fourth born and those of higher and lower economic status. Most of the students' hail from semi-urban areas rather than urban or rural areas.

The analysis is conducted to determine the relationship between divergent thinking, emotional intelligence, and intelligence using Karl Pearson's coefficient of correlation. Based on the correlation scores, the relationship is classified as strong, moderate, and weak.

Table 2.
Relationship between divergent thinking, intelligence, and emotional intelligence.

Variables	DT	IQ	EI
Divergent thinking (DT)	1	0.013	0.202**
Intelligence quotient (IQ)	0.013	1	0.038
Emotional intelligence (EI)	-0.202**	0.038	1

Note: ** Significant at the level of 0.01.

The above [Table 2](#) shows that there is a weak, negative correlation between DT and EI at a level of 0.01. It indicates that even though DT increases, it is not necessary that EQ decrease.

The study also examines the mean difference to understand the role of gender in divergent thinking and variations in emotional intelligence due to gender differences.

Table 3.
Independent t-test for gender and standard difference across divergent thinking and emotional intelligence.

Demographic variables	Variables	Categories	N	Mean	Std. deviation	T	Df	Sig. (2-tailed)	Mean difference
Gender	Divergent thinking	Male	106	87.27	19.343	2.527	176.280	0.012	7.378
		Female	86	79.90	20.732				
Standard	Emotional intelligence	7 th	152	22.74	3.635	3.532	62.344	0.001	2.237
		8 th	40	20.50	3.545				

From Table 3, it is inferred that there is a difference in DT between genders (male and female), and DT is significant at the 95% confidence level. It is evident that male students have more divergent thinking than female students. Also, it is seen that there is a significant difference in the EQ between standards of education in the 7th and 8th grades at a 99% confidence level. The students in 7th grade have higher levels of divergent thinking than 8th grade students.

The analysis of variance (ANOVA) statistical analysis tool is used to compare the variations in divergent thinking across school educational boards, the economic status of participants, and geographic location. Thereupon, it is found that there are no significant mean differences between divergent thinking, economic status, and geographic location.

Table 4 shows the post-hoc results of the difference between divergent thinking and school educational boards such as government-aided state boards, government-unaided state boards, and CBSE schools.

Table 4.
post-hoc results of divergent thinking in schools.

Categories		Sum of squares	Df	Mean square	F	Sig.	Boards of education		Mean difference	Std. error	Sig.
School	B/G	16368.300	2	8184.150	24.933	0.000	CBSE	Matric	-9.559	3.557	0.025*
	W/G	62039.512	189	328.251			CBSE	Govt.	-21.897	2.779	0.000*
	Total	78407.813	191	8512.401			Matric	Govt.	-12.337	3.568	0.002*

Note: B/G – Between groups; W/G – Within groups.
0.025 significant at the level of 0.05.
0.000 & 0.002 significant level of 0.01.

From Table 4, post-hoc results show that there exist a significant mean difference between educational boards of schools and divergent thinking. The mean difference between CBSE and Matriculation, CBSE and State Board Government and Matriculation and State Board Government schools is studied. It is observed that CBSE and government-run state board schools have significant variation in divergent thinking at the level of a 100% confidence interval.

4. Discussion

DT is an essential skill and a valuable asset for everyone, especially students, because it is a creative thought process that boosts productivity by offering many new perspectives. Students must be encouraged to examine a challenge from all angles, fully understand it, and solve the problem after assessing the benefits and drawbacks of many ideas, possibilities, and solutions [26]. This study tries to identify the level of DT among school students who are pursuing their education on different boards. Most of the students (n = 47) fall into the average level of DT (24.3%), while the remaining number of students are seen to perform above the average level (n = 45, 24.3%). Only a few differences are identified among below-average performers (n = 42, 21.8%). Extremely high performers are from CBSE (n = 7, 3.6%), and extremely low performers are from state board government schools (n = 12, 6.2%), while the remaining low performers are from all boards of education (n = 14, 7.3%). Acar and Runco [27] explained that a person who is willing to try new things is more likely to be open to different ideas. Runco and Albert [28] revealed that DT and independence are connected, meaning that people who prefer to be independent of rigid social norms and socially accepted behavior are more likely to come up with innovative ideas as they tend to disregard stereotypical thinking and look at problems from various perspectives. Decreed school rules and norms, available infrastructural facilities, and participatory activities are some factors of the education system that influence the DT of students. Despite ample facilities for scholastic, co-curricular, and extracurricular activities, CBSE schools provide limited independence to students and generally adhere to a formal learning structure.

On the contrary, government-run schools with fewer infrastructural facilities often provide more freedom to students, allowing them to pursue activities that interest them. Therefore, it is not only school infrastructure and environment that play a significant role in the overall development of children; the freedom, encouragement, and promotion of independent, creative, and critical thinking without stifling restrictions prepare students to confidently and intelligently tackle any situation that crops up in the unknown future. More independence with limited access to infrastructural facilities at school and less independence with ample educational facilities are both deterrents to experiencing the full potential of DT. Individual differences like attention span, learning style, attitude, memory, and interest play a predominant role in critical and creative thinking abilities.

Table 2 shows that there is a negative relationship between DT and EQ. It indicates that an increase in DT does not necessarily decrease EQ, but they do have a significant influence on each other. An earlier study reported similar results

that showed emotional intelligence had no real effect on the DT ability of eighth-grade students [18]. In contrast, Geher, et al. [29] found that EQ positively predicts creativity and the possession of many favorable traits. In the current study, there is no significant difference between geographical area and EQ, which implies that the living environment does not influence the level of EQ. However, in an earlier study conducted by Kar, et al. [30], it was concluded that there was no significant difference in the EQ between males and females, but disparities were apparent between the EQs of rural and urban students. In the present study, it is revealed that urban students are better at managing their emotions and are more assertive than rural students. It is seen that 7th grade students score higher than 8th grade students in the EQ assessment tests. So, it indicates that 7th grade students are better at recognizing, understanding, and managing their emotions than 8th grade students. The capacity to postpone fulfillment is a good indicator of emotional intelligence. Resilience is recognized as the foundation of emotional intelligence and is an essential skill to possess, as it enables a person to handle and cope with difficult situations more easily by managing his or her feelings and reactions. Being a sign of emotional intelligence, it does not appear in an IQ test, despite the fact that it is a factor in general intelligence. From the study, it is observed that EQ and IQ have no relationship with each other.

Most of the earlier research studies found that EQ is more important than IQ, but the fact is that they are both related to each other. EQ and IQ intersect with each other, but the point of overlap is not known. On the contrary, there are missing links, such as some people with a high IQ having a low EQ and vice versa. Thus, it can be surmised that a person with optimal levels of both IQ and EQ will be comparatively more successful, as they will perform better at the workplace, enjoy career success, forge good personal relationships, establish positive professional relationships with clients and customers, and make better use of available opportunities. In actuality, the search for their meeting points remains a mirage, as both emotional intelligence and general intelligence appear to have imperceptible meeting points [31, 32].

From Table 3, it is inferred that male students have a higher DT than female students. Runco, et al. [6]; Simonton [33], and Simonton [34] studies also supported this finding. Abdulla Alabbasi, et al. [35] also revealed that there was a distinct gender divide and that more men than women were responsible for the majority of useful modern-day inventions and innovations, such as the telephone, mobile phones, jet engines, etc. Although women had high scores in DT tests and possessed creative potential, in terms of creative achievement and creative performance, there were gender differences in their creative abilities, and males performed better. The poor performance of women was attributed to reasons like a lack of time, opportunities, and recognition. In contrast, literature reviews and surveys of various studies reveal that about nine studies supported the gender differences, and six studies showed that females obtained a higher DT score than males [36]. Interestingly, studying the mean value of DT, Runco and Acar [15] found that (N = 80 studies) there were no significant differences among males and females. However, most of the studies showed that females obtained high scores in DT, while males performed well in creative tasks [35].

Emotional intelligence is an invaluable personal and interpersonal skill; it is defined as the ability to solve problems by using one's thoughts, feelings, and intuition. This involves the ability to influence one's own and others' thinking and actions based on recognition and knowledge of one's own and others' emotions [37-39]. Comprehending the psychological and cognitive conditions of individuals constitutes an essential element of emotional intelligence. EQ facilitates individuals in comprehending and effectively regulating their own emotions, as well as the emotions of others, in a constructive manner, thereby enhancing their level of self-awareness.

CBSE school students performed better on DT assessment tests compared to matriculation and government-run state board school students. Microenvironments like home, school, and work are the most influential factors for DT, especially schools when considering students [40]. For example, new pedagogical methods like Montessori and Freinet lead to higher levels of creativity and innovation than traditional educational philosophy and conventional instructional approaches [41, 42]. Based on their review article (n = 200), Davies, et al. [43] highlighted that the school environment could either foster or suppress the creative abilities of pupils as well as their capacity to consider many possibilities, explore options, and weigh solutions for problem-solving by ignoring constraints and limitations. Influencing factors are the physical environment, accessibility to learning resources and materials, educational setting, availability of teachers, exposure, and play-based learning, as well as interactions among teachers and students [44]. Particularly, the classroom's layout, ambience, and functioning, as well as the teacher's attitude towards creativity, tend to influence and affect the learning process. Formal assessment, choice limitations, peer pressure, competition, and rote learning in the classroom might hinder the growth of creativity and stifle innovation [45-47]. CBSE school students have a higher level of exposure to creative ideation and collaborative problem-solving than students in matriculation and government-run state board schools, which tend to have a more structured teaching approach. Even though teachers try to incorporate creative thinking into classrooms, it is difficult to do so in traditional classroom settings. This is attributed to the fact that most people focus merely on the tangible evidence of a high academic grade rather than innovative or creative work.

The results of the statistical analysis reveal that there is no correlation between DT and IQ. This implies that DT scores do not depend on a person's IQ. Many studies found that creativity and IQ were correlated with each other, and a minimum level of IQ was needed for creativity [48]. A significant number of intelligence researchers consider DT to be an intelligence subcomponent [1, 49]. Chrysikou [50] and Dietrich [51] stated that DT mandated several mental abilities, including information retrieval speed, general knowledge, and motor skills (e.g., the ability to write quickly) [52]. This perspective emphasizes the potential moderating effect of multiple factors on the strength of the association between intellect and DT. Although DT and intelligence were previously considered to be somewhat distinct constructs [53, 54], some researchers now believe that the two constructs may be more similar than was previously believed [55]. It is anticipated that a rigorous empirical examination of the relationship between intelligence and DT will clarify the theoretical relationship between these two important concepts [40, 56].

The statistical analysis of the present study shows that factors such as age, economic status, geographical area, birth order, and hand preference do not influence the capacity for DT in school students. Coren [57] stated that left-handed male users scored higher in DT tests than females. The findings of this study are in opposition to the aforementioned research, demonstrating that there is no statistically significant distinction in levels of DT between the individuals' who are right-handed and those who are left-handed. Many studies have stated that DT is high in the early childhood period of 2 to 9 years. Later, the capacity for creativity and innovation starts to decrease slowly [26, 58]. Researchers found that personal factors like creative potential and environmental factors like education, schools, and learning influence the DT of students and their capacity to creatively explore ideas and resolve challenges. Research has proven that divergent thinking skills and abilities can be significantly improved through training programs that focus on boosting originality, creativity, and out-of-the-box thinking for problem-solving. So, creative ability and DT can be developed and improved through intervention measures such as proper training programs and the deployment of suitable game- or play-based teaching strategies that can serve as creativity-building exercises.

This study has several limitations, including a limited sample size; therefore, the results cannot be generalized and applied to the whole population. Much more research is needed on personality and DT, especially with extroverts, who are more open to examining new ideas and engaging in novel experiences. It is suggested that future studies investigate the relationship between DT and personality among school students. Only verbal DT tests have been conducted for this research. Future research studies should conduct both verbal and non-verbal DT test to obtain a thorough and complete understanding of students' problem-solving and creative thinking abilities.

5. Conclusions

In this research study, it was found that the educational board under which students are being schooled plays a significant role in influencing the levels of DT. Government state board school students are poor at DT tasks due to limited resources, a lack of facilities, and the unavailability of activity-based learning. Gender exercises a considerable influence over DT, with marked differences in the creative thinking assessment scores of boys versus girls. DT and EQ were found to be negatively correlated with each other. IQ and EQ are noted to have no relationship with each other, and other factors such as living area (urban, rural, semi-urban, etc.) and economic status do not influence the DT of the selected study group. Liu, et al. [59] stated that creative thinking skills can be improved through the adoption of creative teaching methods by teachers, experiential learning, and interdisciplinary teaching in an inclusive environment that encourages spontaneity and motivates children to use their imagination by providing them with opportunities to be creative in the classroom. It is inferred that students may have the inherent ability and capacity to be creative but lack the resources or opportunity to freely express it without inhibition, so they may not be able to utilize this talent for original ideation. In order to discover the full value of creativity, a concerted effort must be made to create an environment conducive to it where everyone has equal opportunities to present, discuss, and explore creative and innovative ideas with a receptive mind and in a non-judgmental manner [60]. Further research is required in the area of personal and environmental factors such as parenting styles, classrooms, teaching methods, and technology's influence on the divergent thinking skills and creative abilities of students.

References

- [1] J. P. Guilford, "Creativity: Yesterday, today and tomorrow," *The Journal of Creative Behavior*, vol. 1, no. 1, pp. 3-14, 1967. <https://doi.org/10.1002/j.2162-6057.1967.tb00002.x>
- [2] A. Mohanty, "Information processing and creative thinking abilities of residential and non-residential school children: A pilot study," *Sage Open*, vol. 5, no. 4, pp. 1-12, 2015. <https://doi.org/10.1177/2158244015611452>
- [3] M. A. Runco, "Divergent thinking, creativity, and ideation. In J. C. Kaufman & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity*," Cambridge University Press. <https://doi.org/10.1017/CBO9780511763205.026>, 2010, pp. 413–446.
- [4] I. A. James and H. Birtles, "Twenty-one years of creativity and development: The evolving Newcastle model," *Psychology of Older People. The FPOP Bulletin*, vol. 152, no. 2, pp. 62-69, 2020.
- [5] M. A. Runco and S. Acar, "Divergent thinking as an indicator of creative potential," *Creativity Research Journal*, vol. 24, no. 1, pp. 66-75, 2012. <https://doi.org/10.1080/10400419.2012.652929>
- [6] M. A. Runco, A. M. Abdulla, S. H. Paek, F. A. Al-Jasim, and H. N. Alsuwaidi, "Which test of divergent thinking is best?," *Creativity. Theories–Research–Applications*, vol. 3, no. 1, pp. 4-18, 2016.
- [7] C. L. Taylor, A. EsmailZaghi, J. C. Kaufman, S. M. Reis, and J. S. Renzulli, "Divergent thinking and academic performance of students with attention deficit hyperactivity disorder characteristics in engineering," *Journal of Engineering Education*, vol. 109, no. 2, pp. 213-229, 2020. <https://doi.org/10.1002/jee.20310>
- [8] A. Gerwig, K. Miroshnik, B. Forthmann, M. Benedek, M. Karwowski, and H. Holling, "The relationship between intelligence and divergent thinking-a meta-analytic update," *Journal of Intelligence*, vol. 9, no. 2, pp. 1-28, 2021. <https://doi.org/10.3390/jintelligence9020023>
- [9] M. Giancola, M. Palmiero, and S. D'Amico, "Divergent but not convergent thinking mediates the trait emotional intelligence-real-world creativity link: An empirical study," *Creativity Research Journal*, pp. 1-9, 2022. <https://doi.org/10.1080/10400419.2022.2092338>
- [10] R. J. Sternberg and S. B. Kaufman, *The Cambridge handbook of intelligence*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511977244>, 2011.
- [11] S. Maheshwari, V. Tuladhar, T. Thargay, P. Sarmah, P. Sarmah, and K. Rai, "Do our eyes mirror our thought patterns? A study on the influence of convergent and divergent thinking on eye movement," *Psychological Research*, vol. 86, no. 3, pp. 746-756, 2022. <https://doi.org/10.1007/s00426-021-01520-7>

- [12] M. J. Sánchez-Ruiz, D. Hernández-Torrano, J. C. Pérez-González, M. Batey, and K. V. Petrides, "The relationship between trait emotional intelligence and creativity across subject domains," *Motivation and Emotion*, vol. 35, no. 4, pp. 461-473, 2011. <https://doi.org/10.1007/s11031-011-9227-8>
- [13] W. I. O'Byrne, N. Radakovic, T. Hunter-Doniger, M. Fox, R. Kern, and S. Parnell, "Designing spaces for creativity and divergent thinking: Pre-service teachers creating stop motion animation on tablets," *International Journal of Education in Mathematics, Science and Technology*, vol. 6, no. 2, pp. 182-199, 2018. <https://doi.org/10.18404/ijemst.408942>
- [14] T. Wagner and R. A. Compton, "Creating innovators: The making of young people who will change the world," *Simon and Schuster*, vol. 50, no. 1, pp. 50-425, 2012. <https://doi.org/10.5860/choice.50-0425>
- [15] M. A. Runco and S. Acar, "Do tests of divergent thinking have an experiential bias?," *Psychology of Aesthetics, Creativity, and the Arts*, vol. 4, no. 3, pp. 144-148, 2010. <https://doi.org/10.1037/a0018969>
- [16] B. Shi, L. Wang, J. Yang, M. Zhang, and L. Xu, "Relationship between divergent thinking and intelligence: An empirical study of the threshold hypothesis with Chinese children," *Frontiers in Psychology*, vol. 8, pp. 1-9, 2017. <https://doi.org/10.3389/fpsyg.2017.00254>
- [17] B. Shi, D. Y. Dai, and Y. Lu, "Openness to experience as a moderator of the relationship between intelligence and creative thinking: A study of Chinese children in urban and rural areas," *Frontiers in Psychology*, vol. 7, pp. 1-10, 2016. <https://doi.org/10.3389/fpsyg.2016.00641>
- [18] E. Aldrin, J. P. Mairing, and A. Subagjo, "The effect of emotional intelligence on divergent thinking ability in solving mathematical statistics problems," *Gamaproionukleus*, vol. 1, no. 1, pp. 56-65, 2020. <https://doi.org/10.37304/jpmipa.v1i1.2453>
- [19] J. A. Plucker, M. Karwowski, and J. C. Kaufman, "Intelligence and creativity. In R. J. Sternberg (Ed.), *The Cambridge handbook of intelligence*," Cambridge University Press. <https://doi.org/10.1017/9781108770422.046>, 2020, pp. 1087-1105.
- [20] A. M. Suliman and F. N. Al-Shaikh, "Emotional intelligence at work: Links to conflict and innovation," *Employee Relations*, vol. 29, no. 2, pp. 208-220, 2007. <https://doi.org/10.1108/01425450710720020>
- [21] U. Wolfardt, J. Felfe, and T. Köster, "Self-perceived emotional intelligence and creative personality," *Imagination, Cognition and Personality*, vol. 21, no. 4, pp. 293-309, 2002. <https://doi.org/10.2190/b3hk-9hcc-fjbx-x2g8>
- [22] A. Murphy and H. Janeke, "The relationship between thinking styles and emotional intelligence: An exploratory study," *South African Journal of Psychology*, vol. 39, no. 3, pp. 357-375, 2009. <https://doi.org/10.1177/008124630903900310>
- [23] J. Raven and J. H. R. J. C. Court, *Standard progressive matrices: (including the parallel and plus version) ; with norms for the spm plus and formulae for calculating change scores*, 2000th ed. San Antonio, TX: Pearson, 2003.
- [24] A. Singh and S. Narain, *Emotional intelligence scale users' manual*. Agra: National Psychological Corporation, 2014.
- [25] K. N. Sharma, *Manual for divergent production abilities (DPA)*. Agra: National Psychological Corporation, 2017.
- [26] M. A. Runco, "Positive creativity and the intentions, discretion, problem finding, and divergent thinking that support it can be encouraged in the classroom," *Education Sciences*, vol. 12, no. 5, pp. 1-13, 2022. <https://doi.org/10.3390/educsci12050340>
- [27] S. Acar and M. A. Runco, "Divergent thinking: New methods, recent research, and extended theory," *Psychology of Aesthetics, Creativity, and the Arts*, vol. 13, no. 2, pp. 153-158, 2019. <https://doi.org/10.1037/aca0000231>
- [28] M. A. Runco and R. S. Albert, "The reliability and validity of ideational originality in the divergent thinking of academically gifted and nongifted children," *Educational and Psychological Measurement*, vol. 45, no. 3, pp. 483-501, 1985. <https://doi.org/10.1177/001316448504500306>
- [29] G. Geher, K. Betancourt, and O. Jewell, "The link between emotional intelligence and creativity," *Imagination, Cognition and Personality*, vol. 37, no. 1, pp. 5-22, 2017. <https://doi.org/10.1177/0276236617710029>
- [30] D. Kar, B. Saha, and B. C. Mondal, "Measuring emotional intelligence of secondary school students in relation to gender and residence: An empirical study," *American Journal of Educational Research*, vol. 2, no. 4, pp. 193-196, 2014. <https://doi.org/10.12691/education-2-4-3>
- [31] L. I. Ugwu, "Emotional and general intelligence: Characteristics, meeting points and missing links," *Asian Social Science*, vol. 7, no. 7, pp. 137-140, 2011. <https://doi.org/10.5539/ass.v7n7p137>
- [32] J. A. Plucker, A. Esping, J. C. Kaufman, and M. J. Avitia, "Creativity and intelligence. In S. Goldstein, D. Princiotta, & J. A. Naglieri (Eds.), *Handbook of intelligence: Evolutionary theory, historical perspective, and current concepts* ". Springer Science + Business Media. https://doi.org/10.1007/978-1-4939-1562-0_19, 2015, pp. 283-291.
- [33] D. K. Simonton, "Creativity, automaticity, irrationality, fortuity, fantasy, and other contingencies: An eightfold response typology," *Review of General Psychology*, vol. 20, no. 2, pp. 194-204, 2016. <https://doi.org/10.1037/gpr0000075>
- [34] D. K. Simonton, "Creative ideas and the creative process: Good news and bad news for the neuroscience of creativity," *The Cambridge Handbook of the Neuroscience of Creativity*, pp. 9-18, 2018. <https://doi.org/10.1017/9781316556238.002>
- [35] A. M. Abdulla Alabbasi, T. L. Thompson, M. A. Runco, L. A. Alansari, and A. E. A. Ayoub, "Gender differences in creative potential: A meta-analysis of mean differences and variability," *Psychology of Aesthetics, Creativity, and the Arts. Advance online publication*, 2022. <https://doi.org/10.1037/aca0000506>
- [36] J. Baer and J. C. Kaufman, "Gender differences in creativity," *The Journal of Creative Behavior*, vol. 42, no. 2, pp. 75-105, 2008.
- [37] M. A. Brackett, S. E. Rivers, and P. Salovey, "Emotional intelligence: Implications for personal, social, academic, and workplace success," *Social and Personality Psychology Compass*, vol. 5, no. 1, pp. 88-103, 2011. <https://doi.org/10.1111/j.1751-9004.2010.00334.x>
- [38] G. Geher and K. L. Renstrom, "Measurement issues in emotional intelligence research. In G. Geher (Ed.), *Measuring emotional intelligence: Common ground and controversy*." Hauppauge, NY: Nova Science Publishers, 2004, pp. 3-19.
- [39] J. D. Mayer and G. Geher, "Emotional intelligence and the identification of emotion," *Intelligence*, vol. 22, no. 2, pp. 89-113, 1996. [https://doi.org/10.1016/s0160-2896\(96\)90011-2](https://doi.org/10.1016/s0160-2896(96)90011-2)
- [40] C. Mourgues, B. Barbot, M. Tan, and E. L. Grigorenko, *The interaction between culture and the development of creativity. In L. A. Jensen (Ed.), The Oxford handbook of human development and culture: An interdisciplinary perspective*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199948550.013.16>, 2015, pp. 255-270.
- [41] T. Lubart, F. Zenasni, and B. Barbot, "Creative potential and its measurement," *International Journal for Talent Development and Creativity*, vol. 1, no. 2, pp. 41-51, 2013.

- [42] M. W. Allodi, "Goals and values in school: A model developed for describing, evaluating and changing the social climate of learning environments," *Social Psychology of Education*, vol. 13, no. 2, pp. 207-235, 2010. <https://doi.org/10.1007/s11218-009-9110-6>
- [43] D. Davies, D. Jindal-Snape, C. Collier, R. Digby, P. Hay, and A. Howe, "Creative learning environments in education--A systematic literature review," *Thinking Skills and Creativity*, vol. 8, pp. 80-91, 2013. <https://doi.org/10.1016/j.tsc.2012.07.004>
- [44] B. Barbot, M. Besançon, and T. Lubart, "Creative potential in educational settings: Its nature, measure, and nurture," *Education*, vol. 43, no. 4, pp. 371-381, 2015. <https://doi.org/10.1080/03004279.2015.1020643>
- [45] R. A. Beghetto, "Does assessment kill student creativity?," *In The Educational forum Taylor & Francis Group*, vol. 69, no. 3, pp. 254-263, 2005. <https://doi.org/10.1080/00131720508984694>
- [46] V. T. Kudryavtsev, "The phenomenon of child creativity," *International Journal of Early Years Education*, vol. 19, no. 1, pp. 45-53, 2011. <https://doi.org/10.1080/09669760.2011.570999>
- [47] W. Shi and R. E. Hoskisson, "Advantages of foreignness: Benefits of creative institutional deviance. In Institutional theory in international business and management," vol. 25. Bingley: Emerald Group Publishing Limited, 2012, pp. 99-125.
- [48] M. Karwowski, "Culture and psychometric studies of creativity," *The Palgrave Handbook of Creativity and Culture Research*, pp. 159-186, 2016. https://doi.org/10.1057/978-1-137-46344-9_8
- [49] M. Karwowski *et al.*, "Is creativity without intelligence possible? A necessary condition analysis," *Intelligence*, vol. 57, pp. 105-117, 2016. <https://doi.org/10.1016/j.intell.2016.04.006>
- [50] E. G. Chrysikou, "17 the costs and benefits of cognitive control for creativity," *The Cambridge Handbook of the Neuroscience of Creativity*, pp. 299-317, 2018. <https://doi.org/10.1017/9781316556238.018>
- [51] A. Dietrich, *How creativity happens in the brain*. Palgrave Macmillan/Springer Nature. <https://doi.org/10.1057/9781137501806>, 2015.
- [52] B. Forthmann, D. Jendryczko, J. Scharfen, R. Kleinkorres, M. Benedek, and H. Holling, "Creative ideation, broad retrieval ability, and processing speed: A confirmatory study of nested cognitive abilities," *Intelligence*, vol. 75, no. C, pp. 59-72, 2019. <https://doi.org/10.1016/j.intell.2019.04.006>
- [53] J. W. Getzels and P. W. Jackson, *Creativity and intelligence: Explorations with gifted students*. New York: Wiley, 1962.
- [54] M. A. Wallach and N. Kogan, *Modes of thinking in young children: A study of the creativity-intelligence distinction*. Holt: Rinehart & Winston, 1965.
- [55] P. J. Silvia, "Intelligence and creativity are pretty similar after all," *Educational Psychology Review*, vol. 27, no. 4, pp. 599-606, 2015. <https://doi.org/10.1007/s10648-015-9299-1>
- [56] R. T. Warne, S. Golightly, and M. Black, "Factor structure of intelligence and divergent thinking subtests: A registered report," *Plos One*, vol. 17, no. 9, p. e0274921, 2022. <https://doi.org/10.1371/journal.pone.0274921>
- [57] S. Coren, "Differences in divergent thinking as a function of handedness and sex," *The American Journal of Psychology*, vol. 108, no. 3, pp. 311-325, 1995. <https://doi.org/10.2307/1422892>
- [58] A. Kozbelt, R. A. Beghetto, and M. A. Runco, "Theories of creativity. In J. C. Kaufman & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity*," Cambridge University Press. <https://doi.org/10.1017/CBO9780511763205.004>, 2010, pp. 20-47.
- [59] H. Y. Liu *et al.*, "Effectiveness of interdisciplinary teaching on creativity: A quasi-experimental study," *International Journal of Environmental Research and Public Health*, vol. 19, no. 10, p. 5875, 2022. <https://doi.org/10.3390/ijerph19105875>
- [60] D. Rastogi and N. K. Sharma, "Creativity under concurrent and sequential task conditions," *Creativity Research Journal*, vol. 22, no. 2, pp. 139-150, 2010.