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The Interplay of Individualistic Factors on Divergent Thinking: An Explored Mediating Effect of Problem-Solving Ability Among Engineering Students

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Abstract- Divergent thinking (DT) is a cognitive ability that enables individuals, especially engineering students, to tackle complex problems with originality and creativity. This study examines the mediating effect of problem-solving ability (PSA), on DT, intelligence, memory, and academic performance among engineering students. The study was carried out on 123 final-year engineering students aged 20–21 (mean age = 20.41; SD age =.493) from Vellore district, Tamil Nadu. A descriptive cross-sectional study was conducted, and standardized psychometric questionnaires were used to collect the primary data. The Statistical Package for the Social Sciences (SPSS-26) and Andrew Hayes Macro Process 4.3 software were used to analysis statistical tests like the independent sample t-test, Pearson correlation, and mediation analysis. The results provided empirical evidence on the mediating effect of problem-solving ability on the association between intelligence, memory, and DT among engineering students. The study also provided suggestions for future research on the subject.

Keywords- Academic performance, Divergent thinking, Engineering students, Intelligence, Memory, Problem-solving ability

1. Introduction

In the late 20th century, educators emphasised the importance of every individual having advanced cognitive skills such as divergent thinking and creative thinking due to global changes (Zach & Ophir, 2020). Specifically, creativity is considered an essential concept of scientific significance and practical importance to society, especially in engineering (Runco, 2011). In this fast-moving world, industries and educational institutions agree on the need for multidimensional, higher-order thinking skills for solving problems with various aspects for which the art of innovation is essential (Borg Preca et al., 2023). Creative thinking and innovation are critical elements of success in engineering (National Academy of Engineering, 2008; Taylor et al., 2020). However, most conventional engineering degree programmes do not provide any recognition or incentive for students' creative endeavours, so the value of creativity in modern engineering education is lacking (Kazerounian & Foley, 2007). Worldwide

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surveys have shown that the majority of company executives are satisfied with the technical expertise of their staff. On the other hand, many skilled graduates' lack of inventiveness is a widespread issue (Ritter et al., 2020).

Thus, a degree without creative skills or vice versa will not result in practical employability and successful career development (Taylor et al., 2020). Without fostering creativity in engineering education, we risk falling behind in technological advancements and limiting our ability to tackle complex global challenges. As industries evolve and innovate, the demand for engineers who can think differently and develop novel solutions is becoming increasingly crucial. Encouraging divergent thinking may aid in the pursuit of engineering solutions that are more inclusive and egalitarian (Mahesh et al., 2015). Divergent thinking, as proposed by Guilford in 1967 in his 'Structure of Intellect' (SOI) model, is a core component of creativity. And it is a crucial characteristic for practical engineers, who must adapt to the available tools and resources to address daily issues. The creative process often involves fluency (number of ideas generated), flexibility (number of categories or concepts generated), and originality (unique responses or ideas). However, solving complex problems can be challenging, leading to motivational issues for entity theorists. Creativity in engineering may require a combination of non-academic abilities, such as mastering a field like process, presentation, and being free from fear of failure. Some tasks may require talents related to graphic design and technical skills (Guilford, 1984; Guilford & Hoepfner, 1966). At the same time, prior research suggests that DT assessments exhibit reliability and validity in predicting specific requirements for creative performance (Acar & Runco, 2014). However, it is important to note that these measures do not ensure actual creative achievements, but rather measure creative potential (Runco & Acar, 2012) especially cognitive functions such as memory, intelligence, and problem-solving ability strongly correlate with DT.

DT, a learning method, fosters students' ability to generate diverse solutions for open-ended problems, a crucial skill for engineering students. This approach aims to find innovative solutions for challenging problems. To generate innovative ideas or solutions, proficient problem solvers must tap into their memory and deliberately deviate from conventional notions instead of exploring concepts that are more original or cognitively distant (Raz et al., 2023), resulting in unique solutions for a multifaceted problem known as the individual's problem-solving ability (PSA). The term "problem-solving" describes the mental processes that try to bridge the gap between the current state of things and an ideal future. In psychology, PSA refers to the inherent urge to achieve a specific objective from the current state. The individual initially lacks direct knowledge of how to accomplish the goal, and with the help of cognitive processes (i.e., divergent thinking), they find an effective solution for the problem (Sarathy, 2018). DT generally refers to generating a solution to an open, ill-defined problem (Benedek et al., 2012) Often, ill-defined problems encompass multiple, sometimes contradictory objectives that require resolution, and numerous approaches to address them. However, a careful procedure is required to conceptualise and organise this ill-defined problem before ideas are created, evaluated, and selected for implementation. Initially, an individual recognises, understands, evaluates, and frames a problem during problem-solving. The next step is to develop a unique or novel approach to a problem that allows for creative problem-solving ideas (Raz et al., 2023). This generation of creative ideas for resolving a problem is only possible when the individual develops a new or different understanding and approach to solve a particular problem. Therefore, Runco emphasises, "Divergent thinking tests should be more considered as they estimate the creative problem-solving potential of the individual rather than their actual creativity". DT mostly involves two processes: preparation and incubation, while creative problem-solving includes imagination, sketching, and validating the result. Most of the researchers in previous studies gave more emphasis to imagination than sketching and validation. The Gestalt hypothesis also states that engaging in an activity triggers a sudden "insight" or novel concept. Just thinking about something without imagination doesn't generate a new idea or solution (Mackler & Shontz, 1965). The theory of attention-switching mechanisms provides briefs about the switching mechanism between two distinct modes of operation, such as the focused mode and the defocused mode. The problem representation remains relatively stable in the focused mode, while problem-solving occurs in a focused and purposeful approach through search, planning, and execution mechanisms. In the defocused mode, problem-solving does not always have a clear goal in mind but instead concentrates on generating ideas under the influence of both internal and external stimuli.

Divergent thinking can happen in both modes. During the initial problem-solving stage, in focused mode, it clearly describes the problem and constructs a mental representation in the working memory. In the defocused mode, we generate and test new ideas (Sarathy, 2018).

Memory is demarcated as the cognitive processes of storing and manipulating information and obtaining, encoding, maintaining, and recovering the data. Memory plays a significant role in DT, problem solving, intelligence, and academic performance (Leslie et al., 1969). DT retrieves the information from memory and generates multiple responses to a given question (Takeuchi et al., 2020). The study emphasises the importance of memory in creative thinking, as it enables individuals to retain essential knowledge for solving current problems. In addition, the process of being creative involves the ability to connect various ideas and concepts while also focusing on the ones that are most relevant to the current problem at hand (Orzechowski et al., 2023). Associative theory posits that the formation of new ideas hinges on the activation of semantic elements, only slightly connected to a given cue, through continuous automatic associative processes over time (Mednick, 1962). Still, based on remote association, highly creative individuals produce more responses than low-creative people (Beaty et al., 2014). Simultaneously, their ability to recall unique associations or dissociations is faster than that of individuals with low creativity. Memory is also essential for goal-directed behaviors, supporting cognitive tasks like thought, reasoning, problem-solving, decision-making, and language. While some studies suggest memory does not or marginally affect DT, others demonstrate its direct linkage to DT components such as fluency, flexibility, elaboration, and originality.High memory enhances persistence and focused attention, while low memory leads to defocused attention through enhanced flexibility (Giancola et al., 2023). The dual-process theory explains that engaging in creative tasks requires the use of cognitive resources. This theory suggests that creativity involves both primary and secondary processes, as well as defocused and focused attention. Research has also identified a potential neural basis for the shift between these processing modes. Studies have indicated that idea generation in divergent thinking tests and insight problem-solving tasks may utilize both systems to varying degrees. Furthermore, researchers propose that working memory plays a crucial role in developing DT (Lin & Lien, 2013).

The relationship between intelligence (IQ) and creativity (DT) has been studied for two decades, but the exact connection remains unclear. IQ is defined as the "ability to reason, plan, solve problems, think abstractly, and learn from experience" (Cattell, 1967; Jaarsveld & Lachmann, 2017). Guilford's SOI model suggests creativity is a subset of intelligence, while DT is part of cognitive operation. Renzulli's (1978) three-ring theory of giftedness suggests a close association between intelligence and creativity. The threshold theory suggests that creativity and intelligence are distinct phenomena, with a high level of intelligence necessary but not sufficient for great creativity (Warne et al., 2022). IQ is a more powerful predictor of academic achievement than DT (Breit et al., 2023). The student's GPA or grades were considered for measuring the respondents' academic performance since it is a traditional indicator for measuring academic achievement or performance (Yang & Zhao, 2021). The GPA, also known as grade point average, is used to measure AP. It assesses students' progress throughout their degree programme (Beyazsacli, 2016). It also includes an evaluation of both the assessment and examination results. Moreover, AP is connected to convergent thinking, IQ, and working memory (WM) (Yang & Zhao, 2021).

Despite its essential elements of creative thinking, DT is a common problem for engineers who typically limit their approach to pre-existing viewpoints or techniques (Zhou & Valero, 2015). Conversely, inclusive design methods should explore other perspectives like students' intelligence, memory, academic performance, and problem-solving ability. Most studies analyse the relationship between intelligence (IQ) and DT, leaving the mediating role of problem-solving ability to DT. Few studies have explored this relationship in fields other than engineering. Therefore, exploring how DT is linked with other individualistic variables such as memory, intelligence, problem-solving ability, and academic performance is crucial, especially given the lack of research on analysing the effect of problem-solving as a mediating variable in DT (Sonnleitner et al., 2013).

A. Rationalae of the Study

Adolescence marks a critical period for cognitive development, characterized by significant changes in brain structure and function. During this phase, DT plays a vital role in education, contributing substantially to academic, personal, and professional growth. By fostering open-mindedness, DT empowers individuals to generate innovative solutions from diverse perspectives, motivating them to explore various paths. Moreover, DT challenges conventional thinking patterns, enhancing problem-solving abilities and equipping engineering students with the skills to approach complex challenges from multiple angles. As such, DT is essential for engineering students, as it enables them to develop creative, adaptable, and effective solutions, preparing them for success in their future careers.

Based on the research gap and previous literature evidence, we framed following objectives

1. To assess the relationship between independent variables and dependant variable (DT) among engineering college students

2. To find the mediating influence on the varaibles

3. To examine the impact of demographic factors on divergent thinking among engineering college students

Based on the objective althernative hypothesis are framed,

Ha1: Intelligence, memory, academic performance, problem-solving ability, and divergent thinkng has a significant differences with demographic (gender and geographical) factors.

Ha2: Intelligence, memory, academic performance, problem solving ability, and divergent thinking significant relationship with each other.

Ha3: Problem solving ability has a mediating effect on divergent thinking, intelligence, memory, and academic performance.

2. Methodology

A. Participants and Procedure

In the study, utilizing a descriptive cross-sectional design and employing a simple random sampling method (without replacement), the researcher collected data from 123 engineering students aged 20–21 (mean age = 20.41; SD age =.493) in Vellore, Tamil Nadu State, India. The participants were from different engineering specializations. Prior to data collection, the researcher obtained clearance from the university's Ethical Clearance Committee to maintain ethical considerations throughout the study. We distributed informed consent forms to each participant to ensure their understanding of the study's objectives and potential risks. To collect primary data for the study, the researcher (first author) used the survey method in classroom settings. Before gathering responses, the researcher carefully explained the standardized questionnaires to participants to ensure their full comprehension.

B. Measures

Standard progressive matrices (SPM) are a well acknowledged and frequently employed evaluation instrument for assessing levels of intelligence. The SPM is comprised of five sets (A, B, C, D, and E), with each set including 12 items, resulting in a total of 60 black-and-white items. The duration of the administration is approximately 40–45 minutes. The complexity of the SPM intensifies as the examination advances. The test is designed for individuals between the ages of 6 - 70. The questions consist of a visual geometric design with a missing piece, and the test taker must select the correct piece from six options (A and B) to eight options (C, D, and E). The test is designed to assess one's logical problem-solving skills independently of language proficiency. The test has demonstrated strong reliability, as seen by a Cronbach's alpha coefficient of $\alpha = 0.85$. This indicates that the test consistently measures intelligence across repeated administrations (Raven et al., 2002).

Sharma's Divergent Production Abilities Test (DPA) (Sharma, 2017) was used to assess divergent thinking (DT) levels. This assessment evaluates divergent thinking (DT) by considering the individual's fluency, flexibility, originality, and elaboration performance. This framework comprises six distinct components, namely word production (α=0.67), uses of things (α=0.80), similarities (α=0.68), sentence construction (α=0.84), titles (α=0.85), and solutions/completion (α=0.82). The number of ideas generated determines the fluency component, while the number of categories produced in the list determines the flexibility measurement. The generation of uncommon ideas determines the score of originality in the 'If' response. Responses within the 1% range are awarded 5 marks, while those within the 2% range have 3 marks, followed by responses within the 3% range with 2 marks, responses within the 4% range are assigned 1 mark, and responses within the

5% range are given a score of zero. The evaluation of comprehensive and extensive responses offered measures of elaboration. Finally, the individual results are combined to derive the respondent's total score.

The PGI-memory scale (Pershad, D., & Wig, N. N. 1977) was used to assess the respondent's remote memory, recent memory, mental balance, attention concentration, delayed recall, immediate recall, retention for similar pairs, retention for dissimilar pairs, visual retention, and recognition. Each subtest has a different scoring procedure, and the total maximum possible score for the entire test is 115. The scale has a reliability of 0.71 and 0.85.

The problem-solving ability test (PSAT) (Darchhingpuii, 1988) by the North-Eastern Hill University Department of Education Shillong. It was used to measure the problem-solving ability of the respondents. This test aims to know the respondents' reactions to various activities that help find solutions for multiple issues. The test consists of 20 items and four possible solutions for each statement, marked by the letters a, b, c, and d. The respondents must read each item carefully, choose their first reaction, and encircle the letter corresponding to the response against the question number in the answer sheet to mark the answer. A sample item of the test: 'While playing in your college field, a dog comes and bites one of your playmates. What would be your first reaction to helping him? (a) I will chase the dog. (b) I will call a doctor. (c) I will suggest taking him to the hospital. (d) I will give him first aid. Then split-half reliability and the resulting co-efficient reliability of the test are r = 0.64.

The evaluation of academic performance for engineering students was determined by their cumulative grade point average (CGPA), computed up to the recent semester.

C. Statistical analysis

To analyze the results, quantitative data was systematically coded and performed various parametric tests, such as t-tests and F-tests. We conducted these tests to examine the differences between demographic factors and independent and dependent variables. Additionally, a Pearson correlation was conducted to identify the relationships between the variables. By utilized software tools such as Microsoft Excel, SPSS 26, and Jamovi 2.4.11 for this analysis. Finally, a Bootstrap analysis was carried out using Andrew Hayes' MACRO PROCESS 4.3 (Hayes, 2018) to analyze the mediating effect of PSA, memory and IQ on DT variables.

3. Results

A. Descriptive and inferential statistics

In this study, 72.4% were males, and the remaining 27.6% were females. Based on hypothesis 1, a one-way ANOVA was performed, and the results show that there were no significant differences in geographical area (urban, rural, semi-urban) on AP, DT, IQ, PGI, and PSA among college students (F =.851, P =.430>0.05; DT, F =.879, P =.418>0.05; PGI, F =.058, P =.944>0.05; IQ, F = 1.83, P =.164>0.05; PSA, F =.391, P =.677>0.05).

Table 1 :
Mean Comparison of Males and Females on Ap, Memory, Iq, Psa and Dt

Variables	Male (N 89)		Female (N 34)			
	M	*SD*	*M*	*SD*	*t* (123)	*p*
Academic performance (AP.)	89.94	8.148	84.38	8.004	-1.492	.138
Memory	102.04	11.97	103.65	11.88	-.665	.507
Intelligence (IQ)	49.25	5.133	50.71	5.419	-1.388	.168
Problem-solving ability (PSA)	20.29	3.581	20.47	4.507	-.230	.819
Divergent thinking (DT)	81.45	16.99	84.38	8.004	-1.560	.121

Table 1 displays the results of an independent t-test, indicating that there is no significant difference between male and female engineering students based on gender. These findings suggest that gender does not play a significant role in determining AP, memory, IQ, PSA, and DT in this study. The results indicate that gender does not play a significant role in determining these factors. Consequently, the results contradict our initial hypothesis (H1).

Table 2 shows the results of Karl Pearson's correlation coefficient used to analyze the relationship between AP, memory, IQ, PSA, and DT.

**significant at level of 0.01; *significant at the level of 0.05

The results in Table 2 illustrate the correlation among AP, memory, IQ, PSA, and DT within the

Table 2 :
Mean, Standard Deviation and Correlations Between the Study Variables

Variables	M	SD	1	2	3	4	5
1 Academic performance	82.62	8.15	1				
2 Memory	104.02	14.01	0.21	1			
3 Intellegence (IQ)	49.65	5.23	0.192*	0.92	1		
4 Problem Solving Ability (PSA)	20.34	3.84	-0.117	0.208**	0.224*	1	
5 Divergent Thinking (DT)	82.91	16.90	-0.061	0.395**	0.233*	0.428**	1

group of engineering students. The results indicate a positive correlation between AP and IQ ® =.192, p<0.05) with a 95% confidence level (2-tailed). Nevertheless, there was no substantial correlation between AP, memory, PSA, and DT. Furthermore, PSA has a notable correlation with memory (r =.208, p<0.01) and IQ (r =.224, p<0.05). DT shows a strong connection between memory (r =.395, p<0.01), IQ (r =.223, p<0.05), and PSA (r =.428, p<0.01). It is noteworthy to note that the results indicated that AP does not have a significant relationship with the study variables compared to IQ. DT is associated with all of the study variables, except AP. The findings indicate partial acceptance of H2

Table 3 shows the mediation analysis results used to assess how PSA mediates the relationship between IQ, DT, and memory. We found statistically significant results for the indirect, direct, and total effects of IQ and DT, as well as memory and DT. Figure 1 also shows that PSA has a complete mediation effect on the relationship between IQ and DT, while PSA partially mediates the relationship between memory and DT. PSA's mediating role in the

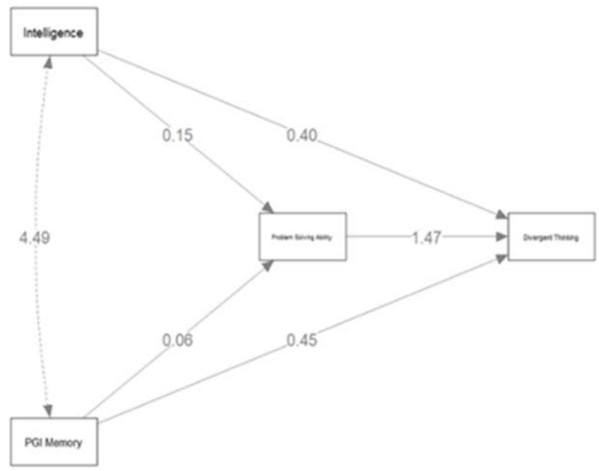

Fig. 1 : Mediation Effect of Psa Among Variable

linkage between AP and the DT total effect is not significant. AP⇒ DT (β=-0.1039, SE= 0.1707 t=-1.262, p>0.207 95% CI= [-0.549,0.119]), direct effect of AP⇒ DT (β=-0.050, SE= 0.162 t=-0.644, p>0.520 95% CI= [-0.421,0.213]), and indirect impact of (β=-0.0536, SE= 0.0645 t=-1.723, p<0.085 95% CI= [-0.237,0.015]) These values clearly demonstrate a lack of significant association between PSA and AP and DT, thereby partially validating H3.

4. Discussion

The objective of the study was to examine the gender differences among variables including AP, memory, PSA, and DT. The researcher's hypothesis postulated that there would be obvious differences between gender and all of the variables taken into account. Nevertheless, the t-test results indicated that there were no statistically significant gender differnces in any of the research variables. The F-test

Table 3 :
Bootstraps Analysis of Total, Direct, And Indirect Effects of The Mediation Model

95% CI (a)								
Type	Effect	Estimate	**SE**	Lower	Upper	**β**	**z**	p
Indirect	IQ ⇒ PSA ⇒DT	0.2267	0.1076	0.0158	0.438	0.0702	2.11	0.035
	M⇒ PSA ⇒ DT	0.0919	0.0467	4.334	0.183	0.064	1.97	0.049
Direct	IQ ⇒ DT	0.4024	0.2510	-0.0894	0.894	0.124	1.60	0.109
	M⇒ DT	0.4525	0.1107	0.235	0.669	0.316	4.09	< .001
Total	IQ ⇒ DT	0.6291	0.2633	0.112	1.145	0.194	2.39	0.017
	M⇒ DT	0.5444	0.1166	0.315	0.773	0.380	4.67	< .001

indicates that there is no statistically significant difference in the living areas of the participants.

Therefore, the first hypothesis did not receive any support. DT did not exhibit any significant gender differences. This finding aligns with previous research suggesting that DT and gender may not have significant differences, according to existing studies (Runco & Acar, 2010). In contrast to previous studies that discovered a notable contrast in gender and divergent thinking abilities, with males outperforming females and scoring higher in DT (Sandhiya & Bhuvaneswari, 2023). This finding aligns with past studies that have shown a historical trend of men being more prominent and innovative in various fields, such as inventing telephones and aeroplanes. The disparity in creative achievement between genders can be attributed to factors like societal pressures, lower expectations for women to engage in creative endeavours, a lack of recognition for creative contributions by women, as well as social and cultural influences that limit women's access to time and opportunities for creative pursuits (Alabbasi et al., 2022). The results of the present study show that female respondents were also equally creative as men. Today's society represents this equality between women and men.

The study also showed that there was no significant gender differences in IQ. Theoretically, in cognitive psychology, males and girls do not differ in general intelligence. Usually, gender differences are only discovered for a particular intellectual skill, such as spatial, verbal, or visual tasks with multiple intelligence tests, rather than general intelligence tests (Reilly et al., 2022). However, women consistently rated their IQ lower than men (effect sizes ranging from 0.22 to 0.47) because females self-doubt their ability and perceive IQ as masculinity (Furnham, 2009; Furnham & Robinson, 2023). In contrast, some studies report that females scored slightly higher than male students (Heaven & Ciarrochi, 2012), demonstrates that gender does not act as a potential source of influence on a person's IQ.

Further, there are no significant gender differences in the respondents' academic performance in this study. In engineering education, there is a notable difference in enrolment numbers between males and females compared to other disciplines, especially in arts and science. The analysis of increasing rates of engineering admissions in recent days shows that both men and women show equal interest in choosing the engineering field. In terms of higher education, girls have done better academically than boys. But gender preferences and domination in specific fields prevail even today, as boys prefer to study engineering than girls, especially in the streams of civil, EEE, and mechanical. Various external and internal factors played essential roles, such as teaching methods, parental motivation and support, advocacy effects for women's empowerment, extracurricular activities, economic difficulties, and financial limitations (Ghazvini & Khajehpour, 2011). As a result, gender played a significant role in increasing disparities in education choice, but not in academic achievement (Wrigley-Asante et al., 2023). Our results explained women have successfully navigated those challenges and are showcasing their abilities on par with men.

There was no gender differences in PSA. In contrast, previous studies show that PSA is higher in males than females, and males solve problems better than females, while females prefer an approachable and avoidant style (Johnson, 1984). However, the study showed no significant gender differences in problem-solving ability. Some of the studies believed that males exhibited superior performance versus females in problem-solving involving word-based scenarios (Ramírez-Uclés & Ramírez-Uclés, 2020). Apart from these gender differences, problem-solving ability is an essential requirement for dealing with the rising day-to-day issues and problems for everyone (Kipman et al., 2022). Various factors, such as limited opportunity and social and family duties, stifled women in the past, limiting their exposure compared to the current situation. Now, women participate equally with men, so problem-solving skills are not dependent on gender. It is based on individuals' problem-solving talents, such as handling new situations, shifting priorities, and responding quickly to unanticipated barriers, as they recognise numerous choices and choose the best one in novel contexts. They are able to consider various possibilities and choose the best course of action in unfamiliar situations. The study's findings reinforce the idea that gender should not be a barrier to success, and that both women and men are capable of achieving great things when given equal opportunities.

The study found no significant gender differences in memory, with most studies indicating no significant difference (Li et al., 2022). In contrast, some studies reported that females performed well in episodic memory (Hill et al., 2014) and slightly higher in autobiographical memory (AM). Males have higher visuospatial ability (Pauls et al., 2013), and when it comes to the neuro-functioning ability of the brain, men prominently tend to use suitable hemispheres, while females primarily use left hemispheres (Hill et al., 2014). Notably, some recent researchers found that memory does not have any significant differences among genders (Giancola et al., 2023). This suggests that while there may be certain cognitive distinctions between males and females, memory function is one area where no gender differences have been found. Hypothesis 1 is not confirmed.

The researcher conducted a correlation analysis according to Hypothesis 2 to evaluate the connection between the variables. This shows a strong relationship between IQ and AP. This is due to the fact that individuals who score higher on IQ tests typically perform better in academic settings. Previous studies have supported this strong correlation between IQ and AP, which shows the influence cognitive abilities can have on academic success, as well as that IQ is considered a strong predictor of AP(Heaven & Ciarrochi, 2012).

IQ and AP are typically associated with convergent thinking (CT), which focuses on finding a single correct solution to a problem, in contrast to divergent thinking (DT). The present study also supports the idea that academic performance has no relationship with DT (Beketayev & Runco, 2016). The present study also supports the idea that academic performance has no relationship with DT (Yang & Zhao, 2021)

The results of the study showed that divergent thinking (DT) is significantly related to IQ, memory, and problem-solving abilities (PSA). Furthermore, other studies have found a direct connection between memory and cognitive abilities such as fluency, flexibility, originality, and elaboration. This suggests that memory may play a crucial role in various aspects of cognitive functioning (Giancola et al., 2023). Problem solvers retrieve information from memory to find an alternate way of understanding, formulate strategies, and find an effective solution for the problem similar to that used to solve a non-insight problem (Fleck, 2008) due to the similarities between memory and insight problem-solving tasks. This perspective suggests that preceding an issue is a stimulus to access relevant details from memory. After that, the retrieved or stored information from the memory is used to solve the current problem (Metcalfe, 1986). Guilford mentioned the compelling relationship between problem-solving ability and memory in his SOI model operation category. Hence, DT tests usually include the problem-solving process. Studies on DT and problem-solving ability show that DT has a significant relationship with real-world problems and positively impacts STEM students' PSA (Borg Preca et al., 2023; Okuda et al., 1991). The study results show PSA and IQ have a well-established and significant relationship. Every intelligence assessment measures students' problem-solving and reasoning skills (Heaven & Ciarrochi, 2012). This research study discovered a significant relationship between IQ and DT. Studies on creativity and intelligence confirm that creativity and IQ have a strong relationship. While some studies suggest that creativity and IQ are not closely associated, the exact nature of their relationship remains uncertain after much investigation (Corazza & Lubart, 2021). Our research findings supported Guilford's Structure of Intellect (SOI) model, which posits that creativity is a component of intelligence. Hypothesis 2 is partially confirmed.

Based on Hypothesis 3, mediation analysis was done, and the results show that problem-solving ability (PSA) plays a mediator role among the independent variables of IQ, memory, and academic performance and the dependent variable of DT. PSA correlates with IQ, (it is related to cognitive abilities like reasoning and decision-making). When a person engages with a problem, they can use their memory to resolve issues based on past experiences, such as retrieving information from the past and attempting to solve a current problem, a process known as "reproductive" (Gilhooly et al., 2012). Similarly, DT tests are typically used to find innovative solutions to problems (Boom et al., 2018) When a person engages with a problem, they can use their memory to resolve issues based on past experiences, such as retrieving information from the past and attempting to solve a current problem, a process known as "reproductive) (Gilhooly et al., 2012). Similarly, DT tests are typically used to find innovative solutions to problems (Raz et al., 2023). In DT, the PSA has a significant impact on IQ and memory variables. Researchers found that PSA partially mediates the relationship between memory and DT; this implies a direct relationship between memory and DT, with PSA acting as a mediator between the variables. Additionally, PSA completely mediates the link between IQ and DT, defining the difference between present and desired conditions (Wiley & Jarosz, 2012). Theoretically, PSA involves any action that reduces the discrepancy to achieve the intended outcome. We have focused on problem solving, which involves resolving issues in real-life settings. The study results in Table 3 prove that the relationship between IQ and DT can be significant in the presence of PSA as a mediator. Given that PSA is a component of memory, IQ, and even the IQ test includes problem-solving questions, it is clear that IQ and PSA are interrelated, with PSA serving as a measure of IQ, a component of memory, and an essential component of creativity. Creativity and problem-solving abilities are inevitable skill sets for the transition from one state to another. The intersection of these two concepts may occur when we consider creativity as a component of problem-solving (Lin & Lien, 2013). Some contend that creativity and problem-solving ability are distinct yet interconnected concepts. The procedures and objectives of the two concepts drive their distinctions. Creativity is an ever-changing process to produce a novel idea for an unfamiliar situation. At the same time, problem-solving ability is a methodical and logical approach that seeks to create a resolution for a known issue (Tan et al., 2019). The study's main goal is to show that problem-solving completely connects IQ and memory, emphasizing how important problem-solving skills are for both IQ and memory. This is because working memory is a key part of problem-solving because it's where information is retrieved (Wiley & Jarosz, 2012; Jalili et al.,2018). (Hypothesis 3 partially accepted).

In the future, educators, trainers, and psychologists will focus on developing students problem-solving skills. The academic curriculum must incorporate problem-solving skills, as they are crucial for developing creativity and divergent thinking, to enhance students' capacity for divergent thinking. Therefore, we must cultivate insight and analytical problem-solving abilities among graduating individuals to enhance their career opportunities (Fleck, 2008). Therefore, the academic curriculum should be designed in such a way as to encourage young adolescents and make them apply divergent thinking approaches in classrooms and workplaces. It encourages students and employees to think outside the box and develop novel solutions to real-world problems (Sandhiya & Bhuvaneswari, 2023).

In the end, we got a thorough understanding of the determinants and explore the mediating impact within this particular group. While acknowledging the study's limitations, such as its small sample size (123) and its restricted geographic area (Vellore district), is crucial, one should exercise caution when generalizing the findings. To further elucidate the factors influencing behaviour within this population, future research should prioritize larger and more diversified longitudinal studies. In this study, we focused on examining the composite score of DT rather than its dimensions. Additionally, we did not analyze the correlation between the focused and defocused modes in memory. Addressing these limitations can lead to a more robust understanding of these dynamics. And it should explore the impact of working memory updating, inhibitory control, and shifting on divergent thinking (DT) to understand its connection to executive functions. It may also include convergent thinking tasks, personality tests, and other variables to provide a comprehensive understanding of creative potential. Students should also consider subjects like science, the arts, and medicine for further analysis, requiring a deeper understanding of peer influences, parents, family, and social environments.

Conclusion

The study concluded that there are no gender differences in AP, memory, PSA, and DT. There is a significant relationship between AP and IQ. PSA has a significant correlation with memory, IQ, and DT. Problem-solving ability (PSA) plays a mediator role among the variables of IQ, memory, on DT. Enhancing one's problem-solving ability (PSA) can lead to improvements in memory, IQ, and DT skills. By sharpening PSA, individuals can better utilize their cognitive resources to tackle challenges effectively and efficiently.

Author Contribution

Conceptualization, methodology, validation, investigation, data collection, coding, analysis, writing, and an original draft were performed by Veerasamy Sandhiya and Mohanraj Bhuvaneswari. All authors read and approved this submitted research article.

Ethical statement

The Institutional Ethical Committee approved this study for Studies on Human Subjects (IECH). Ref.No. VIT/IECH/XIII/2022 /04e

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Data Availability

Author will provide the data based on requirment

Disclosure Statement

The authors reported that there is no conflict of interest.

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