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Understanding Learners' Divergent Thinking Skills through Sex, Literary and Artistic Exposure, and Attitudes

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Abstract

This study examines the differences in divergent thinking skills among Grade 12 STEM students based on sex, exposure to literature and arts, and attitudes toward these subjects. Data were collected from 234 students using creative thinking assessments and surveys. The results showed no significant differences in divergent thinking skills between male and female students. However, significant differences were found based on students' exposure to literature and arts and their attitudes toward these fields. Students with greater exposure and more positive attitudes demonstrated higher fluency, flexibility, originality, and elaboration. The study underscores the importance of integrating literature and arts into STEM education to enhance creativity and recommends curriculum adjustments to foster greater artistic engagement.

Keywords: Divergent Thinking, Sex Differences, Exposure to Literature, Arts Education, Attitude Toward Arts, Fluency, Flexibility, Originality, Elaboration, STEM Education, Creativity in Education

INTRODUCTION

In an increasingly complex and interconnected world, the development of creative thinking skills has become a critical focus in education. At the heart of creativity lies divergent thinking, the ability to generate multiple ideas, explore different perspectives, and offer novel solutions to problems. Divergent thinking encompasses four key components: fluency, flexibility, originality, and elaboration—each contributing uniquely to a person's creative capacity (Guilford, 1968; Runco & Acar, 2012; Torrance, 1974; Vidal, 2008). These skills are essential for students, particularly in the science, technology, engineering, and mathematics (STEM) fields, where innovation and problem-solving are highly valued.

However, the development of divergent thinking skills does not occur in isolation; various factors such as sex, exposure to literature and arts, and attitude toward literature and arts can influence how these skills manifest in students (Baer & Kaufman, 2008; Breen, 2001; Mar et al., 2009; Zwaan, 2003) when literature and the arts are often underappreciated in STEM curricula, despite that they play a significant role in cultivating creativity.

This research investigates the divergent thinking skills of Grade 12 STEM students. Specifically, it seeks to determine whether significant differences exist in the levels of divergent thinking skills based on sex, exposure to literature and arts, and attitudes toward these fields. By examining these factors, the study aims to provide insights into how educational practices can better foster creativity among students in STEM programs, ultimately preparing them for the challenges of the modern world. The findings of this research will contribute to the growing body of knowledge on creativity in education, offering recommendations for enhancing the creative potential of students through interdisciplinary learning and attitudinal interventions.

LITERATURES

Divergent Thinking and Sex. Several studies have explored the role of sex in divergent thinking, producing mixed results. Some research suggests that females tend to outperform males in verbal fluency and elaboration tasks, while males are more likely to excel in tasks that involve spatial creativity and problem-solving (Baer & Kaufman, 2008). However, recent neuroscientific studies indicate that both sexes are equally capable of divergent thinking, although they may approach tasks

differently based on cognitive processing styles (Abraham et al., 2013).

Exposure to Literature and Arts. Exposure to literature and the arts has been widely recognized as a significant factor in developing creativity and divergent thinking skills. According to Mar, Oatley, and Peterson (2009), engagement with literature enhances cognitive empathy and the ability to generate multiple perspectives, both critical for divergent thinking. Similarly, artistic exposure promotes the development of flexible thinking, as individuals learn to appreciate different forms of expression and interpretation (Zwaan, 2003).

Attitude Toward Literature and Arts. Students' attitudes toward literature and the arts play a crucial role in shaping their creative potential. Positive attitudes toward these subjects, often fostered by a supportive learning environment, can lead to greater engagement and, consequently, higher levels of divergent thinking (Breen, 2001). In contrast, negative attitudes, possibly influenced by external factors such as peer pressure or digital media consumption, may hinder the development of creative thinking (Lirca, 2014).

METHODOLOGY

A descriptive research design was utilized to explore differences in divergent thinking skills among Grade 12 STEM students. Independent variables included sex, exposure to literature and arts, and attitude toward these subjects, while the dependent variable was the students' levels of divergent thinking skills.

The sample consisted of 234 students, selected through simple random sampling using the Cochran's formula. Students were then categorized by sex, level of exposure to literature and arts, and their attitudes toward these subjects. An overview of the sample's distribution, according to sex, is shown in Table 1.

Table 1
Distribution of Respondents by Sex

Sex	N	%
Male	120	51
Female	114	49
N	234	100

Employed in the gathering of data to measure the four facets of divergent thinking: fluency, flexibility, originality, and elaboration are a series of creative thinking tests, including verbal and figural tasks adapted respectively from Joy Paul Guilford's Alternative Uses Test (AUT) and Paul Torrance's Test of Creative Thinking (TTCT) based on procedural descriptions and examples (Guilford, 1968; Torrance, 1974). The researcher also utilized original rubrics to rate the responses of each task. The adapted test and researcher-crafted rubrics were then validated by a psychometrician. Additionally, a survey was administered to assess students' exposure to literature and arts and their attitudes toward these subjects, with demographic data collected to account for sex. This survey was pilot tested to a sample of respondents excluded from those already identified for the survey and test proper. The results of the pilot tests for exposure to literature and arts had an alpha value of 0.92, while the attitude towards literature and arts had a value of 0.88.

To determine whether significant differences existed in the divergent thinking skills of students according to sex, exposure to literature and arts, and attitude toward literature and arts, the study utilized t-tests. This statistical tool helped identify whether there were meaningful variations in creative potential across different groups.

RESULTS AND DISCUSSION

Sex Differences. Table 2 highlights the overall similarities in divergent thinking skills between male and female students. The overall mean scores for males ($M = 2.70$, $SD = 0.44$) and females ($M = 2.74$, $SD = 0.38$) are nearly identical, with a t-value of -0.13, indicating no statistically significant difference between the two groups.

Table 2
Distribution of Test Statistics on the Significant Difference in the Levels of Divergent Thinking Skills of Students When Grouped according to Sex

Divergent Thinking Skills	Sex					
	Male [n=120]		Female [n=114]			
	M	SD	M	SD	t	df
Fluency	2.87	0.93	2.86	1.03	-0.009	8
Flexibility	3.23	0.51	3.22	0.60	0.08	8
Originality	2.49	0.46	2.44	0.46	0.11	2
Elaboration	2.21	0.10	2.43	0.13	-3.38	13
Overall	*2.70*	*0.44*	*2.74*	*0.38*	*-0.13*	*4*

Note. The overall rating description for both male and female is proficient.

Both male and female students are rated as proficient in their overall divergent thinking abilities, demonstrating that sex does not have a substantial impact on divergent thinking as a whole.

Upon closer examination of the individual facets of divergent thinking, no significant differences are observed in fluency, flexibility, and originality. Male and female students exhibit similar capacities in generating ideas (fluency), shifting perspectives (flexibility), and producing unique or novel concepts (originality). This suggests that, regardless of sex, students in both groups are equally capable of producing a wide range of ideas and approaching problems from different angles with originality.

However, a notable difference emerges in elaboration, where female students (M = 2.43, SD = 0.13) significantly outperform their male counterparts (M = 2.21, SD = 0.10), as reflected by a t-value of -3.38. This indicates that female students tend to provide more detailed and complex ideas in their responses compared to males, who exhibit less elaboration in their thinking processes. The higher elaboration scores among females suggest that they may be more inclined to thoroughly expand on and refine their ideas during creative tasks.

Despite this disparity in elaboration, the overall divergent thinking skills of both male and female students remain comparable. Both groups exhibit proficiency across the various components of divergent thinking, indicating that gender plays a limited role in shaping general creative abilities (Abraham et al., 2013; Baer & Kaufman, 2008).

Exposure to Literature and Arts. Data from Table 3 reveals significant insights into the role of exposure to literature and arts in shaping divergent thinking skills among Grade 12 STEM students. A key observation is the impact of exposure on fluency, one of the core facets of divergent thinking. Students with good to very good exposure to literature and arts demonstrated higher fluency (M = 2.42, SD = 0.18) compared to those with poor to fair exposure (M = 2.20, SD = 0.08), as indicated by a t-value of 2.72 ($p < .05$). This suggests that greater exposure to creative materials enables students to generate a larger number of ideas, a crucial aspect of fluency (Mar et al., 2009; Zwaan, 2003). The significance of this finding highlights the importance of integrating literature and arts into education to help students develop more prolific creative capacities.

Table 3
Distribution of Test Statistics on the Significant Difference in the Levels of Divergent Thinking Skills of Students When Grouped by Exposure to Literature and Arts

Divergent Thinking Skills	Exposure to Literature & Arts					
	Good-Very Good [n=71]		Poor-Fair [n=163]			
	M	SD	M	SD	t	df
Fluency	2.42	0.18	2.20	0.08	2.72*	7
Flexibility	2.31	0.08	2.26	0.12	0.93	7
Originality	2.26	0.13	2.32	0.10	-0.68	4
Elaboration	2.33	0.03	2.26	0.02	5.07**	12
Overall	*2.33*	*0.06*	*2.26*	*0.04*	*0.14*	*6*

Note. The overall rating description for both good to very good and poor to fair exposure to literature and arts conditions is Developing. *p< .05, **p<.01.

In contrast, flexibility, which measures the ability to shift perspectives and generate ideas across diverse categories, showed no significant difference between the two groups. The t-value of 0.93 indicates that both sets of students – those with high and low exposure – demonstrated similar levels of flexibility in their thinking. This result implies that exposure to literature and arts may not strongly influence the ability to approach problems from different angles or switch between distinct thought processes. Other factors, such as teaching methods or personal cognitive styles, may play a more central role in shaping flexibility.

Interestingly, for originality, students with poor to fair exposure outperformed those with better

exposure, though the difference was not statistically significant (t = -0.68). This could suggest that while exposure to literature and arts nurtures creativity, it may not always lead to more unique or novel ideas. There might be external factors influencing originality, such as personal experiences or cultural influences, which go beyond mere exposure to artistic and literary content.

However, a highly significant difference was found in elaboration, with students who had better exposure to literature and arts (M = 2.33, SD = 0.03) significantly outperforming those with lower exposure (M = 2.26, SD = 0.02), as indicated by a t-value of 5.07 (p < .01). Elaboration, which involves adding complexity and detail to ideas, seems to be deeply influenced by engagement with literature and arts, as these fields encourage students to explore and expand upon ideas thoroughly. This finding underscores the potential of literary and artistic activities to enhance students' capacity for detailed and well-developed creative responses.

Despite the significant differences observed in fluency and elaboration, the overall ratings for divergent thinking did not show a significant difference between the two groups (t = 0.14). This suggests that while certain aspects of divergent thinking are positively influenced by exposure to literature and arts, other components, like flexibility and originality, may require additional support beyond exposure to creative content to develop fully.

In conclusion, the data suggest that exposure to literature and arts positively impacts certain facets of divergent thinking, particularly fluency and elaboration. However, to foster well-rounded creative thinkers, educators may need to combine exposure to creative materials with targeted strategies that specifically enhance flexibility and originality.

Attitude Toward Literature and Arts. The results from Table 4 highlight the influence of students' attitudes towards literature and arts on specific aspects of divergent thinking skills. A significant difference was observed in fluency, where students with a Good-Very Good attitude towards literature and arts (M = 2.18, SD = 0.07) performed better than those with a Poor-Fair attitude (M = 2.12, SD = 0.04), as indicated by a t-value of 2.01 (p < .05). This suggests that students with more positive attitudes toward literature and arts are more capable of generating multiple ideas, reinforcing the importance of nurturing positive perceptions of these fields to foster idea fluency in divergent thinking (Breen, 2001).

Table 4

Distribution of Test Statistics on the Significant Difference in the Levels of Divergent Thinking Skills according to Attitude towards Literature and Arts

Divergent Thinking Skills	Attitude towards Literature & Arts: Good-Very Good [n=86] M	SD	Poor-Fair [n=148] M	SD	t	df
Fluency	2.18	0.07	2.12	0.04	2.01*	8
Flexibility	2.14	0.03	2.14	0.08	0.05	6
Originality	2.15	0.10	2.22	0.19	-0.59	3
Elaboration	2.11	0.05	2.15	0.03	-1.36	13
Overall	*2.15*	*0.02*	*2.16*	*0.04*	*-0.48*	5

Note. The overall rating description for both good to very good and poor to fair attitude towards literature and arts conditions is Developing. *p< .05.

In contrast, no significant differences were found in flexibility between the two groups, with both scoring similarly. The t-value of 0.05 suggests that students' ability to shift perspectives and generate ideas across different categories is not significantly influenced by their attitude toward literature and arts. This indicates that flexibility, a crucial component of creative thinking, may be shaped by factors beyond mere attitude, such as instructional strategies or cognitive development.

Interestingly, while students with a Poor-Fair attitude scored slightly higher in originality (M = 2.22, SD = 0.19) than those with a Good-Very Good attitude (M = 2.15, SD = 0.10), this difference was not statistically significant (t-value = -0.59). This finding suggests that attitude alone may not strongly affect students' ability to generate novel or unique ideas, as originality might be more dependent on intrinsic factors like personal creativity or exposure to diverse experiences.

Similarly, no significant difference was found in elaboration between the two groups, despite

students with a Poor-Fair attitude scoring slightly higher (M = 2.15, SD = 0.03) than those with a Good-Very Good attitude (M = 2.11, SD = 0.05). The t-value of -1.36 suggests that attitudes toward literature and arts do not substantially affect the ability to add detail and complexity to ideas. This indicates that elaboration, like flexibility, may require more targeted interventions beyond cultivating positive attitudes toward creative subjects.

Overall, the comparison between the two groups shows no significant difference in divergent thinking skills, with nearly identical scores (t-value = -0.48). Both groups are rated as "developing" in their overall divergent thinking abilities. These findings suggest that while a positive attitude toward literature and arts can enhance fluency, other facets of creative thinking, such as flexibility, originality, and elaboration, may not be directly influenced by attitude alone. This underscores the need for comprehensive approaches in education that go beyond shaping attitudes, focusing on more holistic strategies to develop well-rounded creative thinkers.

Conclusions and Recommendations. The findings of the study reveal that while divergent thinking skills such as fluency are positively influenced by students' attitudes toward literature and arts, other components of divergent thinking—such as flexibility, originality, and elaboration—do not show significant differences based solely on attitude or gender. Female students demonstrate significantly higher elaboration skills compared to males, and exposure to literature and arts significantly impacts fluency and elaboration. However, overall divergent thinking abilities remain largely similar across gender, exposure, and attitude groups, with both groups falling under the "proficient" or "developing" category.

These results suggest that while nurturing positive attitudes toward literature and arts can enhance the ability to generate ideas (fluency), this alone may not be enough to foster other critical aspects of creativity such as flexibility or originality. It highlights the need for more comprehensive educational interventions to holistically develop divergent thinking skills across all facets.

Given these, the recommendations are as follows:

1. Integrating Literature and Arts into STEM Curriculum: Given the positive impact of literature and arts exposure on fluency and elaboration, schools should integrate more literature and artistic experiences into STEM education. This interdisciplinary approach can help students become more creative problem-solvers by fostering their idea generation and capacity for detail.

2. Promoting Positive Attitudes Toward Literature and Arts: Since a positive attitude toward literature and arts significantly influences fluency, educators should implement programs and activities that build students' appreciation for these fields. Encouraging positive perceptions can motivate students to engage more fully with creative tasks.

3. Targeted Creative Thinking Interventions: To improve flexibility and originality, schools should adopt specific interventions, such as creative thinking workshops, that challenge students to approach problems from multiple perspectives and generate novel solutions. Such activities should encourage students to take creative risks and explore unconventional ideas.

4. Fostering Elaboration in Male Students: Since male students scored significantly lower in elaboration than their female peers, educational programs should provide opportunities for male students to practice adding detail and complexity to their ideas. This could include structured exercises in creative writing, design, and analysis that emphasize depth and thoroughness.

5. Further Research on Divergent Thinking Skills: Additional research should focus on identifying the factors that most influence flexibility and originality, beyond gender, exposure, and attitude. Understanding these

factors can help educators develop more effective strategies for cultivating creativity in students across different contexts.

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