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A Study On Mathematical Aptitude And Mathematical Process Skills Of Pre-University Students

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Abstract:

The ability to process mathematical information effectively and demonstrate logical reasoning is essential for academic success in mathematics, particularly at the Pre-University (PU) level. This study investigates the correlation between mathematical aptitude and mathematical process skills among pre-university students in Karnataka. A descriptive correlational research design was employed, and a stratified random sample was drawn from Government and Unaided colleges in selected districts of the Mysuru division.

Mathematical Aptitude Test including numerical aptitude, quantitative aptitude, spatial aptitude, and logical-mathematical reasoning and Mathematical Process Skills Test including mathematical problem-solving, mathematical reasoning and proof, mathematical communication, mathematical connections and mathematical representation were constructed and used to collect the data The collected data were analysed using Pearson's rank correlation coefficient along with appropriate inferential statistics.

The results revealed a statistically significant positive correlation between mathematical aptitude and mathematical process skills among pre-university students. The findings highlight the importance of strengthening mathematical process skills as a means to enhance overall mathematical aptitude and academic readiness. The study offers valuable implications for curriculum development, assessment practices, and pedagogical strategies in mathematics education at the Pre-University level.

Keywords: Mathematical Aptitude, Mathematical Process Skills, Pre-University Students, Gender, and Types of institution.

1.INRODUCTION:

Mathematics plays a foundational role in the development of analytical thinking, logical reasoning, and problem-solving abilities in students. At the Pre-University (PU) level, students are expected to engage with increasingly complex mathematical concepts that require not only content knowledge but also mathematical aptitude and mathematical process skills (NCTM, 2000). Mathematical aptitude, often defined as a student's innate and developed ability to understand, reason with, and manipulate mathematical concepts, encompasses components such as numerical aptitude, quantitative aptitude, spatial aptitude and logical mathematical reasoning (Krutetskii, 1976). Mathematical Aptitude in mathematics is critical for students intending to pursue further studies in science, engineering, technology, and other math-intensive disciplines. According to Sharma (2016), students with higher levels of mathematical aptitude tend to perform better academically and show more confidence in problem-solving situations.

Mathematical process skills such as mathematical problem-solving, mathematical reasoning and proof, mathematical communication, mathematical connections and mathematical representation are essential for understanding mathematical concepts in depth and applying them in new contexts (Leikin, 2009; Silver, 1997). These mathematical process skills are not only integral to academic success but are also closely tied to the development of mathematical aptitude.

The relationship between mathematical aptitude and mathematical process skills is of particular importance in the Indian context, especially within Karnataka's Pre-University education system. With the implementation of the National Education Policy (NEP) 2020, there is an increased emphasis on fostering higher-order thinking skills and conceptual understanding rather than rote learning. In this regard, exploring how mathematical aptitude relate to mathematical process skills can provide critical insights for educators and policymakers.

While several international studies (e.g., Bicer, Capraro, & Capraro, 2017) have demonstrated the positive impact of mathematical process skills on achievement and aptitude, limited research exists in the Indian PU context. This study, therefore, aims to investigate the correlation between mathematical aptitude and mathematical process skills among Pre-University students in Karnataka. It also examines how this relationship varies with institutional background to better inform instructional practices and curriculum design.

2.NEED FOR THE STUDY

Mathematical aptitude refers to a learner's inherent and acquired ability to understand, reason with, and apply mathematical concepts. The components of both mathematical aptitude and mathematical process skills are critical for successfully navigating mathematical tasks.

Despite their importance, both mathematical aptitude and mathematical process skills are often underassessed or overlooked in current instructional practices, which tend to emphasize procedural

knowledge and rote memorization. This gap results in students being ill-prepared for applying mathematics in real-life contexts or higher academic settings. Moreover, few studies in India have examined the interplay and individual status of Mathematical aptitude and Mathematical process skills, especially at the Pre-University level, where foundational mathematical thinking is crucial for academic advancement.

With the implementation of the **National Education Policy (NEP) 2020**, there is a renewed focus on developing higher-order thinking and skill-based learning. Hence, understanding the status of mathematical aptitude and mathematical process skills among pre-university students is essential to align teaching methods, assessment strategies, and curriculum development with national goals

3.Review of related literature

Chauhan and Ranjan (2024) investigated the mathematical aptitude of prospective teachers from various teacher education colleges under the Indian Institute of Teacher Education. Using a random sample of 168 trainees and analysing data through a t-test, the study found significant differences in mathematical aptitude based on gender and institution type.

Rakesh (2024) explored the relationship between intelligence and mathematical aptitude among tenth-grade science and arts students in Bareilly, Uttar Pradesh. With a sample of 500 students and analysis via correlation and descriptive statistics, the study concluded that intelligence was not significantly related to mathematical aptitude across gender or academic stream

Kamid et al. (2022a) investigated the effect of integrating traditional kite games into geometry lessons on students' process skills and interest in mathematics among 80 fourth-grade students. Using a mixed-method explanatory design, the study employed t-tests and correlation analysis. Findings indicated varying levels of interest and process skills across schools and a significant relationship between students' interest and their process skills.

Kamid et al. (2022b) examined the relationship between problem-solving models and mathematical process skills among 288 students using quasi-experimental design and purposive sampling. Data were analyzed through t-tests and correlation analysis. The study found significant differences in process skills based on problem-solving models and confirmed a positive relationship between process skills and problem-solving approaches.

4.Objectives of the study:

1) To assess the level of mathematical aptitude of pre-university students
2) To assess the level of mathematical process skills of pre-university students
3) To compare the mathematical aptitude of male and female pre-university students
4) To compare the mathematical aptitude of government and private unaided pre-university students
5) To compare the mathematical process skills of male and female pre-university students
6) To compare the mathematical process skills of government and private unaided pre-university students
7) To find whether there is a correlation between mathematical aptitude and mathematical process skills of pre university students.

5.Hypothesis of the study:

- H1: There is no significant difference in mathematical aptitude of male and female pre university students.
- H2: There is no significant difference in mathematical aptitude of government and private unaided pre university students.
- H3: There is no significant difference in mathematical process skills of male and female pre university students.
- H4: There is no significant difference in mathematical process skills of government and private unaided pre university students.
- H5:There is no significant correlation between mathematical aptitude and mathematical process skills of pre university students.

6.Design of the study

The study adopted a **descriptive survey method** to explore the relationship between mathematical aptitude and mathematical process skills.

7.Variables of the study

The following variables were selected for the study

Main variables:

1. Mathematical Aptitude

2.Mathematical Process skills

Background variables:

• Gender

• Type of Colleges

8.Sample of the study

In the present study, random sampling technique was used to select sample of 120 science students (PCMB, PCME & PCMC) from pre-university colleges.

9.Tools used

The data was collected using the Mathematical Aptitude Test and Mathematical Process Skills Test tool constructed by the Researcher.

10.Statistical techniques used

Descriptive statistical measures the percentage analysis, t-test and Pearson product moment correlation used to analyze the data.

11.Analysis and interpretation of data

Analysis of the collected data revealed the following findings:

1) To assess the level of mathematical aptitude of pre-university students

Table no:1 shows the levels of mathematical aptitude of pre-university students.

Levels	Average	Frequency	Percentage
Above average	>34	27	22.5%
Average	14 to 34	69	57.5%
Below average	<14	24	20%

According to table No: 1, majority of the students (57.50%) possess average mathematical aptitude, (22.5%) possess high (above average) mathematical aptitude and (20%) possess low (below average) mathematical aptitude.

2) To assess the level of mathematical process skills of pre-university students

Table no:2 shows the level of mathematical process skills of pre-university students.

Levels	Average	Frequency	Percentage
Above average	>49	20	16.67%
Average	23 to 48	83	69.17%
Below average	<23	17	14.16%

According to table No: 2, majority of the students (69.17%) possess (average) mathematical process skills, (16.67 %) possess high (above average) mathematical process skills and (14.16%) possess low average mathematical process skills.

3) To compare the mathematical aptitude among male and female of pre-university students

There is no significant difference in mathematical aptitude between male and female Pre-university students

Table no.3 shows significant difference in mathematical aptitude among male and female.

Gender	Numbers	Mean	S. D	df	t-value	Significance
Male	19	19.63	10.245	118	2.126	*
Female	101	24.92	19.63			

Table 3, reveals that, obtained t-value (2.126) is greater than the table value (1.980) at the 0.05 level and (2.390) at 0.01 level of significance. Therefore, the null hypothesis is rejected. Hence it is concluded that there is a significant difference between the mathematical aptitude of male and female pre university students.

4) To compare the mathematical aptitude among government and private unaided of pre-university students

There is no significant difference in mathematical aptitude between government and private unaided Pre university students

Table no.4 shows significant difference in mathematical aptitude among government and private unaided Pre university students

Types of institutions	Numbers	Mean	S. D	df	t-value	Significance
Govt	34	27.24	5.252	118	2.184	
Private Unaided	86	22.84	11.245			S

Table 4, reveals that, obtained t-value (2.184) is greater than the table value (1.980) at the 0.05 level of significance. Therefore, the null hypothesis rejected. Hence it is concluded that there it is significant difference between the mathematical aptitude of government and private unaided of pre-university students

5) To compare the mathematical process skills among male and female of pre-university students

There is no significant difference in mathematical process skills between male and female PU students.

Table no.5 shows significant difference in mathematical process skills among male and female.

Gender	Numbers	Mean	S.D	df	t-value	Significance
Male	19	40.37	9.708	118	1.585	NS
Female	101	35.25	13.417			

Table 5, reveals that, obtained t-value (1.585) is lesser than the table value (1.658)

At the 0.05 level and (2.36) at 0.01 level of significance. Therefore, the null hypothesis accepted. Hence it is concluded that there is no significant difference between the mathematical process skills of male and female of pre-university students

6) To compare the mathematical process skills among govt and private unaided of pre-university students

There is no significant difference in mathematical process skills between govt and private unaided Pre university students

Table no.6 shows significant difference in mathematical process skills among govt and private unaided Pre university students

Types of institutions	Numbers	Mean	S.D	df	t-value	Significance
Govt	34	39.18	14.173	118	1.664	S
Private Unaided	86	34.83	12.380			

Table 6, reveals that, obtained t-value (1.664) is greater than the table value (1.658) at the 0.05 level. Therefore, the null hypothesis rejected. Hence it is concluded that there is significant difference between the mathematical process skills of government and private unaided of pre-university students

7) To find weather there is a correlation between mathematical aptitude and mathematical process skills of pre university students.

There is no significant correlation between mathematical aptitude and mathematical process skills of pre university students.

Table number 7 shows significant correlations between mathematical aptitude and mathematical process skills of pre university students.

S.N	Variables	r- value	Correlation
1	Mathematical Aptitude	0.683	Strong and Positive
2	Mathematical Process Skills		

Table 7, shows that the obtained 'r' value is 0.683 between mathematical aptitude and mathematical process skills of pre university students is found that strong and positive correlation. Hence it is found that there is high positive correlation between mathematical aptitude and mathematical process skills.

12.Findings of the study

1. Majority of the students (57.50%) are found to possess average mathematical aptitude, (22.5%) possess high (above average) mathematical aptitude and (20%) possess low (below average) mathematical aptitude

2. Majority of the students (69.17%) are found to possess (average) mathematical process skills, (16.67 %) possess high (above average) mathematical process skills and (14.16%) possess low average mathematical process skills.

3.There is a significant difference between the mathematical aptitude of male and female pre-university students. Comparing the mean value, it is found that mathematical aptitude female students is greater than male students.

4. There is significant difference between the mathematical aptitude of government and private unaided of pre-university students. Comparing the mean value, it is found that mathematical aptitude government is greater than private aided college.

5. There is no significant difference between the mathematical process skills of male and female of pre-university students. Comparing the mean value, it is found that mathematical process skills male students is greater than female students.

6. There is significant difference between mathematical process skills of government and private unaided students of pre-university levels . Comparing the mean value, it is found that mathematical process skills government is greater than private aided college.

7. There is a significant high correlation between mathematical aptitude and mathematical process skills.

13.Conclusion

This study examined the levels and interrelationship between mathematical aptitude and mathematical process skills among Pre-University students in Karnataka. The results indicate that a majority of students demonstrate moderate proficiency in both mathematical aptitude and mathematical process skills, with

significant differences based on gender and type of institution. The analysis revealed a statistically significant positive correlation between mathematical aptitude and mathematical process skills, suggesting that students with higher mathematical aptitude are more likely to excel in areas such as problem-solving, logical reasoning, and analytical thinking.

The findings affirm that mathematical aptitude and mathematical process skills are interdependent constructs, each reinforcing the other in the learning process. This underscores the importance of pedagogical practices that go beyond rote learning and emphasize conceptual understanding, procedural fluency, and cognitive flexibility. Furthermore, the study highlights the need for targeted interventions that cater to the diverse learning needs of students based on their demographic and institutional backgrounds.

In essence, fostering mathematical aptitude through process-oriented, child-cantered approaches can significantly enhance students' overall mathematical competence. The study calls for a rethinking of curriculum design, instructional strategies, and assessment practices to create learning environments that nurture both aptitude and process skills in mathematics, thereby equipping students for higher education and future academic success.

14.Educational implications

The study highlights a strong interrelationship between mathematical aptitude and mathematical process skills, indicating the need for balanced and integrated instructional approaches at the Pre-University level.

1. Curriculum Design: Curriculum must emphasize both conceptual understanding and skill application. Integrating non-routine problems, real-life tasks, and collaborative activities can enhance both mathematical aptitude and mathematical process skills.
2. Teaching Methods: Shift from rote-based instruction to student-cantered strategies like problem-based learning, inquiry, and use of ICT tools to develop logical reasoning and analytical thinking.
3. Differentiated Instruction: Address variations across gender, region, and institution type through customized support, remedial programs, and inclusive practices.
4. Teacher Development: Equip educators with training in designing tasks that develop both aptitude and process skills, aligned with NEP 2020's focus on competency-based education.
5. Assessment Reforms: Move beyond traditional tests; include formative, process-oriented assessments to evaluate reasoning, communication, and problem-solving skills.
6. Policy Recommendations: Promote equity in resources, especially for rural and government institutions, and encourage interventions that nurture mathematical potential.

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