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Problem-Solving Ability and Academic Achievement among Senior Secondary Students Based on Gender in Gwalior

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Abstract

This study aimed to investigate and compare the problem-solving ability and academic achievement of 500 senior secondary school students (250 males and 250 females) in Gwalior, using stratified random sampling to ensure demographic representation. The Problem Solving Ability Test (PSAT) by Dr. L.N. Dubey and Dr. C.P. Mathur (2011) was used to assess cognitive skills, while academic achievement was determined from official records of the past two years. Findings revealed that male students, on average, exhibited higher problem-solving ability than female students, with a statistically significant difference observed in both mean scores and distribution across categories. A greater proportion of males demonstrated extremely high problem-solving skills, whereas more females were found in the high category. Notably, only female students fell into the extremely low problem-solving category. In contrast, female students significantly outperformed males in academic achievement, securing a higher percentage of top grades (A and B), while males were more commonly represented in lower grade ranges. The difference in academic performance between genders was also statistically significant. These results highlight the complex relationship between cognitive abilities and academic outcomes, suggesting that while males may excel in problem-solving, females demonstrate superior academic performance.

Keywords: Problem-Solving Ability, Senior Secondary Students, Gender Differences, Academic Performance, Critical Thinking

Introduction

Problem-solving ability is a vital cognitive skill that enables individuals to analyze situations, generate alternatives, and make informed decisions. In the field of education, especially at the senior secondary level, this skill plays a crucial role in academic success, career planning, and personal development. As students prepare for competitive examinations and life beyond school, their ability to tackle complex problems effectively becomes increasingly important.

The concept of problem-solving ability refers to the capacity to approach unfamiliar or challenging situations systematically, identify possible solutions, and select the most appropriate course of action. According to Dr. L.N. Dubey and Dr. C.P. Mathur (2011), problem-solving involves several dimensions such as logical reasoning, creativity, decision-making, and adaptability. These components are essential for effective learning and real-life application.

Problem-solving ability is a critical skill that significantly influences academic achievement among senior secondary students. This ability encompasses a range of cognitive processes, including analytical thinking, creativity, and the application of knowledge to real-world situations.

Research indicates that students who possess strong problem-solving skills tend to perform better academically, as they can navigate complex tasks and challenges more effectively (Dunlosky *et al.*, 2013) [3]. For instance, a study found that students who engaged in problem-based learning demonstrated higher levels of understanding and retention of material compared to their peers who did not (Barrows, 1996) [1]. Moreover, the relationship between problem-solving skills and academic performance is further supported by the notion that these skills foster a deeper engagement with the learning material. When students are encouraged to tackle problems, they develop a sense of ownership over their learning, which can lead to increased motivation and persistence (Schunk, 2012). This intrinsic motivation is crucial, as it not only enhances academic performance but also prepares students for future challenges in higher education and the workforce. Therefore, educational strategies that emphasize the development of problem-solving abilities are essential for improving overall academic outcomes among senior secondary students (Bransford *et al.*, 2000) [2].

Problem-solving skills in senior secondary students is vital for enhancing their academic achievement. By integrating problem-solving into the curriculum, educators can equip students with the necessary tools to succeed academically and beyond, ultimately contributing to their personal and professional development.

Significance of the Study

The significance of problem-solving ability in relation to academic achievement among senior secondary students cannot be overstated. As students transition into higher levels of education, the complexity of the material they encounter increases, necessitating advanced cognitive skills. Problem-solving ability serves as a foundational skill that enables students to approach academic challenges with confidence and competence.

This study contributes to the growing literature on cognitive abilities in Indian educational contexts. By using a standardized tool like the Problem-Solving Ability Scale (PSAS-Dubey & Mathur, 2011) and focusing on a specific regional group, the findings can inform school-based interventions aimed at improving critical thinking and decision-making skills. Additionally, gender-wise comparisons may guide tailored approaches for male and female students to bridge any existing gaps in cognitive performance.

Literature Review

- Sungur, S., & Tekkaya, C. (2006) [4] conducted a study on the effects of problem-based learning on students' problem-solving skills and academic achievement in science education. The sample consisted of 120 high school students. The study found that students who participated in problem-based learning showed significant improvements in both their problem-solving abilities and academic performance in science subjects.
- Koh, E., & Frick, T. (2009) [5] examined the relationship between problem-solving skills and academic achievement among middle school students. The sample included 200 students from various backgrounds. The study found a positive correlation between students' problem-solving abilities and their performance in mathematics and science, suggesting that enhancing

these skills can lead to better academic outcomes.

- Zohar, A., & Dori, Y. J. (2003) [6] investigated the impact of teaching higher-order thinking skills on students' problem-solving abilities and academic achievement in chemistry. The sample consisted of 150 high school students. The study found that students who were taught using methods that emphasized higher-order thinking showed significant improvements in their problem-solving skills and academic performance in chemistry.
- Higgins, S., & Moseley, D. (2001) [7] explored the impact of ICT (Information and Communication Technology) on students' problem-solving skills and academic achievement. The sample included 300 students across various schools. The study concluded that the integration of ICT in teaching significantly enhanced students' problem-solving abilities and led to improved academic performance.
- Karp, A., & Vollmeyer, R. (2002) [8] conducted a study on the role of self-regulated learning in problem-solving and academic achievement among university students. The sample consisted of 250 students. The findings indicated that students who employed self-regulated learning strategies demonstrated better problem-solving skills and higher academic performance.
- Khan, M. A., & Iqbal, M. (2021) [9] investigated the relationship between problem-solving skills and academic achievement among undergraduate students. The sample included 400 students from various disciplines. The study found a significant positive correlation between problem-solving abilities and academic performance, emphasizing the importance of developing these skills in higher education.

Operational Definitions

- **Problem Solving Ability:** For the proposed study, problem-solving ability referred to the scores obtained by the subjects upon administering the Problem Solving Ability Scale developed by Dubey (2011). This scale was used to assess how effectively the students could identify, analyze, and resolve problems. The participants' performance on this scale reflected their cognitive and logical skills related to problem-solving tasks.
- **Academic Achievement:** For the proposed study, academic achievement referred to the aggregate marks obtained by the sample students in all the subjects during their 11th class final examination. The academic performance of the students in these exams was used as an indicator of their overall achievement, reflecting their intellectual abilities and the extent to which they had mastered the required curriculum.
- **Senior Secondary School Students:** For the proposed study, Senior Secondary School Students referred to those students who had passed their class 11th examination and were currently enrolled in the 12th class in various higher secondary institutions in Gwalior City. These students were selected as the study's sample, as they represented individuals at a critical stage in their academic careers.

Objectives of the Study

1. To study the Problem Solving Ability and Academic Achievement of male and female Senior Secondary School Students school students.

2. To compare male and female Senior Secondary School Students on Problem Solving Ability.
3. To compare male and female Senior Secondary School Students on Academic Achievement.

Hypotheses

1. There is no significant difference between male and female Senior Secondary School Students on Problem Solving Ability.
2. There is no significant difference between male and female Senior Secondary School Students on Academic Achievement.

Sample

Sample Size: The study involved a total of 500 students, with an equal distribution of 250 male students and 250 female students. This sample size was carefully selected to ensure sufficient statistical power and reliability of the findings, while also allowing for meaningful comparisons between different groups, such as gender or school type.

Sampling Technique: To ensure that the sample accurately reflected the diversity of the student population, stratified random sampling was employed as the sampling technique. In this method, the population was first divided into distinct subgroups or "strata" based on relevant characteristics—in

this case, the type of school (government and private) and gender.

Tools Used

1. Problem Solving Ability Test (PSAT) developed by Dr. L.N. Dubey and Dr. C.P. Mathur (2011).

The problem Solving Ability Test (PSAT) developed by Dr. L.N. Dubey and Dr. C.P. Mathur. The test enables us to measure the problem solving ability in order to plan our training programme to develop it by providing training and practice.

In the first draft of the Problem Solving Ability Test 32 statements related to different type of problems based on Intelligence, Reasoning Ability and Mathematical Ability were constructed. This first draft was administered on a students' representative sample of 100 in the age range 11 years to 25 years studying in Upper Primary Secondary, Higher Secondary and College level. Each of the 32 statements had four alternative answers and only one answer was correct. The range of score was 00 to 32.

2. Academic Achievement:

The academic achievement was measured by collected the previous two years marks from the concerned office records.

Data Analysis and Interpretation

Table 1: Frequency Levels of Problem Solving Ability among Senior Secondary School Students with respect to Gender

Problem Solving Ability Levels	Male (N=250)		Female (N=250)		Total (N=500)	
	N	Percent	N	Percent	N	Percent
Extremely High	30	12	20	8.0	50	10
High	90	36	100	40.0	190	38
Above Average	70	28	65	26.0	135	27
Average/Moderate	40	16	35	14.0	75	15
Below Average	15	6	10	4.0	25	5
Low	5	2	10	4.0	15	3
Extremely Low	0	0	10	4.0	10	2

Table 1: shows the Problem Solving Ability among the senior secondary school students. Among male students, 12% showed extremely high problem-solving ability, compared to 8% of females. A larger percentage of females (40%) than males (36%) displayed high levels of problem-solving ability. Additionally, 28% of males and 26% of females were classified as above average. In the average/moderate category, 16% of males and 14% of females were recorded. Below average problem-solving ability was seen in 6% of males and 4% of females. Low levels were noted among 2% of males and 4% of females. Only females (4%) showed extremely low problem-solving ability, with no male representation in this category.

Table 2: Frequency Distribution of Academic Grades among Senior Secondary School Students with respect to Gender

Grade	Male (N=250)		Female (N=250)		Total (N=500)	
	N	Percent	N	Percent	N	Percent
Grade A (90-100)	45	18	55	22	100	20
Grade B (80-89)	80	32	95	38	175	35
Grade C (70-79)	70	28	55	22	125	25
Grade D (60-69)	40	16	35	14	75	15
Grade E (Below 60)	15	6	10	4	25	5

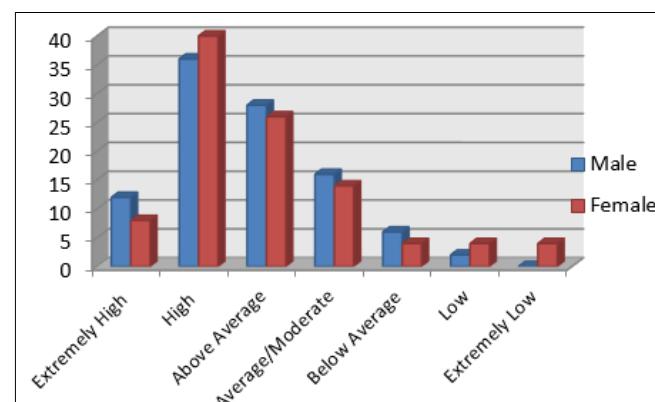


Fig 1: Frequency Levels of Problem Solving Ability among Senior Secondary School Students with respect to Gender

Table 2 provides a summary of academic grades among Senior Secondary School Students with respect to gender. Grade A (90-100), 18% of male students achieved this highest grade level, while a slightly higher percentage of female students (22%) reached this level. In Grade B (80-89), 32% of males were recorded, compared to a larger 38% of females. This grade represents the highest percentage category for both genders. In Grade C (70-79), 28% of males

and 22% of females scored within this range. However, Grade D (60-69), 16% of male students and 14% of female students fell within this grade range. Finally, for Grade E (Below 60), indicating the lowest academic achievement level, 6% of males and 4% of females were in this category.

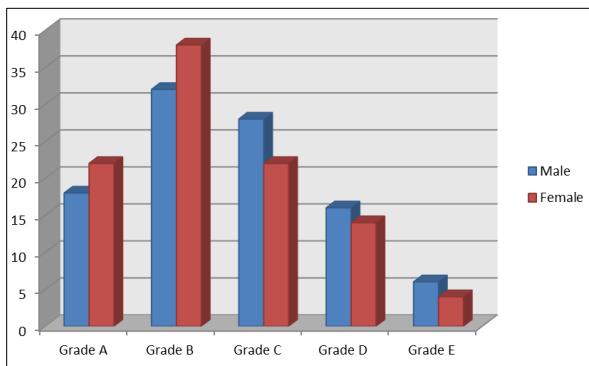


Fig 2: Frequency Distribution of Academic Grades among Senior Secondary School Students with respect to Gender

Table 3: Mean Comparison on Problem Solving Ability among Senior Secondary School Students with respect to Gender

Gender	Mean	S.D.	Mean Difference	t-value	p-value	Significance
Male (N=250)	15.8	3.2	1.3	3.42	0.001	Significant at 0.01 level
Female (N=250)	14.5	3.5				

Table 3 shows the Problem-Solving Ability among the senior secondary school students. The mean score for male students' problem-solving ability was 15.8, while female students had a mean of 14.5, with a mean difference of 1.3. The t-value of 3.42 and p-value of 0.001 indicate a significant difference at the 0.01 level between the groups, it also shows that male students performed better in problem-solving ability than female students.

Table 4: Mean Comparison on Academic Achievement among Senior Secondary School Students with respect to Gender

Gender	Mean	S.D.	Mean Difference	t-value	p-value	Significance
Male	75.6	8.2	2.7	2.94	0.003	Significant
Female	78.3	7.6				

Table 4. shows the Academic Achievement among the senior secondary school students. The mean score for male students' academic achievement was 75.6, while female students had a mean of 78.3, resulting in a mean difference of 2.7. The t-value of 2.94 and p-value of 0.003 indicate that this difference is statistically significant. This shows that female students have significantly higher academic achievement compared to male students.

Major Findings

- A higher percentage of male student's demonstrated extremely high problem-solving ability compared to female students.
- More female students fell into the high problem-solving ability category than males.
- The majority of both genders were categorized as above average or average in problem-solving skills.

- A greater proportion of female students showed below average and low problem-solving ability, with some even falling into the extremely low category—where no male students were recorded.
- The mean problem-solving score for male students was significantly higher than that of female students.
- The difference in problem-solving ability between genders was statistically significant, indicating that male students performed better overall.
- Female students outperformed male students in academic achievement based on grade distribution.
- A greater percentage of female students secured the highest grades (Grade A and Grade B), which was the most common category for both genders.
- Male students were more represented in the lower grade categories (Grade C, D, and E).
- The mean academic achievement score for female students was significantly higher than that of male students.
- The difference in academic performance between genders was statistically significant, showing that female students achieved better results overall.

Conclusion

The study provides a comprehensive analysis of problem-solving ability and academic achievement among senior secondary school students, highlighting notable gender differences. In terms of problem-solving ability, male students outperformed female students both in terms of mean scores and distribution across categories. The mean score for males was significantly higher than that of females, with a statistically significant t-value and p-value. A greater percentage of male students fell into the extremely high category, while more female students were found in the high category. However, no male students scored in the extremely low category, whereas a small percentage of females did, indicating some disparity in the upper and lower extremes of problem-solving ability.

Regarding academic achievement, female students demonstrated superior performance compared to their male counterparts. This is evident from the higher mean academic score obtained by females, along with a greater proportion achieving top grades. More females secured Grade A and Grade B, which are the highest levels of academic performance, while males were more commonly represented in the lower grade categories. Despite having better problem-solving abilities on average, male students lagged behind females in academic achievement as reflected in their overall grades.

These findings suggest that while problem-solving ability plays a role in academic performance, it may not be the sole determining factor. Other variables such as study habits, motivation, and classroom engagement might also influence academic outcomes differently across genders. The results underscore the need for educational strategies that enhance both cognitive skills like problem-solving and academic performance among all students, ensuring balanced development and success in diverse areas.

Educational Implications

- Teachers should incorporate problem-solving activities such as case studies, puzzles, and group discussions into daily lessons.

- Gender-based teaching strategies may help address differences in cognitive abilities and learning styles.
- Schools should provide workshops or training modules focused on logical reasoning and creative thinking.
- Students with low problem-solving ability should receive additional guidance through mentoring and remedial sessions.
- Curriculum designers can emphasize experiential learning methods to foster practical application of knowledge.

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