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Science Problem Solving Ability Among Secondary School Students in Boudh District, Odisha

Anil Kumar Pradhan

Lecturer in Department of Education Government Degree College Khajuripada, (Kandhamal), Odisha

Abstract

This study investigated the science problem-solving ability among secondary school students in Boudh District, Odisha, based on gender (boys and girls) and locality (rural and urban). The research had two main objectives: (1) to study the science problem-solving ability of secondary school students, and (2) to compare their problem-solving ability based on gender and locality. The study adopted the descriptive survey method. The researcher randomly selected eight secondary schools and collected a sample of 80 students (40 boys and 40 girls) from three blocks - Harabhanga, Boudh, and Kantamal of Boudh District. Data were collected using a self-developed Problem-Solving Ability Scale (PSAS), which included five-point and open-ended questions. For analysis and interpretation, measures of central tendency (mean and standard deviation) and the parametric t-test were employed. The results revealed that the mean score of boys (77.8) was lower than that of girls (80.875), and the mean score of urban students (79.95) was higher than that of rural students (78.725). The calculated t-value for gender comparison was 1.709, and for locality comparison it was 0.670. Both values were less than the critical t-value of 1.990 at the 0.05 level of significance and 2.639 at the 0.01 level of significance (with 78 degrees of freedom). Therefore, the study concluded that there was no significant difference in science problem-solving ability among secondary school students with respect to gender and locality.

Keywords: Science Education, Problem-Solving Ability, Secondary School Students, Gender, Locality.

INTRODUCTION

Science Problem solving ability is a fundamental skill that prepare individual to analyse challenges, identify solutions and implement appropriate strategies to achieve desired solution of the problems. It encloses the range of cognitive processes, involving critical thinking, creativity, decision-making and preservice. At its core, problem solving ability including various key elements such as; identification of problem, analysis and understanding, generation of solutions, evaluation and selection, implementation and monitoring etc. Also, problem solving ability is very important in various domains including education, work and everyday life. In education, students who have strong problem-solving ability they can smartly tackle complex assignments, projects, home work and examinations. In work places problem solving ability skill also act as a prime factor for solving problems independently or collaboratively within the respective teams. In day-to-day life, problem solving ability is vital for personal and professional development. According to National Education Policy (NEP) 2020, problem solving ability refers to the

ability of students to identify real- life problems, think critically and creatively, analyse situation from diverse perspectives, develop logical innovative and practical solution through inquiry-based and experiential fact-based learning.

Problem solving ability refers to the capacity of students to recognize and address difficulties encountered in every day life, employing knowledge and reasoning to generate solutions and thereby achieve successful outcomes across multiple type of problems (Martaningsih,2022). The factors like cognitive skills, creativity, metacognition, motivation and persistence, collaboration and communication, environmental factors etc. are influence for the development of problem- solving ability. Whatever may be in 21st century the problem-solving ability is crucial for secondary school students as they are the future human resources of every field of the modern scientific world.

Review of Related Literature

Problem solving ability is the mental ability of the students to identified problems, analyse situations critically or logically, think abstractly, think creatively and apply accurate strategies to move at effective solutions of the problem. For secondary school students, problem solving ability reflects in reasoning, critical thinking, discission making skills, which helps for solving the academic challenges, day to day life situations and real-life issues instinctually and confidently. Here, the investigator reviews the related literature and gets the various ideas from the conclusion and findings of the study.

In literature reviews current research enhances a developmental interest in understanding problem-solving ability (PSA) among students across national levels education and abroad. Padhi et al. (2025) reviewed that the problem-solving skills of secondary school students and highlighted the abilities which are influenced by several factors including teaching methods, socio-economic background, and learning environment.

Similarly, Lalduhawma (2023) found that problem-solving ability among Class XI students based on their stream of study. Studies by Gholami (2023) and Vishwanatham (2021) further revealed that gender and parents' educational qualification significantly affect students' mathematical and general problem-solving ability and performances. These studies collectively emphasize that academic context and demographic variables are important determinants of students' problem-solving ability skills.

International studies such as; Amalina and Vidakovich (2023) reported the crucial differences in problem-solving skills across demographic groups and findings suggested that exposure to diverse learning experiences enhances analytical and problem-solving ability of the students. Zhuzhu and Chunxia (2022) investigated that motivation, teacher support, and classroom environment as prime factors influencing problem-solving ability among middle school students in China. Similarly, Wulansari and Jupri (2022) studied that teachers' perceptions and instructional strategies directly impact students' performance in problem-solving tasks. Stiadi (2024) investigated that developing higher-order thinking skills (HOTS) through suitable questioning and proper practice may significantly improve students' science problem-solving competence. Therefore, the above studies collectively provide the importance of the science problem-solving ability of secondary school students which is highly related to the educational environment of Boudh District, Odisha.

Rationale of the Study

Science problem solving ability is very essential for school students for developing their skills of problem identification, problem understanding, generation of alternatives, decision making, reasoning, creativity

and abstract thinking in science problems. In day-to-day life it is very essential to school students for solving the situation-based problem in the scientific modern world. Also, from the above reviews (Padhi et al., 2025; Lalduhawma, 2023; Gholami, 2023; Vishwanatham, 2021; Amalina and Vidakovich, 2023; Zhuzhu and Chunxia, 2022; Wulansari and Jupri, 2022; and Stiadi, 2024) the investigator finds that some studies (Padhi et, al., Zhuzhu & Chunxia, Stiadi) related to science and general scientific reasoning where as other reviews related to mathematics problem solving and general academic problem solving. But the researcher not get any study related to science problem solving ability of secondary school students in Boudh district of Odisha. But the science problem solving ability is the major aspect for the secondary school students for the development of their problem-based knowledge, temper and skills. Therefore, the investigator feels that the science problem solving ability is necessary in day-to-day life of secondary school students. So, here the investigator wants to study will assess the science problem solving ability of secondary school students in Boudh district of Odisha on the basis of gender and locality. The purpose of the study to assess the influence of the gender and locality of the school on science problem solving ability in secondary school students.

Statement of the Problem

From the above rationale of the study the problem may be stated as the "Science Problem Solving Ability Among Secondary School Students in Boudh District, Odisha**".**

Operational Definition of Key Terms

Science Problem Solving Ability - It refers to the capacity of students to understand, analyse and solve science problems using logical and scientific reasoning.

Secondary School Students - The IX & X students, who are enrolled in the secondary school of Boudh district.

Gender – Here male (boys) and female(girls) students considered.

Locality – It refers to the place of schooling students, grouped as urban and rural areas.

Objectives of the Study

The objectives of the study are as follows;

1. To study the science problem-solving ability of secondary school students.
2. To compare the problem-solving ability of secondary school students on the basis gender (boys and girls) and locality (rural and urban).

Hypothesis of the Study

The hypothesis of the study is as follows;

1. There is no significant difference between the problem-solving ability of secondary school students on the basis of gender.
2. There is no significant difference between the problem-solving ability of secondary school students on the basis of locality.

Delimitation of the Study

This study is limited to only 8 (eight) secondary school and 80 secondary school students from three blocks of Boudh district, Odisha. It has aim only to study the science problem solving ability of secondary school

students in the Boudh district of Odisha.

Methodology

In this study the researcher used descriptive survey method to study the science problem solving ability of secondary school students. For this study all the sample units were collected by choosing the stratified random sampling technique. The researcher was considered eight (8) secondary school from three blocks of Boudh district. The total 80 sample unit was selected by taking 10 students from each school. Out of 80 samples, each 40 units of boy and girl students were taken from rural and urban secondary school of Boudh district.

Tools Used

The researcher was prepared self-developed problem-solving ability scale (PSAS) and open-ended questions chart for the collection of data on the basis of measuring science problem solving ability level of class IX & X students of secondary school. The PSAS was achieved 20 items based on the dimensions of understanding and defining the science problem, generation of possible solution and hypothesis construction, applying problem solving ability concept in day-to-day science and reasoning, interpretation and drawing conclusion skills. Each item of the PSAS was followed by five-point rating of Likert's Method. The scale of each statement was possessed with five options such as SA-Strongly Agree, A-Agree, UD- Undecided, D- Disagree and SD- Strongly Disagree. The open-ended questions chart was achieved 3 items with the science numerical and graphical domains of science subject. The validity of the tools was ensured by the considering the comments of experts.

Procedure of Data collection

After the selection of the sample and confirmation of the tools and techniques for the data collection, the investigator personally visited to the selected secondary school with the permission of the respective Head Master/ Head Mistress of the school. Student studying in class IX &X class were selected by the help of teachers by following systematic random sampling procedures. The selected students were given instructions about the instruments and motivated to respond genuinely to all the items of PSAS and open-ended questions. The data of each variable in the investigation is properly coded to suit for data analysis.

Data Analysis Procedure

After the collection of data from the respondents, the data was analysed quantitatively by using central tendency (mean, median & mode), measure of dispersion (standard deviation), percentage and parametric t-test.

Data Analysis and Interpretation

In this study, the investigator collected data from secondary school students of various schools in Boudh district. The data were analysed quantitatively using the problem-solving ability scale (PSAS) and open-ended questions form. PSAS follows a five-point Likert rating method. In case of positive statements, the responses were scored as 5, 4, 3, 2 and 1 for Strongly Agree (SA), Agree(A), Undecided (UD), Disagree(D), and Strongly Disagree (SD) respectively. Conversely, for negative statements, the scoring pattern was reversed as 1, 2, 3, 4, and 5 for SA, A, UD, D, and SD. After collecting the data from respondents, the researcher tabulated the raw scores into a frequency distribution and calculated the

percentage. As per the need of the study, statistical techniques such as mean, standard deviation, t-test and graphical representation including pie-chart and bar graph were employed for data analysis.

Objective-1: Analysis and Interpretation

Objective-1: To study the problem-solving ability of secondary school students.

The investigator adopted the problem-solving ability scale to examining the problem-solving ability of secondary school students in Boudh district, Odisha. The collected data were calculated as per the PSAS on the basis of Lickert's method and presented here with followed by the analysis.

Table-1: Summary including sample size, mean and standard deviation of problem-solving ability of secondary school students by gender (boys and girls).

Summary	Boys	Girls	Total
N	40	40	80
Mean	77.8	80.875	79.337
Standard Deviation	8.379	7.700	8.039

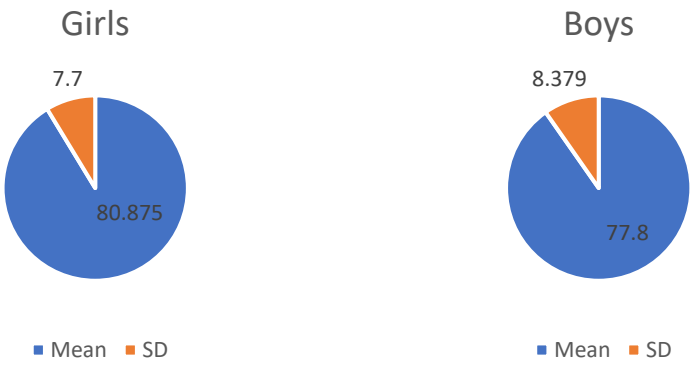


Fig-1: Pie chart shows the mean and standard deviation of boys and girls

Table-1, represent the problem-solving ability scores in science subject of boy and girl students of secondary schools. The mean and standard deviation of problem-solving ability scores in science subject of secondary school students is (79.337 ± 8.039), in which the boy students have (77.8 ± 8.379) and the girl students have (80.875 ± 7.700). From this result it is analyzed that the mean of the boys is 77.8 which is lesser than the girl students that is 80.875 and the standard deviation of the boys (8.379) which is more than the girls (7.700).

Table-2: Summary of problem-solving ability scores in secondary school students by location of school (Rural and Urban).

Summary	Rural Students	Urban Students	Total
N	40	40	80

Mean	78.725	79.95	79.337
Standard Deviation	8.301	8.041	8.171

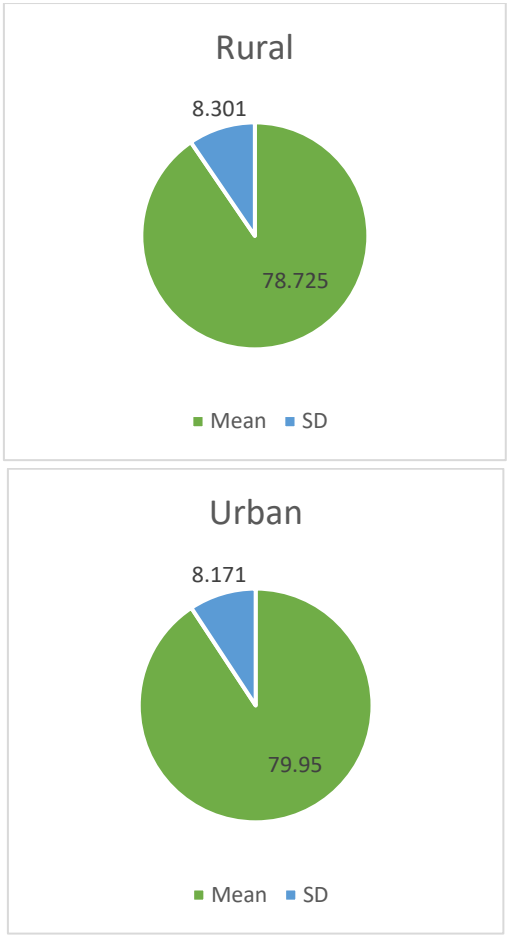


Fig-2: Pie chart shows the mean and standard deviation of Rural and Urban students

The above Table-2, represent the summary of problem-solving ability scores in science subject of rural and urban students of secondary schools. The mean and standard deviation of problem-solving ability scores in science subject of secondary school students is (79.337 ± 8.171), in which the rural students have (78.725 ± 8.30) and the urban students have (79.95 ± 8.041). From the above table-2, it is also concluded that, the mean of the urban students (79.95) which nis more than the result students (78.725) and the urban students possesses less standard deviation as compare to the rural students.

Objective-2: Analysis and Interpretation

Objective-2: To compare the problem-solving ability of secondary school students on the basis of gender (Boys and Girls) and locality (Rural and Urban).

Null Hypothesis (H_{01}): There is no significant difference between the problem-solving ability of secondary school students on the basis of gender (boys and girls).

To test the above null hypothesis, the independent two sample t-test was carried out and the results are presented in the table given below.

Summary of independent two samples t-test with mean, standard deviation, degrees of freedom and t-

value between boys and girls of secondary schools with problem solving ability scores in science subject.

Table-3: comparison of Gender (Boys and Girls)

Gender	n (80)	Mean	S.D.	df	t-value	Significance value (0.05)	Significance value (0.01)
Boys	40	77.8	8.379	78	1.709	Table value (1.990)	Table value (2.639)
Girls	40	80.875	7.7				

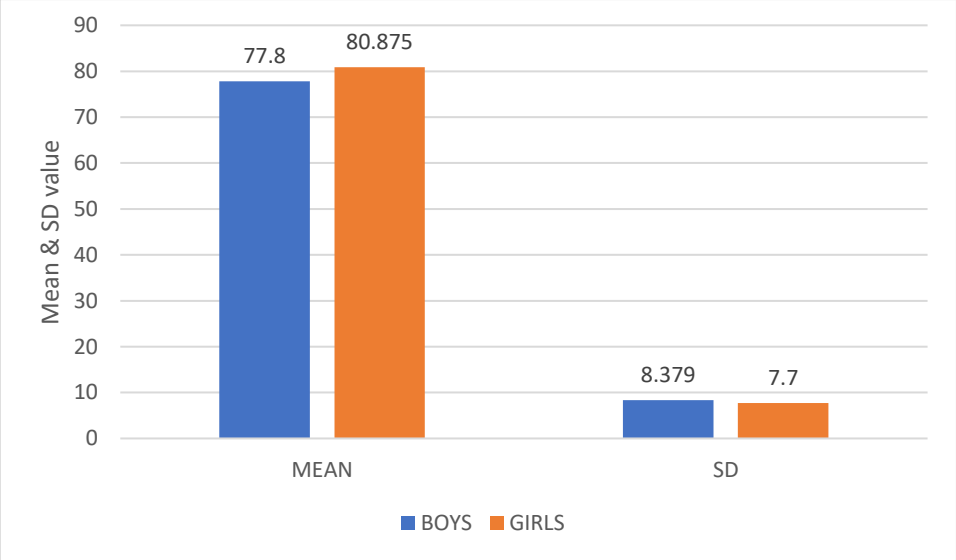


Fig-3: Comparison between boys and girls of secondary schools with problem-solving ability scores in science subject.

The result of the above table clearly shows that; the calculated value of t-test is 1.709 and the critical value of t with 78 degrees of freedom at 0.05 significant level (5% level) is 1.990 and at 0.01 significant level (1% level) is 2.639. It indicates that the calculated value i.e. 1.709 is smaller than both 1.990 and 2.639. It means that, there is no significant difference was observed between boy and girl students of secondary school with problem-solving ability scores in science. Hence null hypothesis H_{01} is accepted.

Null Hypothesis (H_{02}): There is no significant difference between the problem-solving ability of secondary school students on the basis of locality (Rural and Urban).

To test the above null hypothesis, the independent two sample t-test was carried out and the results are presented in the table given below.

Summary of independent two samples t-test with mean, standard deviation, degrees of freedom and t-value between rural and urban secondary school students with problem-solving ability scores in science.

Table-4: Comparison of locality (Rural and Urban)

Locality	n (80)	Mean	S.D.	df	t-value	Significance value (0.05)	Significance value (0.01)
Rural	40	78.725	8.301	78	0.670	Table value (1.990)	Table value (2.639)
Urban	40	79.95	8.041				

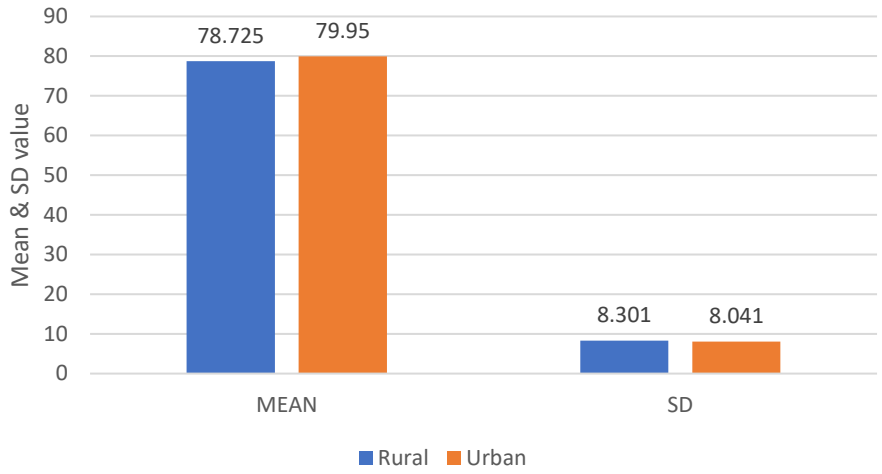


Fig-4: Comparison between students of rural and urban secondary schools with problem-solving ability scores in science.

The result of the above table clearly shows that; the calculated value of t-test is 0.670 and the critical value of t with 78 degrees of freedom at 0.05 significant level (5% level) is 1.990 and at 0.01 significant level (1% level) is 2.639. It indicates that the calculated value i.e. 0.670 is smaller than both 1.990 and 2.639. It means that, there is no significant difference was observed between rural and urban students of secondary school with problem-solving ability scores in science. Therefore, the null H_{02} hypothesis is accepted.

Major Findings of the Study

Findings related to objective-1

1. There was 50% of boys and 50% of girls as sample from total population i.e. 40 number of students from each group.
2. From the table-1, the result was analysed that the mean of the boy group was 77.8, which is lesser than the girl students that was 80.875 and the SD of the boys 8.379 which was more than the girls i.e. 7.700.
3. From the table-2, the mean and SD of PSA score of rural and urban students of secondary school student was (79.337 ± 8.171), in which the rural school students had (78.725 ± 8.301) score and the urban students had (79.95 ± 8.041) scores.
4. From the score analysis the investigator was found that out of 80 students 79 students get the more than 60 scores from 100 score. Means the 98.75% of the students get first class score in problem-solving ability and 11 students secured 90 scores out bof 100. Here, the investigator was found that the more than 13.75% students with high level of problem-solving aboility in science subject.

Findings Related to Objective-2

1. From table-3, the mean of boys students were 77.8 and the mean of girl students were 80.875.
2. The result of the table-4.7, clearly shown that, the calculated value of t-test was 1.709.
3. From the analysis of objective-2, the investigator was found that the null hypothesis (H_{01}) is accepted.
4. From the table-4, the calculated value of t-test was 0.670.
5. From the table-4, the mean of rural student was 78.725 and that of urban student was 79.95, which was slightly different from each other.
6. The investigator was found that the null hypothesis (H_{02}) is accepted.

Findings from Open-ended questions Chart form

1. The investigator was found from the data collection chart form that 54 students attained all the three questions.Means 67.5% of students gives the answer of all three questions.
2. 78 students out of 80 students given the answer of questions 2 & 3.Where as some of the students were not answered the question no. 1.
3. Out of 80 students 2 students attained only question number 2 . but they were not attained the question number 1 & 3 from the open-ended questions chart form.

Result and discussion

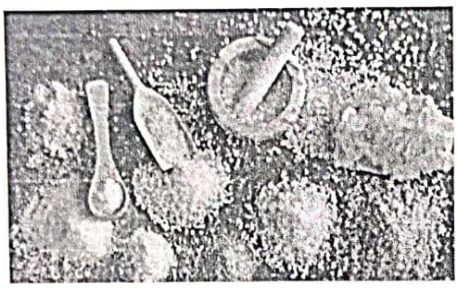
The present research work was planned to find out the problem-solving ability of secondary school students in Boudh district, Odisha on the basis of gender (boys and girls) and locality (rural and urban). Previously, many researches carried out by the other researchers which were same as that of problrm solving ability of secondary school nstudents but from the previous of literature the investigator has not able to find out the exact researches which was related to the problem-solving ability of secondary school students in science subject. In this study the investigator was found that problem- solving ability of secondary school students have no significant difference between gender and locality. This result contrasts with various previous reviews related literatre (Gholami, 2023; Vishwanathan,2021; Amalina & Vidakovich, 2023) i.e. there is a significant variation across demographics factors. This may be the factor like educational oppertunities, facilities available in school, teachers interest towards the students problem solving ability, students interest level for science problems, teachers approaches towards the students problem solving skilss, social and economical back ground of the study.

From the open-ended questions form of this study the investigator was found that 67.5% students were attained the three questions of the data collections chart form. Mean 54 student was attained allnthe questions clearly out of 80 students. The responsed of the students were like attached as follows.

1. A lamp consumes 1000 J of electrical energy in 10 seconds. What is its power?
ଗୋଟିଏ ବିଦ୍ୟୁତ୍ ବଲବ 10 ସେକେଣ୍ଡ ସମୟ ମଧ୍ୟରେ 1000 ଜୁଲ ଶକ୍ତି ବ୍ୟବହାର କରେ ।
ତେବେ ତାହାର ପାୱାର କେତେ ?

Ans- ସମୟ = 10 ସେକେଣ୍ଡ
କାର୍ଯ୍ୟ = 1000J
∴ ପାୱାର = କାର୍ଯ୍ୟ / ସମୟ = 1000J / 10s = 100 ୱାଟ୍ ।

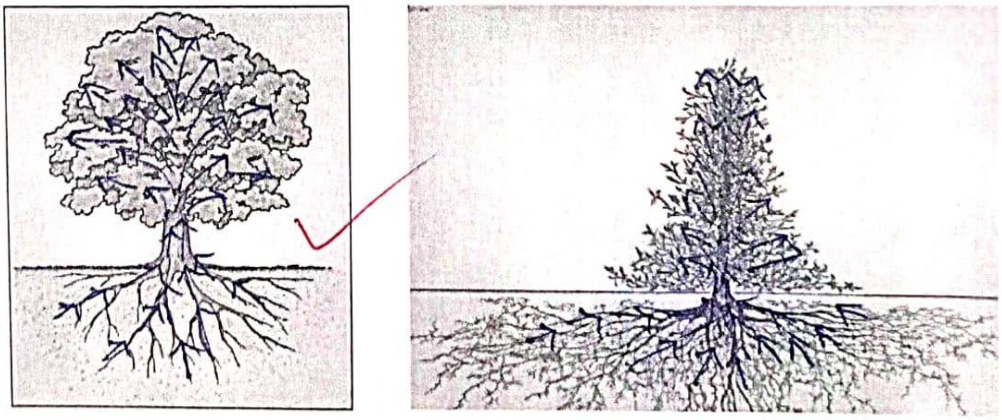
2.



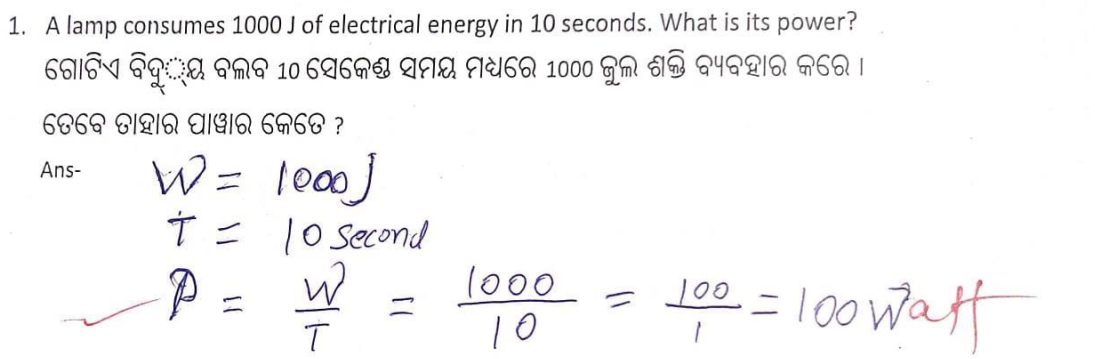
Encircle the chemical formula of the substance which is mentioned in the above fig.
ଉପରୋକ୍ତ ଚିତ୍ରରେ ଦର୍ଶାଯାଇଥିବା ବସ୍ତୁର ରାସାୟନିକ ସଂକେତକୁ ଗୋଲ ବୁଲାଅ ।

a) NaCl b) AgCl c) $NaHCo_3$ d) Na_2Co_3

3. Show the movement of the water during transpiration in a tree by using arrow mark.
ଗଛର ଉତ୍ସେଦନ ସମୟରେ ହେଉଥିବା ଜଳର ପରିବହନକୁ ତୀର ଚିହ୍ନ ମାଧ୍ୟମରେ ଦର୍ଶାଅ ।



Also from the open-ended questions form, the investigator was getting the result that, out of 80 students, nearly 10 students may not popularly known about the unit concept. Due to this more than 12% student was solved the problematic question number-1, but they had not mentioned the unit of power. The sample of the responded as enclosed below;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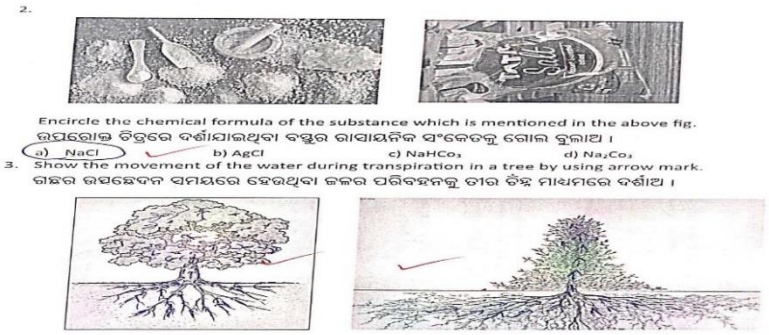
ତେବେ ତାହାର ପାୱାର କେତେ ?
Ans- W = 1000 J
T = 10 second
P = W/T = 1000/10 = 100/1 = 100 Watt

From the open-ended questions form, the result was revealed that, 78 students out of 80 students attained the correct answer of the question-2 and question-3 of the open-ended question form, whereas only 2 students were attained only question number-2.


2.
Encircle the chemical formula of the substance which is mentioned in the above fig.
ଉପରୋକ୍ତ ଚିତ୍ରରେ ଦର୍ଶାଯାଇଥିବା ବସ୍ତୁର ରାସାୟନିକ ସଂକେତକୁ ଗୋଲ କୁଲାଅ ।
a) NaCl b) AgCl c) $NaHCo_3$ d) Na_2Co_3
3. Show the movement of the water during transpiration in a tree by using arrow mark.
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This result may be the factors like student's interest level towards the problem-solving ability, teaching practices and day to day experiences, teacher interest towards the students and teaching learning approaches and environmental background of the students.

Educational Implications

A few educational implications of the study were decided by the investigator based on the findings of the study, which may helps us to understand the problem and improve the educational system.

1. All concern subject teachers should be properly trained and suggest to conduct a practical oriented classes frequently.
2. Students should be given more practical work in the concerned variable like problem-solving ability in science.
3. The presented study helps to explain the students with different aspects of science use in daily life and enable them to recognize that the science plays an important role in human life.
4. The present study helps to develop the power of resoning, critical thinking and application of problrm-solving knowledge among the students.
5. The present study helps to create the close interaction between the students mind and modern world.
6. The result will help to teachers to formulate appropriate teaching learning strategies which are suitable to secondary school students.
7. The present study helps to teachers, students, parents and stakeholders for developing the curriculum content which is suitable to learning style of secondary school students.

8. The study will helps to provide quality education to secondary school students.

Suggestion for further Research

The following suggestion were suggested for the further research;

1. The same study may be undertaken on larger sample of Boudh district.
2. The same study may be conducted for students of primary school and university college.
3. Effectiveness of problem-solving ability on accademic acchievement an experimental study may be undertaken.
4. The study like this may be conducted for students studing in any private, semi-government and residential schools of Boudh district.
5. A study of problem- solving ability of teacher may be conducted.
6. A study of teacher cometence in problem solving ability in science and mathematics may be conducted.
7. The same study may be conducted with other variables like teachers, administrator and management of the secondary school.

Conclusion

The present study evaluated the science problem solving ability of secondary school students in Boudh district of Odisha. Findings revealed that the mean score of boys (77.8) was lower than that of girls (80.875), and the mean score of urban students (79.95) was higher than that of rural students (78.725). The calculated t-value for gender comparison was 1.709, and for locality comparison it was 0.670. The study highlights that while the students gave response there remains a significant gap in their application related understanding of scientific problems. Also, some students were not able to solve the open-ended questions properly which were related to science concepts. This suggests a need for more problem practiced, activity based, inquiry oriented, reasoning based and experimental learning approaches in science classroom of the secondary school. In this modern scientific era, strengthening of science problem solving ability is not only crucial for scientific learning, but also nurturing for rationality, creativity, reasoning, problem-solving, and independent thinking skills in the student's mind. As students are the mirror and future citizen of the modern scientific progressive society the science problem solving ability and its factor like reasoning, rationality, creativity, abstract thinking etc. are very essential for the secondary school students.

References

1. Amalina, I.K., & Vidakovich, T. (2023). Development and differences in mathematical
2. problem-solving skills: A cross-sectional study of differences in demographic
3. backgrounds. Heliyon, 9(5). https://doi.org/10.1016/j.heliyon.2023.e16366
4. E. Stiadi (2024). Analysis of elementary school students' problem-solving abilities in solving
5. HOTS questions. International Journal of Research and Review. 2024; 11(4): 442-447.
6. DOI: https://doi.org/10.52403/ijrr.20240449
7. Gholami, H. (2023). Performance of Malaysian Foundation Level Students in Mathematical
8. Problem Solving as well as Gender Comparison. Mathematics Teaching Research
9. Journal, 15(2), 104-120. https://files.eric.ed.gov/fulltext/EJ1394816.pdf
10. Lalduhawma, R. (2023). A Study on Problem-Solving Ability of Class XI Students in Aizawl
11. City in Relation to their Stream of Study. International Journal of Creative Research

12. Thoughts (IJCRT), 11(3), 103-108. https://ijcrt.org/papers/IJCRT2303709.pdf
13. Martaningsih et al., (2022). STEM problem-based learning module: A solution to overcome
14. elementary students' poor problem-solving skills. Pegem Journal of Education and
15. Instruction, 12(4), 340-348. https://doi.org/10.47750/pegegog.12.04.35
16. Ministry of Education. (2020). National education policy 2020. Government of India. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
17. Padhi et al., (2025). Problem Solving Skills of Secondary School Students: A Review.
18. International Journal of Creative Research Thoughts 13(3 March 2025):14. http://dx.doi.org/10.1729/Journal.44775
19. Vishwanatham, J. (2021). Problem-Solving Ability in Mathematics Among Secondary School Students with Respect to Parents' Educational Qualification. The International Journal of Indian Psychology, 9(4), 917-922. https://ijip.in/wp-content/uploads
20. 2021/11/18.01.087.20210904.pdf Wulansari, P., and Jupri, A. (2022). Students' Mathematical Problem-Solving Ability: Mathematics Teachers' Perception in Sumatra. International Conference on Education in Mathematics, Science and Technology, 113-129. https://files.eric.ed.gov/fulltext/ED631060.pdf
21. Zhuzhu, X., & Chunxia, Q. (2022). Middle school students' mathematical problem-solving ability and the influencing factors in mainland China. Frontiers in Psychology. https://doi.org/10.3389/fpsyg.2022.1042315