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INFORMATION AND COMMUNICATION TECHNOLOGY ON PROBLEM SOLVING ABILITIES OF STUDENTS OF HIGHER SECONDARY STUDENTS: AN EXPERIMENTAL STUDY

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Abstract

The world in the 21st century is changing fast due to the continuous advancement of technology. All such advancements are somehow connected to mathematics and Science. Mathematics and Science is no longer perceived as a subject for basic computations. Rather, Science knowledge is considered as one of the key catalysts of such advancement. According to Redecker and Johannessen (2013), students must be prepared with sufficient Science skills and competencies to cope with this 21st-century world. That indicates students must have to learn Science with proper understanding. Research shows that students fail to develop a meaningful understanding of Science if it is taught with an emphasis on drill and practice and rote learning of formulas. It is argued that learning Science becomes effective when the teaching and learning approach aims to develop students' conceptual understanding rather than focusing on the correct solution to a problem. In India our country always has been a major seat of learning for centuries and education has ever been looked on Indian culture as a holistic effort. The NEP (1986) was a landmark in our education system, based on a depth review of the Indian educational system. With advent, rapid expansion and use of information and communication technology in every sphere of life. To work with ICT in science teaching is also helpful up to secondary level as it helps to create a concrete focus on teaching with holistic cognitive behaviour in the teaching-learning process. Present study has investigated the impact of ICT on learning science and problem-solving ability on the achievement of students. Result shows there is no significant difference in problem solving abilities of students of science of senior secondary classes of CBSE or JAC Board. There is no significant difference in the problem-solving abilities of students (Boys and Girls) of senior secondary classes of CBSE and JAC Board. But there is significant difference in problem solving abilities of students of senior secondary classes teaching through traditional teaching and teaching with ICT. Therefore, ICT has major impact on learning and Research shows effectiveness of ICT in teaching-learning process of education system.

Keywords: ICT-facilitated classroom, conceptual understanding, reasoning skill, case study, intervention, ICT (Information & Communication technology), CBSE (Central Board of Secondary Education), JAC. Board (Jharkhand Academic Council Board), Higher Secondary classes, Achievement ability, Problem Solving Ability, Effectiveness Interdisciplinary, Traditional Teaching.



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1.0 Introduction

Our country has been always a major seat of learning for centuries and Education has even been looked at Indian culture, as a holistic effort. After Independence, our country witnessed phenomenal educational development both in qualitative and quantitative terms. The NEP (1986) was a landmark of our education

system after the Program of Action (POA) makes educational structure comprehensive and differential. Technology has considered the important factor for rapid growth and development of students Computer assisted Instructional, Educational technologies. Information and communication technology etc. have become popular in education system. ICT in education having accessibility and attractiveness by using different types of tools. The effect of ICT tools in educational domain transformed to increase gains for students to enhance their cognitive abilities, analytical attitude and scientific temperament. Science and technology considered an important factor for rapid growth and development in modern era of education system. Present era is called the age of information and technology which computed with informative platform like internet, chrome, Wikipedia,

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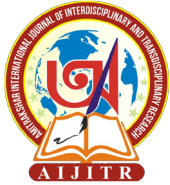
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yahoo etc. Today research shows that the use of computer and internet makes the classroom more interactive and communicative with intelligent friend of teacher and learner. In 1964-66, Indian education commission under the chairmanship of Dr. D.S Kothari gave the recommendation of science teaching and learning

- Science and mathematics should be taught as a compulsory subject for all students as an integral part of general education during first ten years of schooling.
- Science should be modernized, stressing on the investigatory approach and with understanding the basic principles. Laboratory work will need considerable Improved. UNESCO consider information technology as “Scientific, Technological and Engineering disciplines and Management techniques used in information handling and processing their application. Computer and its interaction with man and machines associated social, economic and cultural matters.” New Avenue information as E-Learning, E-journal, Mobile have been used as a part of information and communication technology. It is used in every corner of educational level including such areas:

- Teaching
- Diagnostic and Remedial teaching
- Evaluation
- Psychological testing
- Development of Reasoning and Thinking
- Development of Instructional material

Chan L: “The fundamental to next generation school have 1:1 learning experience that is every student will equipped with laptops, I pad, tablet or other computerized devices.” Heeks R: “ICT is one of the key skills needed to access and enrich learning of all kind of education. It will be communicated with the world in which next generation growing up. It will play vital role of education, whatever they do called ICT literate.” Bingham has Classified the scientific attitude has attributes that is critical thinking, open-mindedness, search for truth, spirit for query, confidence etc. which are essential for solving the problem scientifically. ICT in science teaching become helpful at secondary level to create a content focus on teaching to holistic, connotative behaviour teaching. High quality instructional and modules material will be available through Internet and be available to every individual to access the knowledge.

1.1 Literature Review

Students with proper conceptual understanding and adaptive reasoning in science are vital in this fast-changing world. Conceptual Understanding (CU) is one of the science abilities that enables students to organize their knowledge. Scientific understanding means knowledge about unrelated concepts and the ability to explain their relationship (Kilpatrick et al., 2001; Kenedi et al., 2019). Students can apply and adapt acquired Scientific ideas to explain new Scientific concepts (Kilpatrick et al., 2001). The authors claimed that students could use several Scientific representations and communicate their ideas if they have a conceptual understanding. Adaptive reasoning (AR) is thinking logically, estimating the answer with proper justification, and judging Scientific truth (Milgram, 2007). Consequently, students with adaptive reasoning skills have the ability to estimate, support their claims with arguments or proof, and draw inferences (Kilpatrick et al., 2001). In a study, Marasabessy (2021) claimed that students’ logical thinking abilities will be formed by involving them in non-routine tasks. In this situation, students connect concepts and context by their logical thinking capability. Besides, reflective thinking skills (e.g., the ability to explain, the ability to justify) are also generated by logical thinking. Students’ adaptive reasoning ability is vital as it helps them cope with real-life situations (Marasabessy, 2021).

1.2 Rationale of the study

The integration of Information and Communication Technology (ICT) fundamentally transitions science education in the Ranchi district from rote memorization to active, inquiry-based cognitive processing. Local research and educational initiatives indicate that ICT tools directly bridge the gap between abstract scientific theories and practical, real-world problem-solving abilities among high school and higher education science students. The structural rationale for deploying ICT to advance problem-solving capacities in this specific region breaks down into several key dimensions.

1. Concrete Visualization of Abstract Scientific Phenomena

Traditional classrooms in Jharkhand often struggle to convey abstract fields like quantum mechanics, molecular genetics, or organic chemistry through a simple chalkboard.

Virtual Simulations: Utilizing platforms like PhET Interactive Simulations or Labster Virtual Labs allows students to run risk-free, repeatable experiments.

Cognitive Impact: Instead of passively memorizing scientific laws, students can actively manipulate independent variables (e.g., changing pressure or temperature) and visually isolate cause-and-effect relationships. This strengthens their hypothesis-testing and variable-isolation capabilities.

2. Bridging Educational and Cultural Disparities

Ranchi features a diverse student demographic, including a significant population of both tribal and non-tribal students.



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Equitable Learning Environments: Studies focusing on high schools in Ranchi Town show that traditional text-based pedagogies can unintentionally widen performance gaps due to differing socio-cultural background baselines.

Cognitive Impact: ICT acts as a universal instructional equalizer. Multi-sensory software, digital whiteboards, and localized multimedia tools decode language barriers and give all students equal visual and interactive pathways to build essential troubleshooting skills.

3. Fostering Experiential and Collaborative Thinking

State-led education policies have actively moved away from teacher-centric lecturing toward outcome-based, student-led discovery.

State Initiatives: Under the Rashtriya Avishkar Abhiyan, the Jharkhand Education Project Council (JEPC) collaborated with private foundations to launch student-led Math and Science Clubs in Ranchi and surrounding districts.

Cognitive Impact: These initiatives supply ICT-enabled kits that demand collaborative data analysis. Working together through a learning management system or shared software teaches students to debate peer feedback, evaluate diverse perspectives, and cooperatively solve open-ended scientific challenges.

4. Transitioning to Computational and Analytical Data Handling

The modern professional landscape in Jharkhand heavily prioritizes data-driven engineering and science sectors.

Tool Familiarization: Local technical institutes and schools of excellence in Ranchi increasingly introduce science students to computational logic through specialized software like MATLAB, LabVIEW, and basic data analytics tools.

Cognitive Impact: Rather than spending hours mapping manual data entries, students use ICT to instantly plot data points, analyze trends, and identify anomalies. This automated efficiency frees up mental space, allowing them to focus on high-level diagnostic tasks and mathematical deductions.

Hence keeping all these viewpoints in mind, present study naming has been undertaken by investigator. After discussing the above paragraph, the researcher has to point out the research topic given in statement of problem.

1.3 Statement of the Problem:

The researcher was selected the following topic entitled as “INFORMATION AND COMMUNICATION TECHNOLOGY ON PROBLEM SOLVING ABILITIES OF STUDENTS OF HIGHER SECONDARY STUDENTS: AN EXPERIMENTAL STUDY.”

1.4 Objectives of Study:

1. To study the impact of ICT on problem solving abilities of students of senior secondary classes.
2. To study the effectiveness of ICT on problem-solving abilities of students of senior secondary classes.

1.5 Hypothesis of Study:

1. There is no significant difference on problem-solving abilities of students of senior secondary classes affiliated to JAC Board and CBSE Board.
2. There is no significant difference on problem solving abilities of students of senior secondary classes learning through traditional method and learning through ICT.

1.6 Design of the study

Present research work is focus on problem-solving abilities of science of secondary school students learning through by traditional teaching and by ICT. It will be an implication for educational researchers to frame the policies and plans. Research work interdisciplinary in nature as it attempts to combine human behaviour with information technology. The procedure adopted to conduct the study of Problem-Solving ability showing difference between CBSE and JAC Board students of Science Stream It will be show the difference among boys and girls regarding problem-solving abilities of CBSE and JAC Board. Further it will show the difference CBSE and JAC Board should regarding problem-solving abilities by using traditional method of teaching and by ICT. Experimental method has been adopted for solving educational problems who are studying local as well as international aspect of education.

Controlled Group:

Students of secondary classes of JAC. and CBSE Board.

Traditional method of teaching

Uncontrolled Group/ Experimental Group:

Teaching through ICT

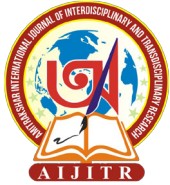
The current research work deals with achievement ability of students of science of secondary school. It will deal with students of 11th and 12th of science of JAC and CBSE Board in Ranchi district Jharkhand..

Independent Variable:

Achievement ability

1.7 Methods of the study

Experimental method is used for data collection which is more fast, cheap, easy and most flexible.



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1.8 Self-made Standardized Tool: Achievement ability test (11th and 12th class)

Test is prepared with the textbook of 11th and 12th JAC Board and CBSE Board. 11th physics achievement test related to content. Work, energy and power, Heat and energy and Electro waves and 12th Physics achievement test related to Optics (Reflection and Refraction of light), Electromagnetic waves and Atom theory. The questionnaire is related to objective of knowledge, understanding, application and skill.

Reliability coefficient $r=0.89$ for achievement ability. Mean, S.D, T- values are used to analysis the data. The chi-square test is based on the statistic that measures the divergence of the observed data from the values to be expected under null hypothesis of no association. The obtained value from the analysis of achievement of ability was coded as data in access field Statistical Package for Social Science (SPSS) to perform statistical analysis.

1.9 Analysis interpretation and findings of the study

Here the researcher testing hypothesis as well as objectives was as follows.

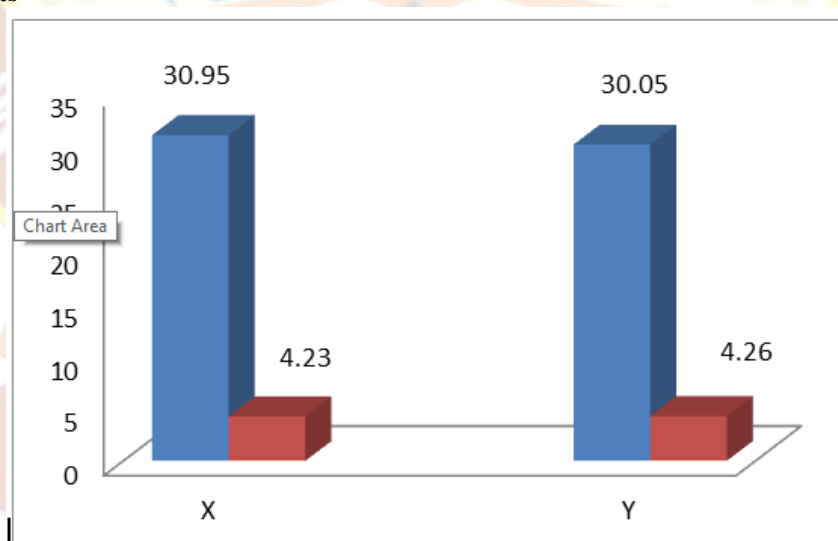
1. Showing difference between CBSE and JAC Board regarding problem solving ability

The mean and standard deviation of problem solving ability of CBSE and JAC Board adolescents along with t-value are given in table 4.1

Group Board	N	Mean	S.D	df	Sig.level	t- value		Result
						CV	TV	
CBSE	100	30.95	4.23	198	0.05	1.49	1.97	Rejected significant
JAC	100	30.05	4.26					

Table 4.1 shows the mean differences of CBSE and JAC board students. It was showed that means scores and SD of CBSE students is 30.95 and 4.23 and that of JAC board students are 30.05 and 4.26 respectively. The calculated t-value is 1.49 which in comparison with the table value 1.97 with df equal to 198 was found significant at 0.05 level. It indicates that there is significant difference in the mean scores of CBSE Board students and JAC Board students at 0.05 level of significance. As from the table 4.1, it is clear that mean scores of CBSE Board students (30.95) are higher as compared to mean scores of JAC Board students (30.05). Therefore, it may be concluded that CBSE Board students have significantly higher level of problem solving abilities as compared to JAC Board students. Therefore, the Null Hypothesis 1—There is no significant difference in CBSE Board students and JAC Board students is rejected.

Graphical Presentation of difference between CBSE and JAC Board regarding problem solving abilities of higher secondary school students



X= Mean and SD of problem solving ability of higher secondary school students of CBSE were 30.95 and 4.23 respectively. Y= Mean and SD of problem solving ability of higher secondary school students of JAC Board were 30.05 and 4.26 respectively

2. Showing difference between CBSE and JAC Board student (Boys and Girls) regarding problem solving ability

The mean and standard deviation of problem solving ability of CBSE and JAC Board student (Boys and Girls) along with t-value are given in table 4.2



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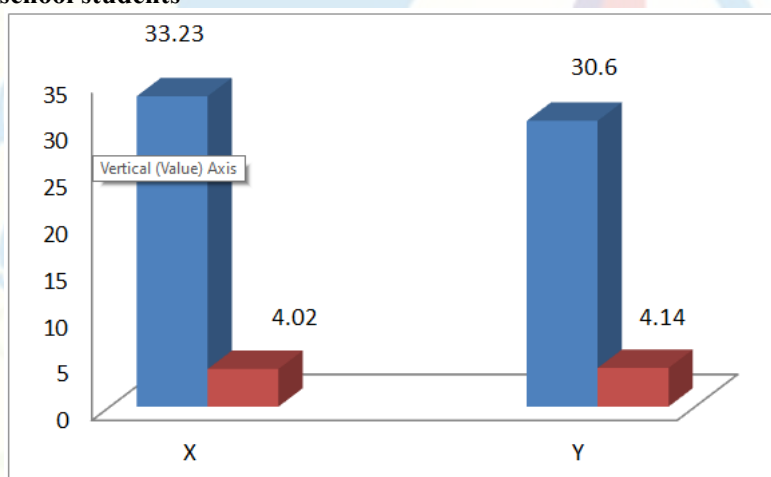
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Group Board	N	Mean	S.D	df	Sig.level	t- value		Result
						CV	TV	
Boys	100	33.23	4.02	198	0.05	0.79	1.97	Rejected significant
Girls	100	30.60	4.14					

Table 4.2 shows the mean differences between Boys and girls of CBSE and JAC board students. It was showed that means scores and SD of boys students of CBSE and JAC board is 33.23 and 4.02 and that of girls of CBSE and JAC students are 30.60 and 4.14 respectively. The calculated t-value is 0.79 which is comparison with the table value 1.97 with df equal to 198 was significant at 0.05 level. It indicates that there is significant difference in the mean scores of boys and girls of CBSE Board students and JAC Board students at 0.05 level of significance. As from the table 4.2, it is clear that mean scores of boys of CBSE and JAC Board students (33.23) are higher as compared to mean scores of girls of CBSE and JAC Board students (30.60). Therefore, it may be concluded that boys of CBSE and JAC Board students have significantly higher level of problem solving abilities as compared to girls of boys of CBSE and JAC Board students. Therefore, the null Hypothesis 2—There is no significant difference between boys and girls of CBSE and JAC Board students is rejected.

Graphical Presentation of difference between CBSE and JAC Board (Boys and Girls) regarding problem solving abilities of higher secondary school students



X= Mean and SD of problem solving ability of higher secondary school students CBSE and JAC Board Boys student were 33.23 and 4.02 respectively.

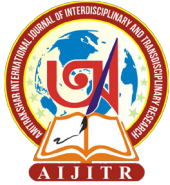
Y= Mean and SD of problem solving ability of higher secondary school students CBSE and JAC Board girls student were 30.60 and 4.14 respectively

3. Showing difference between CBSE and JAC Board students regarding problem solving ability using ICT and traditional method of teaching

The mean and standard deviation of problem solving ability of CBSE and JAC Board student by using ICT and traditional method of teaching along with t-value are given in table 4.3

Group Board	N	Mean	S.D	df	Sig.level	t- value		Result
						CV	TV	
ICT	100	32.27	3.71	198	0.05	8.81	1.97	Rejected Significant
Traditional	100	28.86	3.56					

Table 4.3 shows the mean differences of emotional intelligence of urban and rural adolescents. It shows that means scores and SD of urban and is 55.96 and 14.94 and that of rural are 58.80 and 10.18 respectively. The calculated t-value is 2.49 which in comparison with the table value was found is not significant at 0.05 level. It indicates that there is no significant difference in the emotional intelligence scores of urban and rural adolescents at 0.05 level of significance. As from the table 4.19, it is clear that mean scores of rural adolescents (58.8) are higher as compared to mean scores of urban adolescents (55.96). Therefore, it may be concluded that rural adolescents have significantly higher level of emotional intelligence as compared to urban adolescents. Therefore, the Hypothesis 2—There is no significant difference in emotional intelligence of urban and rural adolescent's



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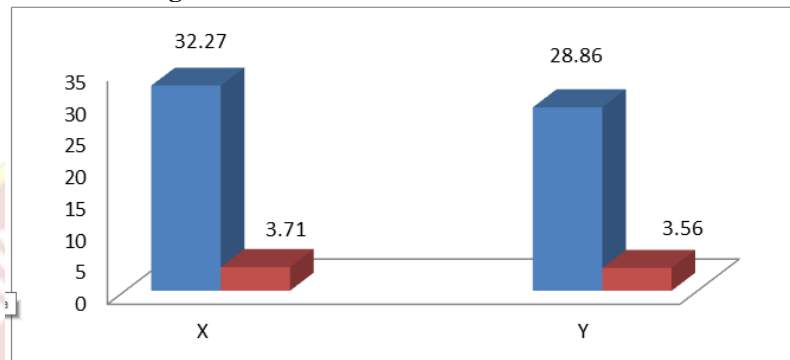
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stands is partially accepted.

Graphical Presentation of difference between CBSE and JAC Board students regarding problem solving ability using ICT and traditional method of teaching.



X= Mean and SD of problem solving ability by using ICT of higher secondary school students were 32.27 and 3.71 respectively.

Y= Mean and SD of problem solving ability by using traditional teaching method of higher secondary school students were 28.86 and 3.56 respectively.

Group used ICT has higher level of significance than the group used traditional method of teaching.

1.10 Result:

- There is no significant difference in the problem-solving abilities of students of science of senior secondary classes of CBSE and JAC Board.
- There is no significant difference in the problem-solving abilities of students (Boys & Girls) of senior secondary classes of CBSE and JAC Board.
- There is significant difference in the problem solving abilities of students of senior secondary classes teaching through traditional and ICT.

1.11 Conclusion

Present research work analysis shows the effectiveness of ICT on problem solving abilities of students of science senior of secondary classes. For the conclusion of effectiveness ICT learning material is more effective than traditional teaching. The enhancement of achievement by using ICT was found significant. Which shows by using ICT than the group used traditional method of teaching. Thus, the technology has demonstrated great impact on the learning and achievement of students.

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