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STATUS OF SCIENCE TEACHING AT THE SECONDARY STAGE

Sasmita Behera, Dr. Rajalakshmi Das

Research Scholar, Reader in Education

Master of Education
Radhanath Institute of Advanced Studies in Education, Cuttack, Odisha, India

Abstract: This study explores an overview of science education at the secondary level in Cuttack district of Odisha. The research aimed to evaluate key aspects such as infrastructure, instructional practices, teaching aids, use of ICT, teacher skills, and student achievement. A descriptive survey method was employed with a sample of 15 secondary schools, involving 30 science teachers, 75 Class IX students, and 15 school heads. Data were collected using questionnaires, interviews, and observation schedules. Findings indicated that while most schools had science laboratories and some ICT facilities, traditional teaching methods were predominantly used. A minority of teachers adopted innovative approaches like the 5E model. Teachers reported several challenges, including inadequate periods for science instruction, lack of storage for materials, and insufficient training. The study recommends improving infrastructural facilities, promoting activity-based teaching, and providing periodic in-service training for science teachers, Enhancing the quality of science education at the secondary level is essential.

Index Terms - Science Teaching, Secondary Education, Teaching Methods, ICT in Education,Teacher Training, Instructional Materials, Student Achievement

I. INTRODUCTION

Human beings possess an inherent curiosity. They strive to comprehend the 'how' and 'why' of all-natural phenomena and their surroundings. This quest for knowledge initially includes fundamental aspects of the natural world. For example, a child exhibits curiosity about the mechanics of wind, the composition of clouds, and the transformation of a small seed into a majestic tree.[1]. As he grows up, he comes across more complicated events and objects. He inquires, 'What is the source of metals like gold and silver?' or 'How is a television able to receive and broadcast exact pictures of far-off incidents and programs or functions of distant places? The human mind is perpetually engaged in the pursuit of

exploring the unknown. This endeavor to satisfy the spirit of inquiry, along with the methodologies employed to delve into the complexities of nature, can be aptly described as science.

Human beings, through their inherent intelligence, have consistently endeavored to adapt to the natural world by developing methods and strategies that serve their interests. They have persistently sought to harness the forces of nature to enhance their comfort and ensure their safety. These endeavors have culminated in the scientific method, which underpins the foundation of all scientific inquiry.[1] Springer US (2011) Inquisitive Behaviors

II. REVIEW OF RELATED LITERATURE

Vidyapati and Pareek (2009) investigated science teaching in rural secondary schools using a sample of 250 students and 27 teachers from 25 schools. Data collection involved surveys and observation. Results indicated that 90% of schools lacked dedicated labs, lab facilities were underutilized, and science exhibitions were infrequent. Most schools had only one teacher for both physical and biological sciences.

Mohanty (2010) examined infrastructure and instructional aspects in rural secondary schools. Tools included teacher and student feedback. The study found that 80% of teachers used teaching aids and reference books, but many-faced high workloads and time constraints. Science exhibitions were common, but large class sizes and lack of preparation time limited effective teaching.

Swain (2011) assessed science teaching in rural Odisha schools with 150 Class-X students and 50 science teachers. Surveys and academic records were used. The study found that most teachers held B.Sc., B.Ed. degrees, and 69% of schools had separate science labs. Teachers predominantly used the demonstration method and various instructional materials. Challenging topics included Heat, Atoms, Light, and Respiration.

Mizzis (2013) explored challenges encountered by educators instructing beyond their area of expertise. Tools included teacher interviews

and classroom observations. Findings showed teachers were more confident and effective when teaching within their specialization than

outside it.

Alharbi (2014) studied the impact of ICT in science classrooms. Student perception surveys were used. Results showed that ICT enhanced teacher confidence and student engagement, and supported curriculum implementation. The study recommended better integration of technology in teaching.

Ngozi and Halima (2015) investigated biology lab facilities and student performance in Zaria, Nigeria. The study analyzed SSCE results and lab resource data. Findings indicated poor lab facilities, limited practical sessions, and a strong positive relationship between lab use and academic achievement.

Savelsbergh (2016) examined the effect of innovative teaching strategies in science and math, such as inquiry-based learning and ICT integration. Findings highlighted significant improvements in student attitude and achievement, especially among younger learners.

III. STATEMENT OF PROBLEM

The problem under study is stated as: **STATUS OF SCIENCE TEACHING AT THE SECONDARY STAGE.**

IV. OBJECTIVES OF THE STUDY

The objectives of the study were:

1. To study the status of science teaching at the secondary stage with regard to:

- Availability of science laboratory and laboratory equipment
- Provision of ICT
- Number of periods allotted for teaching science
- Methods followed by the teachers
- Skills used by the teachers
- Availability of teaching aids
- Teaching aids used by teachers
- Science activities conducted
- Evaluation procedure adopted
- Achievements of the students.

2. To study the need for in-service training of the teachers in teaching science at the secondary stage.
3. To study the problems faced by teachers in teaching science.
4. To give suggestions for effective teaching science at the secondary stage.

V. DELIMITATION OF THE STUDY

The research was limited to 15 secondary schools in the Cuttack district, which are affiliated with the Board of Secondary Education, Odisha. The study focused on teachers instructing Science at the secondary level and students in class IX

VI. METHOD

The present study employed a Descriptive Survey method to examine the status of science teaching at the secondary stage in the Cuttack District

VII. SAMPLING

Out of all the secondary schools in the Cuttack district of Odisha that are affiliated with the Board of Secondary Education, Odisha, 15 schools were chosen at random. From these schools 30 teachers teaching science were taken. The teachers were selected through the method of purposive sampling. A total of 30 teachers and 75 students from class IX, along with 15 heads of institutions, were randomly selected from each school, with 5 students chosen from each institution.

THE STRUCTURE OF THE SAMPLE POOL IS GIVEN

TABLE 1

S. No.	Name of the Schools	No. of Science teachers	No. of Class-IX Students	Number of Heads of Institutions
1.	Balu Bazar High School, Cuttack	2	**5**	1
2.	Marwari High School, Cuttack	2	**5**	1
3.	Practicing Govt. Girls' High School, Cuttack	2	**5**	1
4.	B.N. Bidya Pitha, Athgarh, Cuttack	2	**5**	1
5.	Ravenshaw Girls' High School, Cuttack	2	**5**	1
6.	Kajibazar High School, Cuttack	2	**5**	1
7.	Govt. Girls' High School, Athgarh, Cuttack	2	**5**	1
8.	Ranihat High School, Cuttack	2	**5**	1
9.	Board High School, Cuttack	2	**5**	1
10.	City High School, Cuttack	2	**5**	1
11.	Badambadi High School, Cuttack	2	**5**	1
12.	Ravenshaw Collegiate School, Cuttack	2	**5**	1
13.	Sabitri Ratha Bidyapitha, Athgarh, Cuttack	2	**5**	1
14.	Ananta Beaura Bidya Pitha, Kuleilo, Cuttack	2	**5**	1
15.	Govt. High School Kakhadi, Cuttack	2	**5**	1
	Total	**30**	**75**	**15**

VIII. STATISTICAL TECHNIQUES USED

The data gathered from the questionnaires, interview schedules, and observation schedules was analysed using both frequencies and percentages. In addition to the quantitative analysis of the responses, the investigator also employed qualitative analysis methods.

IX. TOOLS USED

The following tools were developed by the investigator for the purpose of data collection.

1. Questionnaire for Teachers Teaching Science.
2. Questionnaire for Students.
3. Interview Schedule for Head of the Institutions.
4. Observation Schedule.

X. PROCEDURE OF DATA COLLECTION

The investigator collected data personally by visiting the institutions. After selecting 15 schools in the Cuttack District, the investigator visited the schools with the questionnaires meant for teachers teaching science and students, an interview schedule for the heads, and an observation schedule. They were requested to fill out the questionnaire freely. The filled questionnaires were collected from them after they had completed them. An interview was conducted to collect information from the heads of the institutions. The investigator also observed the classrooms of teachers teaching science in the Cuttack District.

XI. ANALYSIS OF DATA

Table 2 summarizes the key findings of the research, focusing on the main variables analysed, their values, and the statistical significance. It provides a clear reference for understanding the relationships among the studied factors related to determining the status of science teaching at the secondary stage.

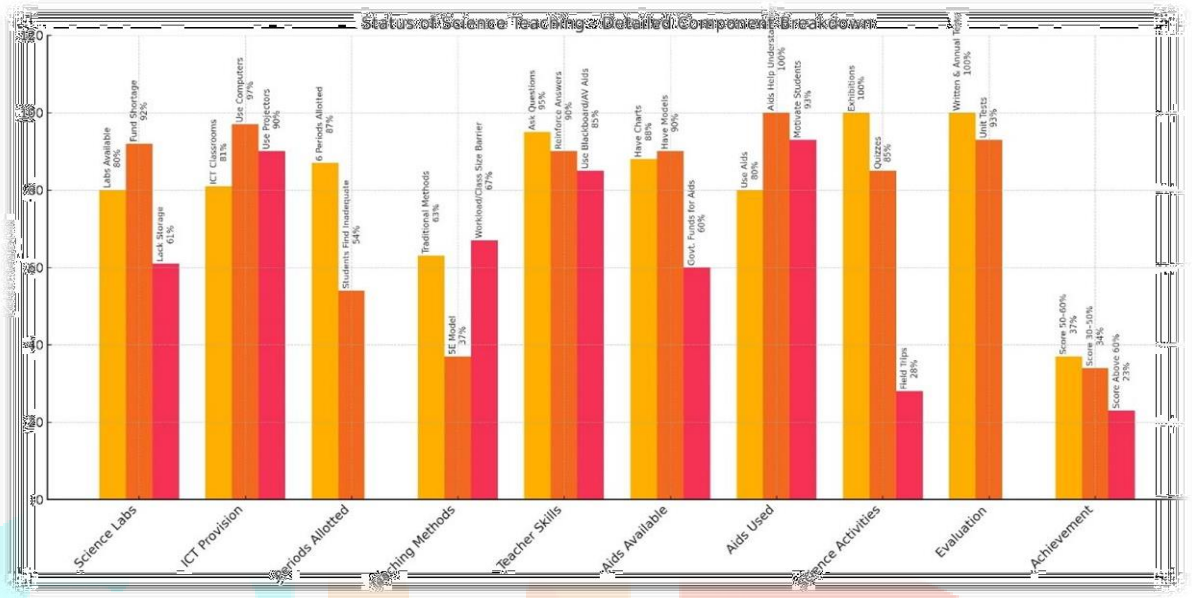
Table 2

The status of science teaching at the secondary stage

Focus Area	Key Findings with Percentages
Availability of science laboratory and equipment	80% have labs; 92% face fund shortages; 61% lack storage
Provision of ICT	81% ICT classrooms; 97% use computers; 90% use projectors
Number of periods allotted	87% of schools allot 6 periods/week; 54% of students find it inadequate
Methods followed by teachers	63% use traditional methods; 37% use 5E model; 67% cite workload/class size as a Barrier
Skills used by teachers	95% ask questions; 90% reinforce answers; 85% use blackboard & AV aids
Availability of teaching aids	88% have charts; 90% have models; 60% receive govt. funds for aids
Teaching aids used	80% use aids; 100% say aids help understanding; 93% say they motivate students
Science activities conducted	100% hold exhibitions; 85% quizzes; 28% field trips; 12% science clubs
Evaluation procedure adopted	100% use written tests & annual exams; 93% conduct unit tests

Achievements of students	37% scored 50–60%; 34% scored 30–50%; only 23% scored above 60%

To study the need for in-service training of the teachers in teaching science at the secondary stage.



The Graph Related to Table 2

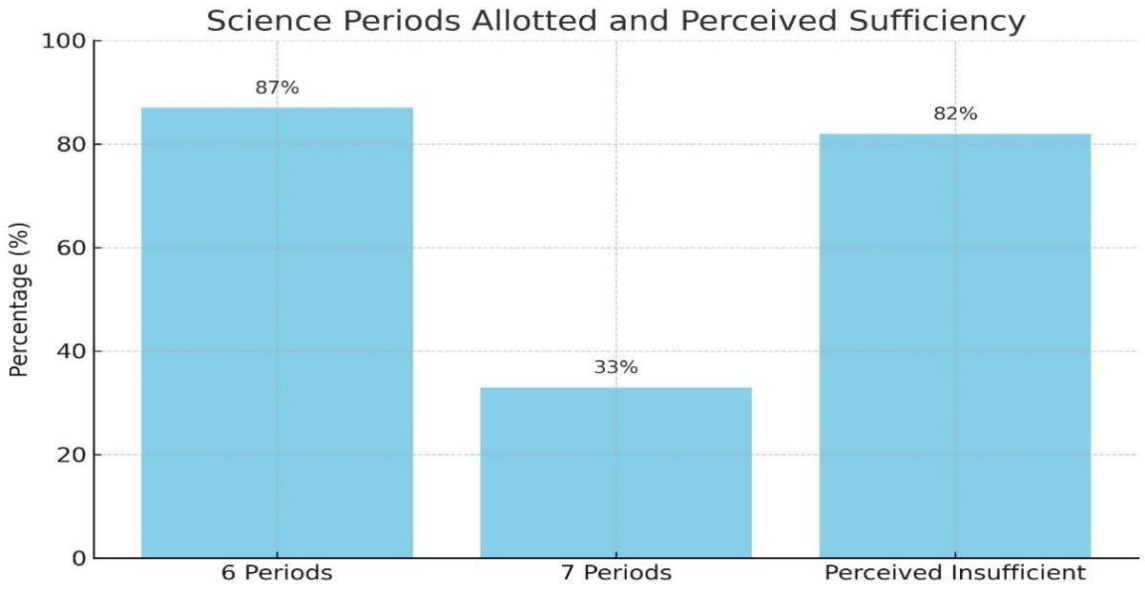
NUMBER OF PERIODS ALLOTTED FOR SCIENCE TEACHING PER WEEK

The number of periods allotted for teaching science in the schools has been presented in Table 3

Table 3

Number of Periods Allotted for Science Teaching Per Week

Class	Number of periods (per week)	Teachers	
		N	%
IX	6	13	87
	7	5	33



Graph related to number of periods allotted for science teaching per week

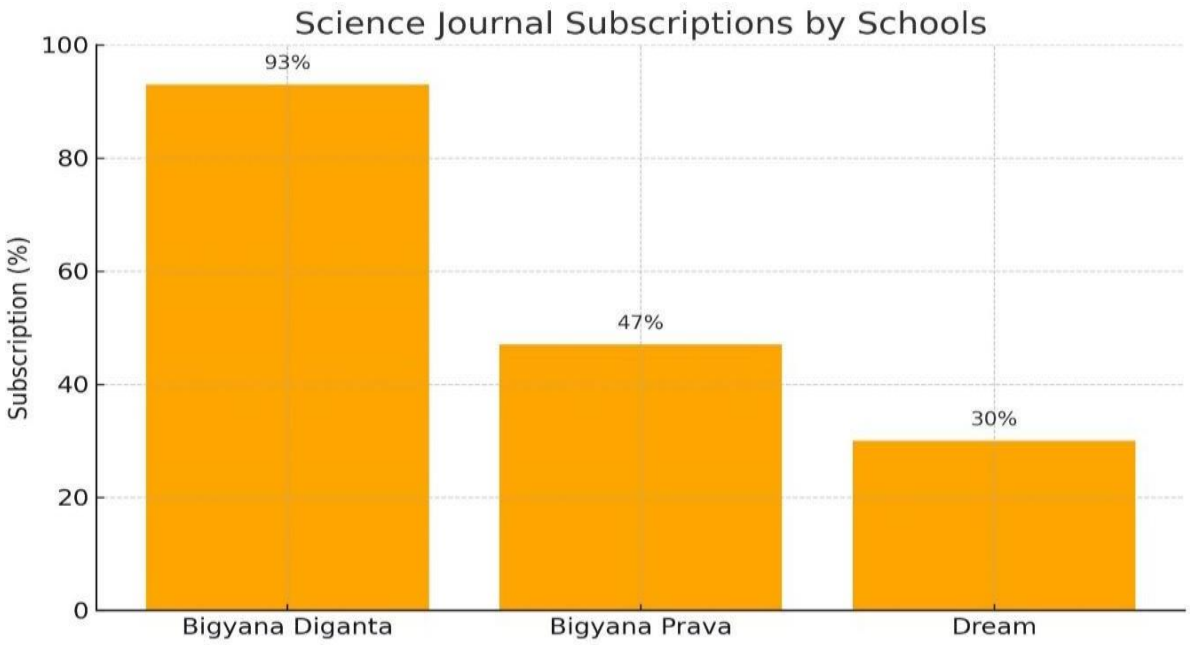
SUBSCRIPTION TO SCIENCE MAGAZINES / JOURNALS

To the question "Does your institution subscribe to science magazines/journals?" 42 per cent of teachers stated in the affirmative. The teachers who responded affirmatively were further asked to mention the name of the journals/magazines. Their responses are presented in the Table 4

Table 4

Journals / Magazines of Science

S. No.	Name of the Journals / magazines	Teachers	
		N	%
1.	Bigyana Diganta	1	93
2.	Bigyana Prava	7	47
3.	Dream	4	30



Graph related to science journal subscriptions by schools

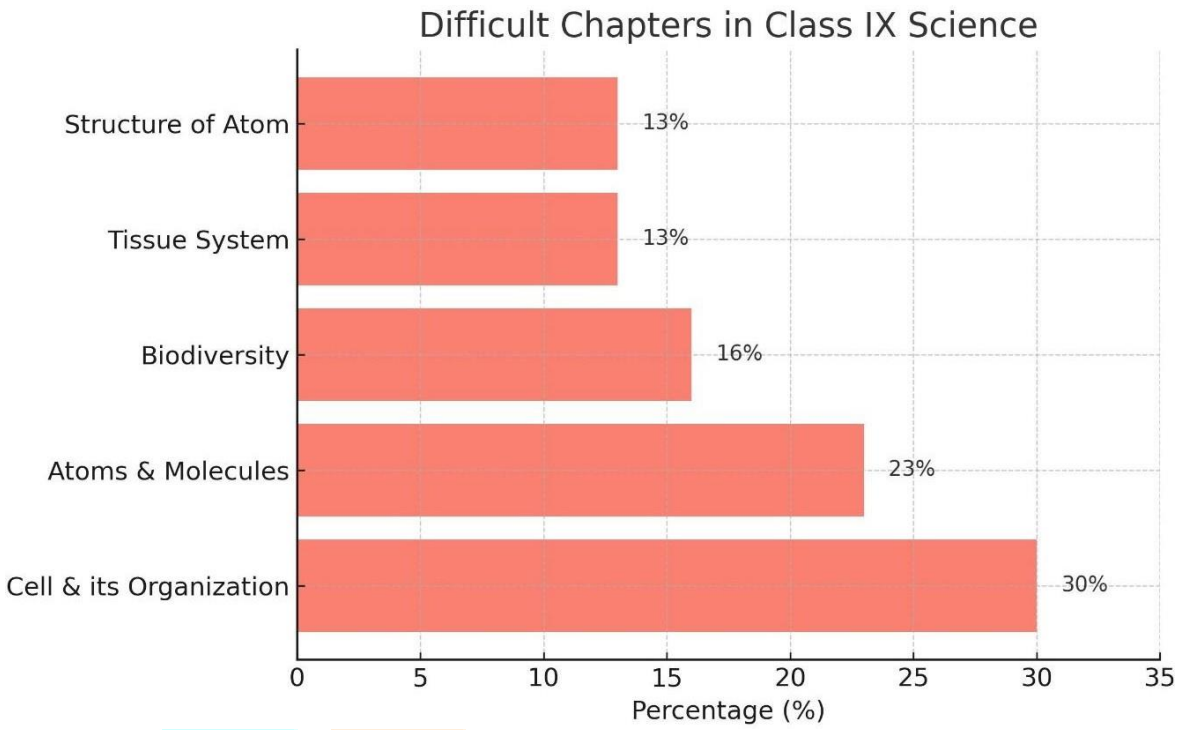
DIFFICULT CHAPTERS IN SCIENCE

The difficult chapter in the class IX science book, as mentioned by teachers, has been presented in the Table 5

Table 5

Difficult Chapters in Class IX Science Book

SL No.	Difficult Chapters	Teachers	
		N	%
1.	Biodiversity	5	16
2.	Cell and its organization	9	30
3.	Tissue system	4	13
4.	Atoms and molecules	7	23
5.	Structure of Atom	4	13



Graph for difficult chapters in Class IX science book

CO-CURRICULAR ACTIVITIES ORGANIZED IN SCHOOLS RELATING TO SCIENCE

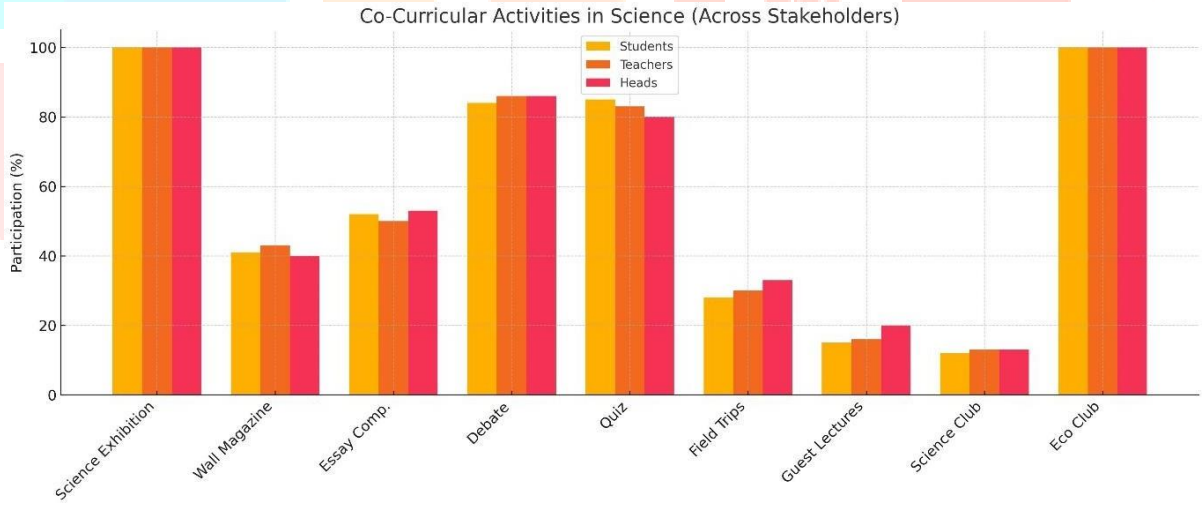
The co-curricular activities organized in schools to motivate students towards science have been presented in the table 6

Table 6

Co-curricular activities organized in schools relating to science

S. No.	Co-Curricular Activities	Student		Teachers		Head of the Institutions	
		N	%	N	%	N	%
1.	Science exhibition	75	100	30	100	15	100
2.	Wall magazine on science articles	31	41	13	43	6	40
3.	Science related essay competition	39	52	15	50	8	53

4.	Science related debate competition	63	84	26	86	13	86
5.	Science based quiz competition	64	85	25	83	12	80
6.	Field trips	21	28	9	30	5	33
7.	Guest lectures in science	11	15	5	16	3	20
8.	Science Club	9	12	4	13	2	13
9.	Eco. Club	75	100	30	100	15	100



Graph related to co-curricular activities in science

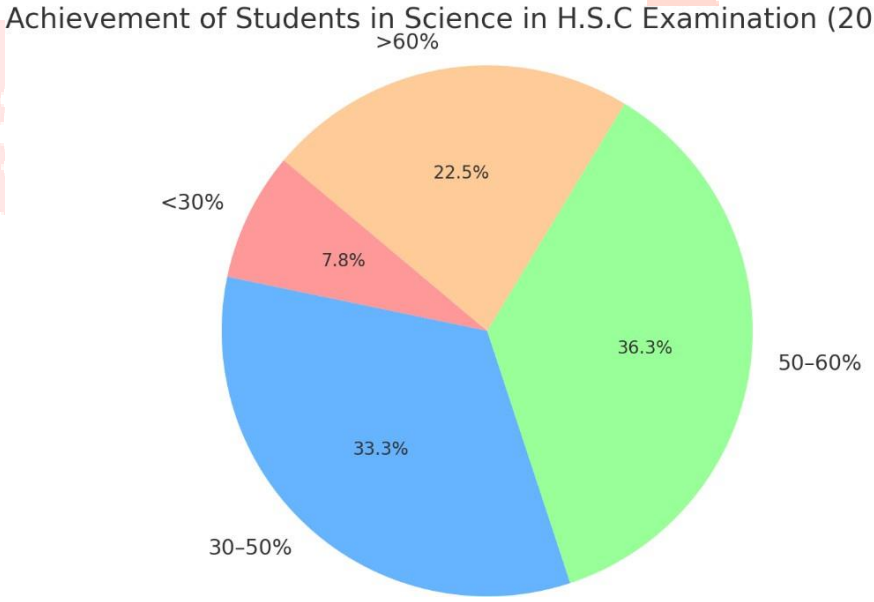
STUDENTS' ACHIEVEMENT IN SCIENCE

The achievement of students in science in the H.S.C Board Examination (2016-17) has been presented in the Table 7

Table 7

Achievement of Students in Science in H.S.C Examination

S. No.	Class X (Board)	Students	
		N	%
1.	Less than 30 per cent	141	8
2.	Between 30-50 per cent	599	34
3.	Between 50-60 per cent	652	37
4.	Above 60 per cent	370	23



Graph related to the achievement of students in science in H.S.C examination

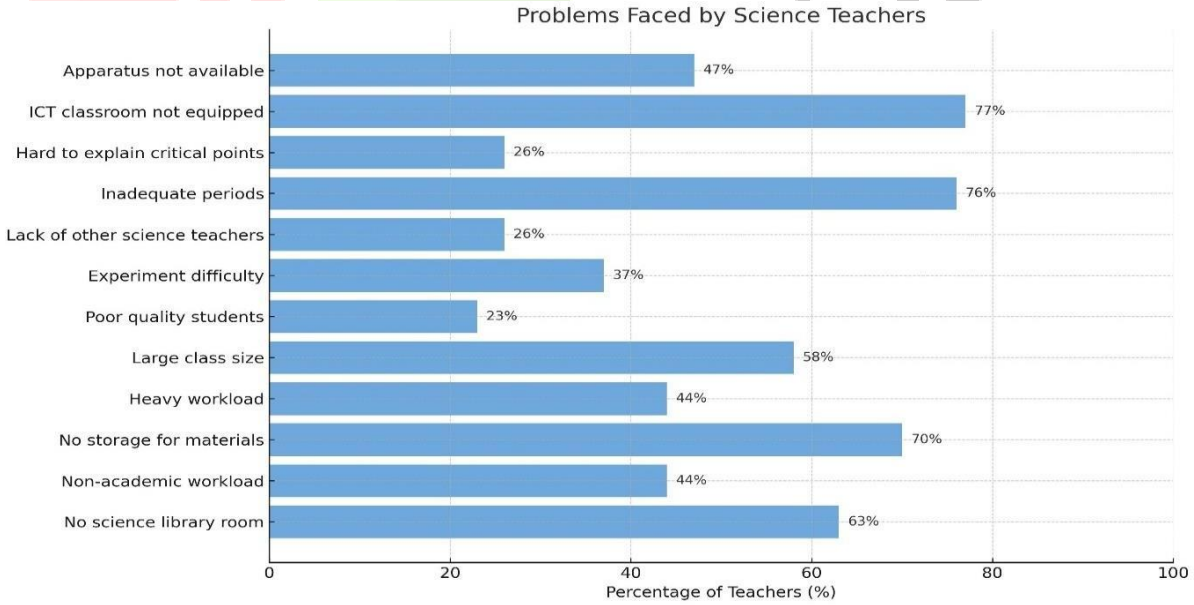
PROBLEMS FACED BY THE TEACHERS TEACHING SCIENCE

The problem faced by teachers in teaching science has been presented in Table 8.

Table 8

Problem Faced by Teachers Teaching Science

S. No.	Problem Faced by Teachers	Teachers	
		N	%
1.	Science apparatus is not available in schools	14	47
2.	ICT based Classroom is not equipped	23	77
3.	Difficulty to explain critical points in science	8	26
4.	Periods allotted is not adequate	23	76
5.	Other Science teachers are not available in schools	8	26
6.	Difficulty to conduct experiment in class	11	37
7.	Poor quality of students	7	23
8.	Large size class	17	58
9.	Heavy work load	13	44
10.	Lack spaces for storage of instructional materials	21	70
11.	Load of other nonacademic work	13	44
12.	Non-availability of separate science Library room	19	63



Graph related to the problem faced by science teachers

SUGGESTIONS OF STUDENTS FOR EFFECTIVE TEACHING OF SCIENCE IN THE CLASS

The students' suggestions for enhancing science teaching in the classroom have been summarized in Table 9.

Table 9

Suggestions of Students for Effective Teaching of Science in the Class

S. No.	Suggestion	Students	
		N	%
1.	Establishment of a separate science library room	41	55
2	Allotment of more periods per week for science	37	49
3	The teacher should conduct different experiments in class	64	85
4	Appointment of more science teachers	42	56
5	The teacher must clarify the difficult concept	56	78
6	Teachers should use different models, pictures	29	38

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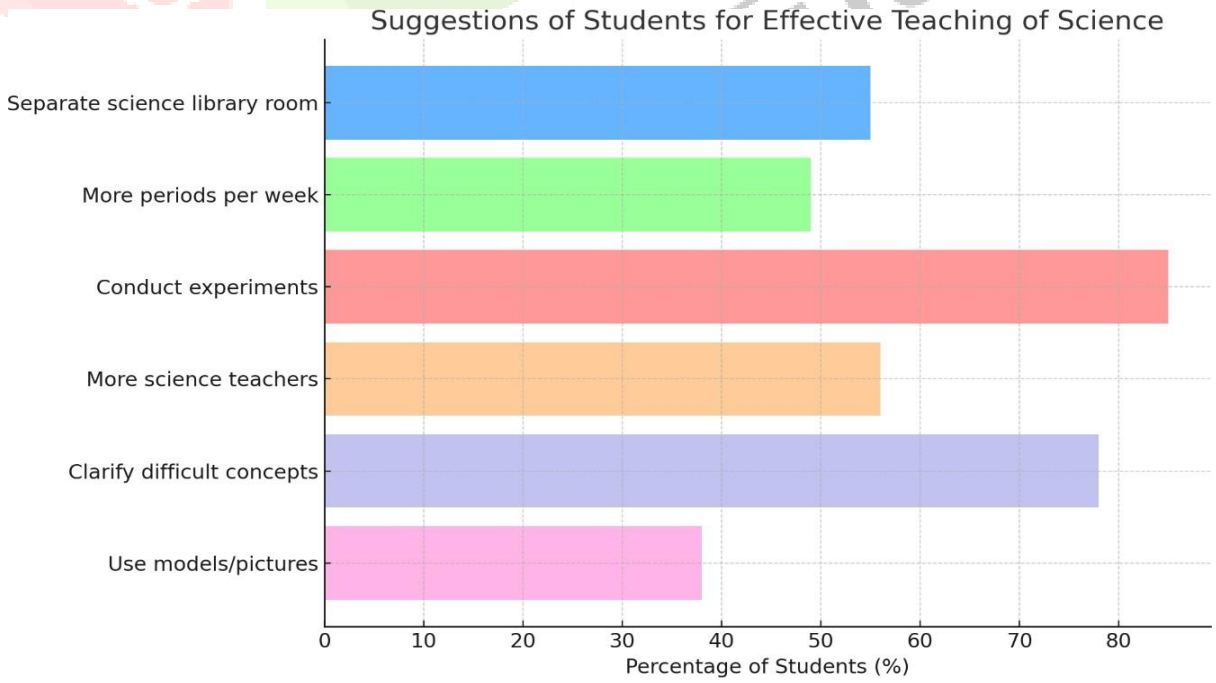


Graph related to Suggestions of Students for Effective Teaching of Science in the Class

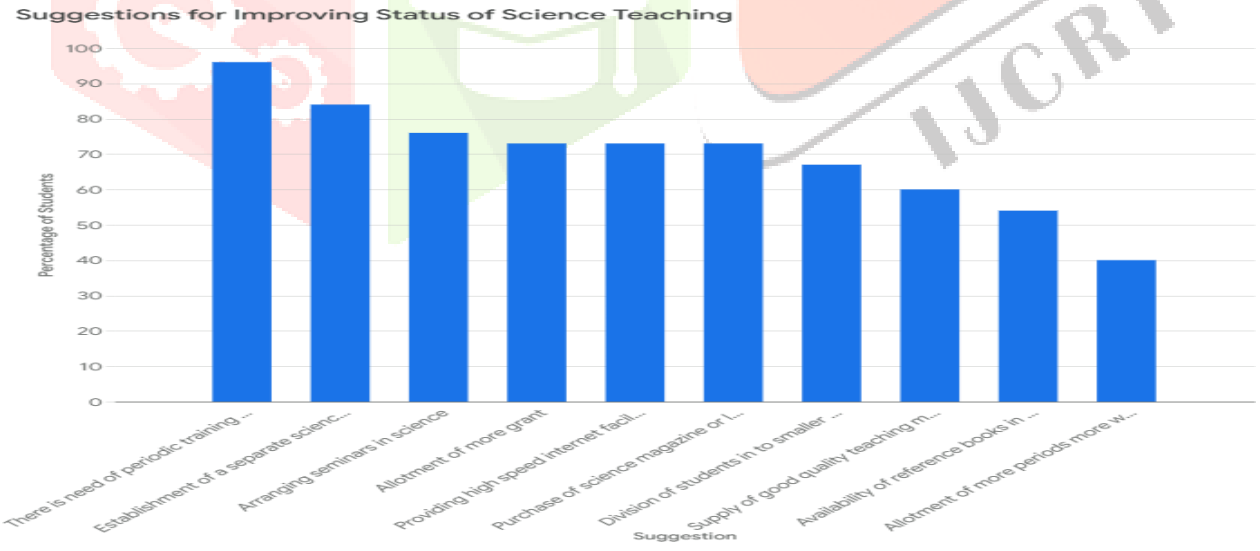
SUGGESTIONS OF TEACHERS FOR IMPROVEMENT OF STATUS OF SCIENCE TEACHING

The suggestions given by teachers for improving the status of science education in secondary school have been presented in the table 10.

Table 10

Suggestions for Improving the Status of Science Teaching

S. No.	Suggestion	Students	
		N	%
1.	There is need of periodic training of teachers in content and pedagogy	29	96
2.	Allotment of more grant	22	73
3.	Establishment of a separate science library room	25	84
4.	Allotment of more periods more week for science	12	40
5.	Division of students in to smaller groups	20	67
6.	Providing high speed internet facility in schools for teachers and students	22	73
7.	Availability of reference books in science for teachers	16	54
8.	`Purchase of science magazine or learning materials	22	73
9.	Arranging seminars in science	23	76
10.	Supply of good quality teaching materials	18	60



Graph related to Suggestions for Improving the Status of Science Teaching

x. MAIN FINDINGS

The following are the main findings of the present study:

- The science teachers possessed a variety of educational qualifications. Notably, 60 percent of them held both B.Sc. and B.Ed. degrees.
- More than 80 per cent of students stated that they read science as: It develops their mental power, scientific attitude, and knowledge about the environment and environmental problems, it talks about interesting facts without leaving much for their imagination.
- Majority of the schools (80 per cent) had separate science laboratory.
- About 75 per cent of science teachers prepared science lesson by reading reference books and collecting or preparing teaching aids.
- A significant majority of educators, accounting for 63 percent, adhered to traditional methods in the preparation of their science lesson plans. In contrast, 37 percent of science teachers implemented the 5E instructional model for their lesson planning.
- Among the 10 percent teachers who did not follow the right method, 67 per cent teachers did not follow the right method because of heavy work load, large size class and lack of teaching aids.
- Majority of the science teachers (89 per cent) followed demonstration method to provide instruction in science.
- All the teachers introduce the lesson to provide instruction in the class.
- About 79 per cent teachers introduced the lesson by putting leading questions, showing teaching aids and setting examples of real-life experiences.
- Science teachers used different skills to provide instruction such as: asking questions while teaching science, encouraged students to get right answers, used black board while teaching drew diagrams figures in the blackboard and showed teaching aids.
- Over 85 percent of educators and students reported that instructional materials, including charts, models, images, test tubes, test tube holders, magnets, prisms, tuning forks, and burners, were accessible in their educational institutions.
- Among the 15 percent of science teachers who stated negatively, more than 60 percent of them stated that lack of funds and lack of space for storing the materials were the reasons for the non-availability of instructional materials.
- More than 85 percent of teachers, students, and heads of institutions stated that they use ICT in the teaching of science subjects.
- The majority of science teachers (80 percent) used instructional materials to provide instruction in science.
- Among the 80 percent of teachers who used instructional materials to provide instruction in science, all of them stated that the instructional materials help the students for better understanding, motivation, clarifying abstract terms, and effective teaching.
- Over 85 percent of educators, students, and institutional leaders reported utilizing Information and Communication Technology (ICT) in the instruction of science.

- The majority of science teachers (75 percent) prepared low-cost teaching aids to teach science.72 per cent of teachers attended Samartha –IV science training program within the year 2014-15 organised by OPEPA for 5 days for their professional development in science.
- About 87 percent of schools 6 periods and in rest 33 per cent of schools 7 periods had been allotted per week to provide instruction in science.
- Majority of science teachers (82 per cent) stated that the total number of periods allotted to teach science was in-sufficient.
- A few schools sub scribed science journals like Bigyana Diganta, Bigyana Prava and Dream.
- The difficult chapters mentioned by students and teachers include: Biodiversity, Cell and its organisation, Atoms and Molecules and structure of atom.
- More than 79 per cent of teachers, students and heads of the institutions stated that science exhibitions, science related debate competitions and science-based quiz competitions were being organised in their schools.
- More than 72 per cent of teachers and heads of the institutions stated that their students participated in co-curricular activities in block level competition, inter-school competition.
- Around 23 per cent of students secured above 60 per cent marks in science. Furthermore, 37 per cent students secured between 50-60 per cent marks. However, 34 per cent students secured between 30-50 per cent and 8 percent students secured less than 30 per cent marks in science in H.S.C. examination of 2016-17.
- 100 per cent schools conducted half yearly examination and annual examination in science to know the performance of students in science. Unit test and surprise test were also being conducted by many schools.
- All teachers and students stated that written test was being conducted in their schools to know students' achievements in science.
- All teachers and students stated that marks were being awarded to evaluate students' performance and achievements in science in their schools.
- More than 60 per cent of science teachers stated the problems such as: ICT based classroom was not equipped, it was not possible to conduct experiments in class, lack of space for storage of instructional materials, periods allotted is not adequate and separate science library room were not available in schools.
- Around 48 per cent students stated that some chapters were difficult to understand in science. Majority of science teachers suggested that there was need of periodic in-service training of teachers in content and pedagogy, allotment of more grants, establishment of separate science library room, division of students in to smaller groups, providing high speed Internet facility in schools for teachers and students, purchase of science magazine or learning materials, organisation of seminar in science, supply of good quality teaching materials for improving status of science teaching at secondary stage.

XI.EDUCATIONAL IMPLICATIONS

On the basis of the findings, of the study the following suggestions may be given to improve the quality of science teaching in secondary schools of Cuttack District.

- In the secondary schools, there is a need to establish more ICT based class rooms, separate science library and science laboratory with adequate apparatus as per the guideline of RMSA.
- Science teachers may be trained to use various constructive methods by following 5E model to improve the performance of the students on science. Periodic in-service training may be given to science teachers for up-gradation of their content knowledge, skill and competencies.
- In order to bring accountability in to the system, there may be an evaluation of teachers preferably by their students. A suitable mechanism needs to be developed for corrective measures if the quality of teaching is poor.
- Adequate financial assistance may be provided by the state government to the secondary schools to purchase instructional materials.
- In the present day of e-learning, the students of secondary schools should not be left far behind. Efforts may be taken by the NGOS, co-operate giants and the Government to impart basic computer and internet skill to all students of secondary schools.
- Library facilities with internet connections may be available all the students. The institution may subscribe more science journals for the benefit of teachers and students.

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