

Status of Science Education in Senior Secondary Schools of Urban Block of Nagaon, Assam

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Abstract

Science education is a vital component of general education, aimed at dispelling societal superstitions and fostering logical, independent thinking. In an era of rapid technological advancements, scientific knowledge and its application have become increasingly significant. The paucity of researchers and scientists in India points to a need for improved science education to inspire and increase the number of scientific professionals. This study examines the state of science teaching in high schools of Nagaon town, focusing on resources, laboratory infrastructure, teacher competencies, and student perceptions of science education.

Keywords:

Science Education, Teacher Competencies, Laboratory Facilities, Practical Learning, Science Infrastructure

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Introduction

Science education nurtures curiosity in students and enhances their ability to think rationally about the world. It encourages critical questioning and equips students with the knowledge to solve real-world problems. By understanding scientific principles, students can grasp the fundamentals of modern technology and develop practical problem-solving skills. Familiarity with laboratory tools like microscopes and telescopes further deepens analytical capabilities and technological understanding, which are essential for everyday life.

Science Education

Science education also fosters a scientific approach and mindset, vital for progress and societal advancement. According to the Scientific Policy Resolution (Government of India, 1958), the cultivation of science on a large scale is necessary for national development. The Indian Education Commission (1964-66) emphasized that science-based education aligned with cultural values is fundamental to national progress and security.

Competencies of Science Teachers

Effective science teaching requires educators trained in contemporary methods and techniques (Cavas, 2011; Padilla, 1990). Teachers should be adept at managing science clubs, improvising apparatus, using teaching machines, and applying programmed instruction (Okebukola, 1986). Science teachers must possess a Bachelor of Science (B.Sc.) degree for high school teaching, a Master of Science (M.Sc.) degree for higher secondary education, and a Bachelor of Education (B.Ed.) for professional qualification (Bajracharya, 1986). Additional desirable attributes include sincerity of intent, intellectual acumen, effective communication skills, objectivity and straightforwardness, reliability and diligence, patience and leadership abilities, scientific thought and attitude, and efficiency in instructional material preparation (Pella, 1976; Rajendra Prasad, 2008). An exemplary science teacher engages students through stimulating curiosity, incorporating real-world applications, guiding inquiry without providing direct answers, and conducting experiments (Aurah & McConnell, 2012).

1. **Contemporary Training** – Educators should be trained in modern teaching methods and techniques (Cavas, 2011; Padilla, 1990).
2. **Special Skills** – Teachers must be able to:
 - Manage science clubs
 - Improvise apparatus
 - Use teaching machines
 - Apply programmed instruction (Okebukola, 1986)
3. **Academic Qualifications** – Science teachers should have:
 - **B.Sc.** for high school teaching
 - **M.Sc.** for higher secondary education

- **B.Ed.** for professional qualification (Bajracharya, 1986)

4. **Desirable Personal Attributes** – Including:

- Sincerity of intent
- Intellectual acumen
- Effective communication skills
- Objectivity and straightforwardness
- Reliability and diligence
- Patience and leadership abilities
- Scientific thought and attitude
- Efficiency in preparing instructional material (Pella, 1976; Rajendra Prasad, 2008)

5. **Student Engagement Practices** – A good science teacher should:

- Stimulate curiosity
- Incorporate real-world applications
- Guide inquiry without giving direct answers
- Conduct experiments (Aurah & McConnell, 2012)

Concept of Secondary Schools

Secondary education is the stage of formal schooling that follows elementary or upper primary education and precedes higher secondary education. Traditionally, in India, it covers Grades 9 and 10, catering to students aged 14–16 years (Ministry of Education, 2020). It provides a broad-based education that prepares learners for both higher studies and the world of work (Bajracharya, 1986). The academic focus at this level lies in strengthening foundational concepts in science, mathematics, social science, and languages, alongside developing reasoning, analytical ability, and problem-solving skills (Pella, 1976). Co-scholastic components such as sports, arts, cultural activities, and value-based education are integrated to ensure holistic development, while activities like science exhibitions, debates, and social service programs encourage experiential learning and social responsibility (Cavas, 2011). As a bridge between basic literacy and advanced knowledge, secondary education

plays a critical role in nation building by equipping young citizens with the skills necessary for responsible participation in economic, cultural, and civic life (Rajendra Prasad, 2008).

In alignment with the vision of the National Education Policy (NEP) 2020, secondary education has been restructured within the 5+3+3+4 school system, where the secondary stage covers Grades 9–12, split into Grades 9–10 and Grades 11–12 (Ministry of Education, 2020). NEP 2020 promotes flexible and multidisciplinary subject choices, removing rigid streams, and emphasizes critical thinking, creativity, scientific temper, and problem-solving (Okebukola, 1986). Vocational education, introduced from Grade 6, continues into the secondary stage with practical, hands-on training (Aurah & McConnell, 2012). Assessment reforms aim to shift from rote memorization to competency-based evaluation, making board examinations easier and more meaningful by testing core competencies (Padilla, 1990). The policy also prioritizes inclusion and equity by encouraging the return of dropouts, offering open and distance learning (ODL) options, and providing infrastructure and digital tools for disadvantaged groups. Integration of technology through digital platforms, online resources, and virtual labs supports blended learning for flexibility and accessibility (Wang, 2013). Ultimately, NEP 2020 envisions secondary education as a life-preparation stage, equipping students with academic, vocational, and life skills for holistic future readiness (Ministry of Education, 2020).

Review of Literature

Several studies have examined various dimensions of science education, teacher preparation, and learning resources across different countries. Aurah and McConnell (2012) compared Kenyan and U.S. pre-service science teacher training programs, finding that U.S. teachers demonstrated 30% higher self-efficacy, with female educators excelling in adaptive teaching strategies. Babang, Samsudin, and Suhandi (2022), through a bibliometric analysis of the TPACK framework in science education, reported growing emphasis on digital literacy (40% of studies) and interdisciplinary collaborations (25%). Bajracharya (1986) identified a misalignment between the science curriculum and student needs in Nepal, with over 70% of schools lacking laboratory equipment, resulting in rote learning and disengagement. Cavas

(2011) found that Turkish girls showed greater motivation in biology while boys preferred physics, with an overall 15% decline in engagement at higher grades. Similarly, Murphy and Smith (2012) observed that structured curriculum courses in Ireland enhanced content mastery by 45% and fostered positive teaching attitudes. In Saudi Arabia, Mathew and Alidmat (2013) revealed that the use of audiovisual aids in EFL classrooms improved student engagement, stimulated thinking, and replaced monotonous learning environments.

Other researchers have focused on collaborative learning, technology access, and teaching styles in science education. Okebukola (1986) emphasized the value of peer-led activities, showing that group tasks enhanced problem-solving skills by 35% compared to individual work. Wang (2013) explored the digital divide between rural and urban schools in Southern Taiwan, finding that while urban schools had superior technological infrastructure, there were no significant differences in teacher and student attitudes or proficiency levels toward technology integration based on location. This suggests that beyond infrastructure, factors such as training, motivation, and pedagogical approaches have a greater influence on technology use in classrooms. Collectively, these studies highlight the importance of adequate resources, modern teaching strategies, digital literacy, and inclusive pedagogical approaches in enhancing science education and student engagement.

Significance of the Study:

The present study on the *Status of Science Education in Senior Secondary Schools of Urban Block of Nagaon, Assam* is significant as it addresses critical aspects of science teaching that directly impact student learning outcomes and the cultivation of scientific temper. In an era of rapid technological advancement, quality science education is essential for fostering logical thinking, innovation, and problem-solving skills, aligning with the vision of the National Education Policy (NEP) 2020 to develop a scientifically literate and skilled citizenry. By examining teacher competencies, laboratory facilities, and student engagement in science-related co-scholastic activities, the study provides empirical insights into existing strengths and gaps in the region's educational system. The findings, which highlight deficiencies such as inadequate infrastructure, limited practical exposure, and low participation in experiential learning activities, offer valuable guidance for policymakers, school administrators, and educators in implementing

targeted interventions to enhance science teaching. Ultimately, this research contributes to improving educational quality, promoting equity, and preparing students in Nagaon to actively participate in national progress and socio-economic development.

Objectives of the Study:

- To examine the availability and trends of laboratory facilities for science education
- To investigate co-scholastic activities related to science education

Analysis of the objectives:

- **Objective I:** To examine the availability and trends of laboratory facilities for science education

Table 1: Laboratory Facilities Available in the Schools for Science Education

Sl. No.	Name of School	Laboratory Equipment Available
1	Nagaon Government Boys' Higher Secondary School	Slide, funnel, filter paper, thermometer, test tube, conical flask, burner, prism, needle, and mirror lens.
2	Dawson Higher Secondary School	Slide, tripod stand, funnel, filter paper, thermometer, mirror lens, prism, magnetic compass, litmus paper, acid, needle, chemicals, salt, and dissecting box.
3	Haiborgaon Higher Secondary School	Slide, funnel, filter paper, mirror lens, salt, acid, burner, needle, and chemicals.
4	Motiram Bora Higher Secondary School	Slide, funnel, filter paper, mirror lens, salt, acid, and burner.
5	Urban Higher Secondary School	Slide, acid, salt, filter paper, litmus paper, burner, needle, and funnel.
6	Bengali Girls' Higher Secondary School	Slide, acid, salt, filter paper, litmus paper, and burner.
7	Ratna Kanta Borkakoti Higher Secondary School	Slide, acid, salt, filter paper, litmus paper, burner, needle, and funnel.
8	Morikalang Higher Secondary School	Slide, acid, salt, filter paper, litmus paper, burner, and needle.

Source: Field Survey, 2024

Interpretation of Findings:

The presence of appropriate laboratory equipment is fundamental to the proper functioning of a science laboratory. The investigation revealed that a majority of schools lacked the necessary apparatus for conducting scientific experiments. Despite receiving government funds, many schools in Nagaon town do not possess adequate or up-to-date laboratory equipment. Consequently, students' interest in science has been limited, with only a few showing enthusiasm for the subject. Out of 15 schools surveyed, only eight had laboratories equipped with essential materials. To evaluate the adequacy of laboratory facilities, it is essential to compare the available resources with a standard list of equipment required for conducting basic science experiments in secondary schools. The following table outlines the essential equipments that a well-functioning school science laboratory should have:

Table 2: Essential Equipments for Science Laboratory

Category	Equipments
General Equipment	Tripod stand, test tubes, test tube holders, beakers (various sizes), measuring cylinders, conical flasks, burettes, pipettes, funnels, filter paper, spatula, burner, and thermometer.
Physics Equipment	Prism, mirror lens, magnetic compass, vernier calipers, meter scale, spring balance, ammeter, voltmeter, resistors, connecting wires, and a simple electric circuit kit.
Chemistry Equipment	Litmus paper, acids (HCl, H ₂ SO ₄ , etc.), bases (NaOH, KOH), common salts, chemical reagents, dissecting box, and a distillation setup.
Biology Equipment	Microscope, slides, dissecting needles, Petri dishes, specimen jars, and biological charts.

Source: Draft NEP 2020

The data presented above indicate that out of the 15 schools surveyed, only eight had functioning laboratories. However, even these schools lacked critical scientific apparatus essential for practical learning. Comparing the available resources with the model list, the following key deficiencies were observed:

- **Physics Deficiencies:** Most schools lacked important physics equipment such as vernier calipers, spring balances, ammeters, voltmeters, and electric circuit kits, which are essential for conducting electricity and mechanics experiments.
- **Chemistry Deficiencies:** While some schools had acids, salts, and chemicals, only

one school had a tripod stand, and none possessed a complete distillation setup or sufficient chemical reagents for experiments.

- **Biology Deficiencies:** No school had a microscope, which is fundamental for biological studies. The absence of Petri dishes, specimen jars, and biological slides further limits the ability to conduct practical biology lessons.

Due to these deficiencies, science teachers in these schools face significant challenges in conducting laboratory-based learning. Many experiments outlined in the curriculum cannot be performed, leading to. As a result, science teachers were unable to conduct practical lessons on topics requiring these tools. This limitation hindered the teachers' ability to cover the full range of experiments specified in the curriculum. a theory-dominated approach rather than practical-based science education.

The findings highlight a critical gap in the availability of science laboratory facilities in senior secondary schools in Nagaon town. The lack of essential equipment not only affects the quality of science education but also reduces students' enthusiasm and engagement with the subject. Addressing these deficiencies through targeted funding and resource allocation is crucial for improving science education outcomes in the region.

Furthermore, during data collection, investigators found that the construction of science laboratories was still in progress in some schools, and therefore, not all 15 schools in the region had been fully assessed. In the absence of dedicated laboratory spaces, practical sessions were often conducted in regular classrooms. In many cases, laboratory equipment remained stored in school storerooms rather than being accessible for regular use. Additionally, a significant number of high schools lacked specialized science instructors or demonstrators to facilitate practical classes, further affecting the quality of science education.

Objective 2: To investigate co-scholastic activities related to science education

The data presented in the figure 1 indicate that none of the sampled schools demonstrated substantial engagement in scientific activities. While schools organized an annual "school week" emphasizing aesthetic and physical activities, scientific activities were notably absent from these events. This reflects a significant gap in fostering scientific interest and experiential learning among students. The above table explained by following bar graph.

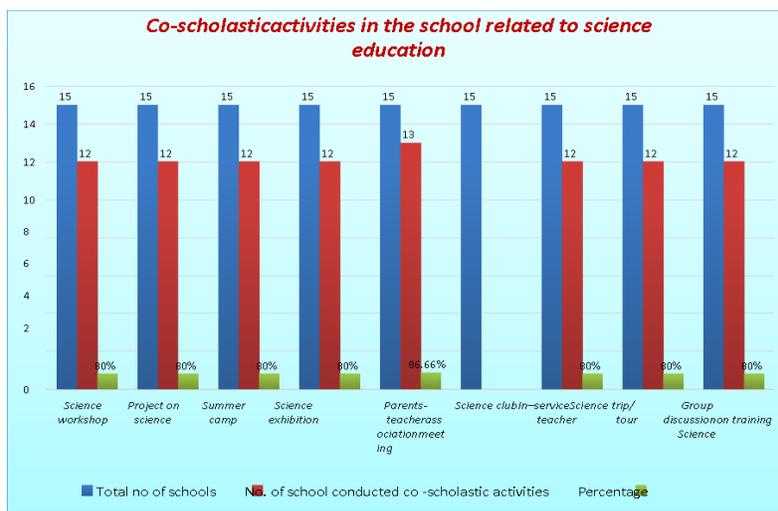


Fig. 1: Co-scholastic activities in the school related to science education.

Suggestions:

This study is crucial as it provides empirical data regarding the availability of science laboratories and equipment in schools. The findings highlight that a large proportion of schools conduct science classes without the requisite scientific apparatus, leading to an overemphasis on theoretical instruction at the expense of practical application. Given the experiential nature of science education, this issue must be urgently addressed. Adequate financial support should be allocated for the provision and maintenance of science facilities and equipment.

Additionally, schools exhibit low participation in co-scholastic activities related to science education. Since co-scholastic activities stimulate student engagement and creativity, regular organization of seminars, orientation programs, science exhibitions, and science tours is recommended to cultivate scientific curiosity and hands-on learning experiences.

Conclusion:

In addition to qualified science teachers, the effective teaching of science at the secondary school level requires the appointment of laboratory assistants, demonstrators, and laboratory attendants. However, this investigation revealed a lack of such resources in the sampled high schools. It is imperative for the government to make provisions for the recruitment of laboratory personnel, including laboratory assistants and demonstrators, to support science education. Furthermore, efforts should be made to encourage student participation in co-

scholastic activities that enhance scientific learning and practical skills.

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