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Language, power, and science education: Sociological study of scientific vocabulary and classroom inequality in Odisha

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Abstract
Science education is often presented as universal, objective, and culturally neutral. However, the language through which science is communicated within classrooms and textbooks can produce significant educational inequalities. This paper examines how scientific jargon, technical vocabulary, and English-derived scientific language shape students' experiences of science education in Odisha government schools. Drawing on Pierre Bourdieu's concepts of linguistic capital and symbolic violence alongside sociological perspectives on science education, the study analyses how language functions as a mechanism of inclusion and exclusion within science classrooms. Using qualitative data from classroom observations, student interactions, and interviews conducted in government schools in Odisha, the paper demonstrates that many students, particularly those from rural, non-English-speaking, lower-class, and female backgrounds, experience science as linguistically distant and intellectually intimidating. Scientific terminologies and textbook language often remain disconnected from students' everyday linguistic worlds, contributing to fear, low participation, rote memorisation, and declining interest in science subjects. The paper argues that science education in India cannot be understood independently from questions of language, class, gender, and cultural capital. The study contributes to debates on the sociology of science education, language inequality, and educational exclusion in postcolonial schooling contexts.

Keywords: Science education, language, symbolic violence, scientific vocabulary, Odisha, Bourdieu, educational inequality

Introduction

Science education occupies a central position within contemporary educational systems because it is widely associated with modernity, development, rationality, and economic progress. In India, science subjects are frequently represented as pathways to upward social mobility, professional success, and national development. However, despite the expansion of schooling and curricular reforms, access to meaningful science learning remains highly unequal across social groups. Students from rural, lower-class, non-English-speaking, and marginalised social backgrounds often experience science education differently from their urban and middle-class counterparts.

One of the least explored dimensions of inequality in science education is language. Science classrooms are saturated with technical terminologies, abstract concepts, symbolic representations, and English-derived vocabularies that frequently remain disconnected from students' everyday linguistic experiences. Scientific terms such as "photosynthesis," "chromosomes," "electromagnetic induction," "molecular structure," "mitochondria," and "refraction" often become difficult for students not only conceptually but linguistically. Consequently, science is frequently perceived as a difficult, fearful, and inaccessible subject.

In postcolonial societies such as India, language functions as an important mechanism of educational stratification. English and English-derived scientific language continue to enjoy symbolic prestige within schooling systems, particularly in science education. Scholars have argued that language in schools is not merely a medium of communication but also a source of power, legitimacy, and social distinction (Bourdieu, 1991) [4]. Students possessing familiarity with dominant linguistic codes often experience greater confidence and academic success, whereas students from linguistically marginalised backgrounds struggle to adapt to institutional expectations.

The problem becomes particularly visible in government schools where students primarily come from rural, lower-middle-class, first-generation learner, and non-English-speaking backgrounds. In Odisha, many students communicate in Sambalpuri/Kosli, tribal languages, colloquial Odia, or local dialects within their everyday lives. However, science textbooks and classroom teaching often rely upon Sanskritised Odia, technical scientific terminologies, and English vocabulary. This creates a significant gap between students lived linguistic worlds and the institutional language of science.

Research in science education suggests that language significantly shapes students' conceptual understanding, classroom participation, and attitudes toward science (Lemke, 1990) [8]. Scientific discourse operates through specialised vocabularies and symbolic systems that students must acquire in order to participate successfully in science classrooms. However, unequal access to linguistic resources often transforms science learning into a process of memorisation rather than understanding.

Several studies in India have highlighted how English-medium dominance and technical classroom language create educational barriers for students from government schools and rural backgrounds (Annamalai, 2004; Mohanty, 2009) [2, 9]. The language of science is often treated as universally intelligible despite the fact that scientific terms are socially unfamiliar to many students. As a result, classroom learning

frequently becomes mechanical and examination-oriented rather than experiential and meaningful.

The issue is also deeply gendered. Girls from rural and lower-class families frequently face additional barriers in science classrooms because of lower confidence in speaking technical language, fear of making mistakes, and social conditioning that associates science with masculine intelligence and rationality. Feminist scholars in science education have argued that science classrooms often privilege masculine forms of participation and confidence while marginalising girls' classroom voices (Harding, 1991) [7].

This paper examines how scientific vocabulary and classroom language contribute to educational inequalities in Odisha school science education. Drawing on Pierre Bourdieu's concepts of linguistic capital and symbolic violence, the paper analyses how scientific language privileges students possessing dominant linguistic and cultural capital while marginalising students from rural, lower-class, and non-English-speaking backgrounds. The paper particularly focuses on how language contributes to fear of science among students and shapes unequal participation within science classrooms.

Theoretical Framework

Bourdieu, Language, and Symbolic Violence

Pierre Bourdieu (1991) [4] argues that language functions not merely as a communicative tool but as symbolic capital within educational institutions. Schools privilege particular linguistic forms and cultural expressions associated with dominant social groups while marginalising other linguistic practices. Students possessing familiarity with dominant linguistic codes gain institutional legitimacy and academic recognition.

Science education becomes an important site for the operation of symbolic violence because scientific knowledge is often communicated through abstract, technical, and institutionally legitimised language. Scientific vocabularies appear neutral and universal, yet access to such language remains socially unequal. Students from middle-class and English-speaking backgrounds frequently possess greater exposure to scientific terminologies through family environments, private schooling, coaching institutions, and digital resources. In contrast, students from rural and economically marginalised backgrounds encounter scientific language as unfamiliar, alien, and intimidating.

Bourdieu's concept of symbolic violence helps explain how educational inequalities become normalised within science classrooms. Students who struggle with scientific vocabulary are often perceived as academically weak or intellectually incapable rather than victims of unequal linguistic access. Consequently, science education reproduces social hierarchies by rewarding dominant linguistic capital while devaluing local linguistic experiences and everyday knowledge systems.

The paper also draws upon sociological critiques of science education that question the assumption of science as culturally neutral. Scholars in science and technology studies (STS) argue that science learning is shaped by social, linguistic, and cultural contexts rather than existing independently from society (Aikenhead, 2006) [1]. Scientific knowledge therefore becomes accessible unevenly across social groups depending upon their linguistic resources and educational exposure.

Basil Bernstein's (1971) [3] distinction between restricted and elaborated codes is also useful in understanding classroom communication. Students from middle-class backgrounds are more likely to possess familiarity with elaborated linguistic codes that align with institutional expectations, whereas working-class and rural students often experience difficulties in comprehending formal and abstract classroom language. Science classrooms particularly privilege elaborated linguistic structures due to the specialised nature of scientific discourse.

The study further engages with Paulo Freire's (1970) [6] critique of banking education. In many science classrooms, students are expected to memorise scientific terminologies without meaningful contextual engagement. Such pedagogic practices transform science into a process of rote learning rather than critical understanding. Students who fail to reproduce scientific language accurately are often labelled weak despite their experiential understanding of the natural world.

Thus, language in science education operates simultaneously as:

1. A medium of knowledge transmission,
2. A mechanism of symbolic power,
3. A source of educational stratification,
4. And a tool of inclusion and exclusion.

Methodology

This study employs qualitative methodology to understand how scientific vocabulary and classroom language shape students' experiences of science education in Odisha government schools. The study forms part of a broader sociological investigation on school science education and students' perceptions in Odisha.

The research was conducted in two government secondary schools located in the Kalahandi district of Odisha. One school was situated in a semi-rural region, while the other represented a relatively urban educational setting. The schools were selected because they catered primarily to students from lower-middle-class, rural, tribal, and economically marginalised backgrounds.

The study included students from Classes IX and X because science education becomes increasingly specialised and examination-oriented at the secondary level. A total of 123 students participated in the broader study, including both boys and girls from diverse caste, class, and linguistic backgrounds.

The study employed multiple qualitative methods:

1. Classroom observations,
2. Semi-structured interviews,
3. Focus group discussions,
4. Informal student interactions,
5. And textbook analysis.

Classroom observations were conducted during science teaching sessions to understand teacher-student interaction, language use, classroom participation, and students' responses to scientific terminologies. Particular attention was paid to:

- students' hesitation in responding,
- pronunciation difficulties,
- code-switching practices,
- classroom silence,
- and memorisation-oriented teaching.

Semi-structured interviews were conducted with students and teachers to understand their perceptions regarding science language and classroom learning. Students were asked about:

- difficulties in understanding science,
- fear associated with science subjects,
- classroom participation,
- textbook language,
- and examination experiences.

Teachers were asked about

- classroom language barriers,
- teaching strategies,
- students' comprehension difficulties,
- and the role of English terminology in science teaching.

Focus group discussions enabled students to collectively reflect upon their classroom experiences and educational anxieties. Many students openly discussed fear of science subjects, difficulty understanding scientific terms, and lack of confidence in answering science questions publicly.

The study also analysed secondary school science textbooks prescribed by the Board of Secondary Education (BSE), Odisha. The analysis focused on:

- scientific terminologies,
- English-derived vocabulary,
- complexity of textbook language,
- and disconnect between textbook language and everyday student communication.

Data collected through interviews, classroom observations, and discussions were coded thematically. Themes such as fear of science, language barriers, classroom silence, gender differences, symbolic exclusion, and rote learning emerged repeatedly across the data.

The study followed ethical research practices. Student identities were anonymised and pseudonyms were used wherever necessary.

Results and Discussions

Vocabulary as Educational Barrier

The study found that scientific terminology constitutes one of the most significant barriers to science learning among government school students in Odisha. Many students reported that science subjects become difficult not necessarily because of scientific concepts themselves but because of the unfamiliar language through which science is taught.

Students repeatedly expressed fear regarding pronunciation, memorisation, and comprehension of scientific terms. Terms such as "photosynthesis," "endoplasmic reticulum," "electromagnetic induction," and "respiration" were perceived as linguistically alien and disconnected from everyday communication.

A Class IX student from a rural background explained:

"We can understand examples when teachers explain in local language, but the words written in the textbook are very difficult. We forget the spellings and meanings during examinations."

The findings suggest that students often memorise scientific terms mechanically without conceptual understanding. Scientific language becomes associated with examination fear and academic anxiety rather than curiosity and exploration.

The problem becomes more severe because many science teachers themselves switch between Odia and English while teaching scientific concepts. Although teachers attempt to simplify explanations using colloquial language, examination systems ultimately privilege formal textbook vocabulary. Consequently, students experience a contradiction between classroom explanation and examination expectations.

The study therefore demonstrates that language itself becomes an educational barrier within science classrooms.

English and Symbolic Power in Science Education

The findings reveal that English continues to function as a source of symbolic prestige within science education. Students frequently associated English pronunciation and scientific vocabulary with intelligence and academic superiority.

Students from relatively urban and economically better-off backgrounds displayed greater confidence while answering science questions because of greater exposure to English vocabulary through tuition centres, private coaching, YouTube, and digital learning resources.

In contrast, students from rural and first-generation learner backgrounds frequently remained silent during classroom interactions despite understanding concepts informally. Several students reported fear of ridicule if they pronounced scientific terms incorrectly.

One girl student stated:

"I know the answer but I am scared to say it in class because I cannot pronounce the scientific words properly."

This demonstrates how scientific language operates as symbolic capital within classrooms. Students possessing dominant linguistic capital gain confidence and recognition, whereas others internalise feelings of inadequacy.

The findings align with Bourdieu's argument that educational institutions reward dominant linguistic practices while presenting them as natural indicators of merit and intelligence.

Rural and Lower-Class Students' Experiences:

The study found that students from rural and economically marginalised backgrounds experienced science education as socially distant and culturally unfamiliar. Many students reported that the language used in science textbooks differs significantly from the language spoken within homes and communities.

Students from Sambalpuri-speaking and tribal-language-speaking families particularly experienced difficulties in adjusting to formal textbook Odia and scientific terminology simultaneously.

A teacher observed:

"Students understand science better when examples are connected with agriculture, village life, or local practices. But textbooks use technical language and abstract examples."

The findings suggest that science education often fails to connect with students' lived experiences and linguistic realities. Consequently, students perceive science as a subject meant primarily for urban and English-speaking populations.

Several students also reported that parents were unable to assist them in science learning because scientific terms and textbook language remained unfamiliar even to educated family members.

Thus, science education reproduces class inequality not only through access to infrastructure and resources but also through unequal access to linguistic capital.

Gender, Language, and Fear of Science

The findings reveal important gendered dimensions of science learning. Many girls reported lower confidence in speaking scientific language publicly within classrooms.

Girls frequently remained silent even when they knew answers because they feared making mistakes while pronouncing scientific terms. Classroom observations revealed that boys were more likely to attempt answers publicly despite inaccuracies, whereas girls preferred silence to avoid embarrassment. Teachers also unconsciously associated scientific confidence with male students. Boys were often encouraged to participate in laboratory demonstrations and science competitions more actively than girls.

One female student explained:

"Science is difficult because there are many hard words. Boys answer quickly even if wrong, but girls feel shy and scared."

The findings suggest that scientific language intersects with broader gender socialisation processes. Science classrooms often privilege aggressive participation and linguistic confidence associated with masculine behaviour.

The absence of supportive classroom environments intensifies fear among girls, particularly those from rural and economically weaker backgrounds.

Classroom Silence and Symbolic Violence

One of the most significant findings of the study is the prevalence of classroom silence within science education. Students frequently avoided asking questions because they feared being judged for weak pronunciation or inability to use scientific terminology correctly. Science classrooms therefore become spaces where linguistic inadequacy is internalised as intellectual inadequacy. This reflects Bourdieu's concept of symbolic violence where students accept educational hierarchies as natural rather than socially produced. Students blaming themselves for "weakness in science" often fail to recognise that science classrooms privilege particular forms of linguistic and cultural capital.

The findings also reveal that many teachers equate memorisation of scientific terminology with scientific understanding. Students who reproduce textbook definitions accurately are often perceived as intelligent even when conceptual understanding remains weak.

Thus, scientific language functions not only as a pedagogic tool but also as a mechanism of educational exclusion.

Conclusion

This paper explored how language shapes students' experiences of science education in Odisha government schools. The findings suggest that science is not experienced equally by all students. For many rural, lower-class, first-generation learner, and female students, science classrooms are also linguistic spaces where confidence, participation, and academic identity are negotiated.

Scientific terminology, textbook language, and English-derived vocabulary often created distance between students and science learning. Many students experienced science through fear of pronunciation, memorisation pressure, and classroom silence rather than curiosity or experimentation. Over time, some students began to see science as a subject meant mainly for urban, English-speaking, or academically privileged students.

The study also shows that educational inequality in science cannot be understood only through infrastructure, laboratories, or curriculum content. Language itself becomes an important source of exclusion. Students who are already familiar with dominant linguistic forms enter classrooms with greater confidence, while others struggle to translate their understanding into institutionally accepted scientific language. Similar observations have been made by Ramanathan (2005) and Mohanty (2009) [9, 11] in their discussions on language hierarchies and educational inequality in India.

At the same time, the findings indicate that students engaged more actively when teachers connected science concepts with local experiences, familiar examples, and everyday language. Such moments suggest that science education becomes more meaningful when it recognises the linguistic and cultural worlds students come from. Aikenhead (2006) [1] similarly argues that contextual and culturally connected science education improves student participation and understanding.

Unless science classrooms become more linguistically inclusive, many students will continue to experience science less as a field of discovery and more as a subject associated with fear, silence, and memorisations.

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