



Recommended citation for this Article:

Chakrawarty, S. (2025). Unlocking Science Potential at Middle Stage: Exploring Contributing Factors and Intervention Strategies. *Pedagogy of Learning*, 11, (2), 09-16. Available at: <http://pedagogyoflearning.com>

Unlocking Science Potential at Middle Stage: Exploring Contributing Factors and Intervention Strategies

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Article Publication Date: 30 October 2025

Article DOI: 10.46704/pol.2025.v11i02.002

Abstract: Education is the cornerstone of scientific advancement and modernization. Through education, individuals acquire the knowledge and skills necessary to understand and apply scientific principles. Science education should not be mere transfer of accumulated knowledge rather it should develop an insight of scientific process and attitude so as to enable the child to construct knowledge. The objectives of the study to identify dominant factors that affect low achievement in science in Grade-8 and to suggest remedial measures to overcome low achievement of Science. In order to study this objective questionnaire to the teacher and student and Interview schedule to the parents was used and was administered on 200 students, 18 teachers and 30 parents of the respective students in 6 different types of schools restricted to Bokaro district in Jharkhand. The study is limited to students of Grade-8 only. The result of the study mainly focuses on four sub-dominant factors of the areas related to Curriculum and textbooks, Evaluation/ Examination patterns, Teachers Characteristics/ Qualifications, School-environment. Hence it can be concluded that improving these areas can lead to better academic performance in science and overall learning among learners at middle stage.

Keywords: Low Achievement, Science, Curriculum, Evaluation, School-environment

Introduction

Education is a vital input in modernization in today's world of science and technology. It is education alone which determines the level of prosperity, well-being and security of every individual. The educational system is confined to perpetuate the social system, productivity, creativity, adherence to moral codes, leadership, citizenship and above all to provide equalization of opportunity. Education plays a vital role in equipping human beings to lead a balanced and harmonious life. It tries to seek happiness not only at physical level, but also at the mental, social, emotional and aesthetic level. So, education is a process which is especially designed to facilitate an all-round development of each and every person. However, in spite of many efforts made, numerous books have been written elucidating the social, economic and political importance of elementary education. A number of official resolutions have been adopted and judgments pronounced on various occasions to ensure education for all Indian children still the goal of universal elementary education remains elusive. According to Sen (2002) "Primary education in India suffers not only from inadequate allocation of resource, but after enough also from terrible management and organization. According to the author, "Organisation and governance of primary school" has remained a neglected subject in much of India. Educationists opined "the problem cannot be solved on the same level or which it was created. One has to rise above it to the next level". Research into student curiosity and the quality of student-teacher relationships further underscores that emotional and interpersonal factors play a mediating role in students' engagement and

science outcomes, indicating that fostering curiosity and assertiveness alongside strong teacher support can enhance science achievement (Kibga *et al.*, 2025).

Importance of Science in School Education

Science teaching is essential for understanding the world through knowledge of the law of nature. It also provides man with a tool for organizing his thinking and for Classifying his experience. Education has to impart the basic scientific and technological knowledge necessary for the younger generation to carry out an increasing number of occupations, essentially in the productive sector to encourage scientific and technological vocations, as well as to foster an awareness among young people and adults.

Scientific and technological development can be carried on only with the support of an interested and informal public educational activity. science and its teaching have acquired special significance in the modern world. No nation could hope to survive unless it read a sound tooting in the field of applied and basic science. Science education consists of development of concept regarding physical phenomenon. Among the various learning experience in science for the elementary level, the teachers, Class teaching, student, learning from text book and other materials are most important. If the science courses for children are analyzed it appears that these includes a body of various terms, facts and principles of science. Proper understanding of facts, concepts principles and process involved in the physical and biological environment. Understanding of basic concept can be considered as the most important at levels of education particularly at preparatory and middle stage.

The rapid advancement of science and technology and increasing need for scientists and technologist have made it all the more important to provide for science-based education in the schools. Vigorous methods for the cultivation and promotion of science should be adopted. The secondary Education commission has recommended that every secondary school pupil should study general science as a compulsory subject, so that he gains a basic quantum of scientific knowledge as a part of his general education.

Review of related Literature

Long back research done by Biswas (1986) found contextual gap existed between the framing of objectives by the National Education Commission and the National Curriculum and syllabus committee. And the schools did not implement the curriculum appropriately. Again Mandila, (1988) has conducted study on Attitudes of Secondary Stage Students towards Science curriculum and its relationship with achievement motivation and concluded there were significant differences in some aspects such as scientific temper and teaching method. Kar (1990) retrieved that Boys we found to be more favorably disposed towards Science than girls. Alexander (1990) conducted study on the relationship of critical thinking, Science aptitude and social-economic status to the Science achievement of second year PUC students and found high scores on critical thinking, scientific achievement and socio-economic status favour achievement in Science. Padhi (1993) found that there was a significant correlation between academic self-concept in science & cognitive and home environment dimensions with a specific reference to control, protectiveness, social isolation which were positive too on the other seen dimension the correlation was low and some were negative and negligible too. Caldor (1997) found one of the main factors associated with low student achievement is poverty. Student living in persistent poverty are more likely than other students to suffer from many conditions prevent their learning. Jena (2000) also conducted a study on, "Identification of educational barriers in reading general Science of children with learning difficulties and application of remedial measures." Major findings of the study were significant difference in pretest and post-test group of children in reading ability. There is tremendous progress on attention, memory language, matter problem of the children at past period of testing. In the study done by Tatar, Cengiz, Cemal, & Nail (2016). The result of the study shows that the most important factors affecting student science achievement according to student science teachers are the items in the dimensions of teacher and curriculum. A recent longitudinal investigation of a comprehensive teacher professional development program found that when middle school science teachers engaged in sustained in-service support focused on inquiry-based pedagogy, science literacy, and integrated instruction, students' science achievement, literacy, and motivation improved significantly over time (Ragusa *et al.*, 2023). Similarly, studies connecting students' attitudes toward

science with Classroom experiences have highlighted that positive Classroom interactions and cooperative instructional practices are associated with more favorable attitudes, which in turn support engagement and achievement in science (Fulmer *et al.*, 2019). Motivational and contextual research using international large-scale data also suggests that students' motivational beliefs about science—their interest, confidence, and goal orientation—are linked to better science performance in middle Class, signaling the importance of student perceptions of both Classroom goal structures and supportive teacher behaviors for achievement (TIMSS, 2019 Research, 2024).

It has been realized that science education should not be mere transfer of accumulated knowledge rather it should develop an insight of scientific process and attitude so as to enable the child to construct knowledge. National Policy on Education (1986) has also emphasized on science teaching and said "science education programs will be designed to enable the learner to acquire problem solving and decision-making skill". Science Achievement has long been the center of research since the present of science curriculum in schools and after each new implementation of science curriculum reform across the world. International Mathematics and Science study in 1999 (TIMSS,1999) and the succeeding Trends in International Association for the evaluation of educational Achievement, also focused on student mathematics and Achievement mainly at Grade 4 and 8, and provided an opportunity for the participating countries/regions and their students to obtain a national overview of its pupil's. with an international comparative perspective.

Whatever attempts have been made at upper primary level/ middle stage by the researcher are rare and systematized. Collectively, these findings emphasize that unlocking science potential at the middle stage involves not only curriculum and assessment reforms but also intentional teacher development, supportive Classroom climates, and strategies that nurture student motivation and positive attitudes toward science learning. Here in this present study the researcher has tried a systematic and comprehensive effort for identification of factors of low achievement in science at middle stage and accordingly suggested the remedial measures to overcome low achievement of Science.

Objectives of the study

1. To identify dominant factors that affect low achievement in science in Grade-8 with respect to the components viz. Curriculum and textbooks, Evaluation/examination patterns, Teachers characteristics/qualifications, and Teaching Effectiveness and Student Learning.
2. To evaluate remedial measures to overcome low achievement of Science.

Delimitations of the study

In view of constraints of time and resources the present study has following delimitations.

- i. The study is limited to students of Grade-8 only.
- ii. The study is restricted to Bokaro district in Jharkhand which covers 6 schools.

Methodology

The present study is a survey type of research. the population in the study is from upper primary schools of Bokaro district, Jharkhand. The sample of the study consisted of six schools namely Project Girls high school, Kasmar, Bokaro. Kendriya Vidyalaya No.1, Bokaro, Bokaro Ispat Vidyalaya-VI/A, Bokaro Ispat Vidyalaya-IX/A, D.A.V. Public School, Bokaro and +2 High School, BSL-VID. A questionnaire was designed to collect data from the students of Class VII reading in Selected school located at Bokaro district. The questionnaire for students consisted of twenty questions having four close-ended questions. In order to study the objective, questionnaire was administered on 200 students. And interview schedule for parents having 18 questions was taken to interview thirty parents of sampled students.

Findings

Table No. 1: Identified Dominant Factors of Curriculum and text –books

Sub Factors	1st Dominant Factor	2nd Dominant Factor
Type of Science Curriculum	General Science Curriculum	Integrated Curriculum
Does not Cater to Various Needs	Deals with Theoretical Generalization	Jumbling of Facts
Text Books not Sufficiency in Self Activity	Difficult Concepts	Lacks Sufficient Figures
Text Lesson Difficult to Comprehend	Lack of Conceptualizing and Variation at Local Needs	Lack of Adequate Information

Table No. 2: Identified Dominant Factors of Evaluation/Examination patterns.

Sub Factors	1st Dominant Factor	2nd Dominant Factor
Science paper does not access genuine understanding	Problem solving & critical reasoning abilities are not well.	Outside text book, assessment is not done
Present examination is not up to mark	Deep fear and complexes in child	Non-formal co-curricular activities are not accessed.
Teacher evaluation is not done properly	Student loses interest from reading	Deserving students are neglected
Home assignment not given or evaluated	Teacher's negligence.	Lack of cross checking by parents

Table No. 3: Identified Dominant Factors of Teachers Characteristics/Qualifications

Sub Factors	1st Dominant Factor	2nd Dominant Factor
Science teacher not able to explain all the facts in correct way	Following traditional method.	Less conceptual clarity.
Science teacher does not discuss with student	Start new chapter to complete syllabus.	Tell student to memorize.
First period not taken by lady science teacher	Responsibility at home.	Long distance of home from school.
When subject teacher does not teach science	Unable to explain properly.	Student loses interest.

Table No. 4: Identified Dominant Factors of School-environment

Sub Factors	1st Dominant Factor	2nd Dominant Factor
Class size is big.	Effect Class room management.	Teachers pays less attention towards back benchers.
Children does not ask question.	Lack of conceptual clarity.	Fear of teacher.
Outside Class activities are not given importance.	Time allotted for a Class is less.	Time allotted for a Class is less.
Unavailability of physical infrastructure	Not able to perform activity-based learning.	Effect teachers' productive output.

Views from Parents

Most of the parents also accepted, they do not check their child's assignment, most of the responses made was they are not invited by school to look answer script of child. Some of the concern parents are only aware of evaluation/ examination patterns; 90% of the child have fear during examination; 28% of the parent said they enquire whether the teacher is teaching well or not, most of the parents are not

aware of their ward's homework. Most of the parents are not aware of the teacher's characteristic/qualifications which indirectly hamper their student's achievement. Cause of low achievement in science at middle stage were also supported by the parents, and it was found that some of the concern parent are only aware of Classroom situation.

Discussion

Thus, from the above justification of teachers and parents it can be found that the above-mentioned reasons are the most dominant factor which causes low achievement in Science at middle stage. Research findings indicate that an overloaded and abstract curriculum (e.g., NCERT, 2019), examination patterns emphasizing rote memorization over conceptual understanding (Black & Wiliam, 2009), and variations in teacher qualifications and pedagogical competence (Darling-Hammond, 2017) significantly affect students' academic performance. Furthermore, studies suggest that inadequate school infrastructure, limited laboratory facilities, and an unsupportive learning environment further contribute to poor achievement in Science (UNESCO, 2015). Collectively, the literature emphasizes that curriculum reform, adoption of formative and competency-based assessment, continuous professional development of teachers, and improvement of school learning resources are essential for enhancing students' achievement and interest in Science.

Objective 2: To suggest remedial measures to overcome low achievement of Science.

Findings: Remedial measure to bring about improvement in Science teaching.

- Simple language should be used in developing concept.
- Stage by stage evaluation is necessary in every Class.
- Active pupil participation must be encouraged in the Class
- Student interest has to be drawn towards the lesson by asking inquisitive questions
- Teacher can use current affair and create interest among students to look into newspapers/magazines.
- Field visits should become a part of Science teaching as it provides use first-hand experience to the students or various science aspects.
- Friendly environment between the students and the teacher is must for better learning of the Science.
- To know the understanding level of the content among the students.
- Rote learning should be avoided and application type questions should be emphasized.
- The teaching content should be related to natural or physical environment.
- Teacher can re-arrange the units as per the need. This can bring reality to learning.
- Project works and practical given at the end of each lesson will have to be taken seriously by the teachers as they provide extensive learning and develop co-operative values among the students.

Discussion

The findings of the study indicate that low achievement in Science is mainly influenced by curriculum and textbooks, Evaluation/examination patterns, Teachers characteristics/qualifications and Teaching Effectiveness and Student Learning. It is observed that excessive dependence on rote memorization and lecture-based teaching limits conceptual clarity and reduces students' interest in the subject. The study suggests that Grade 8 students' achievement in Science is influenced by teaching strategies, assessment, and Classroom environment. Using simple language, encouraging participation, and connecting lessons to real-life situations improve understanding and engagement (Piaget, 1972; NCERT, 2019; Vygotsky, 1978). The use of simple and clear language, along with continuous and stage-wise evaluation, helps in identifying learning gaps and strengthening students' understanding. Formative, stage-wise evaluation and experiential activities such as projects and field visits enhance learning outcomes (Black & Wiliam, 2009; Kolb, 1984; UNESCO, 2015). Supportive teacher–student relationships and reducing rote learning further promote conceptual understanding and higher-order thinking (Darling-Hammond, 2017; National Research Council, 2000). Encouraging active participation through questioning, discussion, and interaction makes the classroom more engaging and improves comprehension.

Furthermore, emphasis on application-based learning, practical work, projects, and field visits enhances students' scientific thinking and provides meaningful learning experiences. Relating scientific concepts to real-life situations and the natural environment increases relevance and curiosity. A friendly and supportive teacher–student relationship creates a positive learning atmosphere where students feel confident to express their doubts. Therefore, effective teaching strategies, proper planning, and a conducive classroom environment are essential for improving students' achievement and sustained interest in Science.

Conclusion

Science occupies a prominent place in the school syllabus. Reading the importance of the subject the present investigator had conducted this study in order to highlight the different causes leading to poor achievement of the learners in the said subject. As such it was observed that textbook on science of the supplied state lacks conceptual Classify and suitable examples for better comprehension of learnings. Further the concerned subject teachers need to develop positive frame of mind towards the subject and should look towards using appropriate and relevant teaching learning aids for better presentation, of different complex concepts. However, the genuine interest of the learners towards the subject can be ensured by a dedicated effort of all the personal directly or indirectly involved with the process.

Elementary school education plays the most crucial role in one's life. But in the present context it has got many weaknesses to mention a few of these are inappropriate curriculum, faulty system of evaluation, lack of seriousness of implementing the objectives of education on the part of home as well as attitude and scientific temper within learner, lack of correlating the environment with teaching learning system and many other such factors.

Science is an accumulated and systematized learning in general usage restricted to natural phenomena. The progress of Science is marked not only by an accumulation of fact but by the emergence of scientific method and of the scientific attitude science is a product as well as process.

These were not only told by the teachers or administrators but these views were also supported by the parents and students. For removing low achievement in Science at middle stage, parent involvement is critical. Generally, most of the parents does not engage in many different types of involvement strategies, such as providing space and materials for reading interacting with the teacher about their academic achievement, providing general oversight or monitoring of study.

Some of the student said they do not ask questions in the Classroom because of their hesitation and most of the time their friends use to laugh, some of the student are not living with their parents because of the new syllabus they are not able to understand the trend. When scientific concepts are not within the reach of students, they feel difficult to concentrate, finally leading to low achievement in Science.

Improving science achievement at the middle stage requires a holistic approach that addresses curriculum, assessment, teacher support and student engagement. By targeting the key factors affecting learning and implementing effective interventions, schools can unlock students' potential, foster positive attitudes toward science, and create an inclusive environment that promotes sustained success to embrace learning with confidence and thrive in science learning journey.

References

- Alexander, B. (1990). *A study of relationship of critical thinking, science aptitude and socio-economic status to the science achievement of second year*. PUC students M.Phil., Edu. Bangalore Univ. Fifth Survey of NCERT, New Delhi.
- Begum, K.H. (1990). *Problems of teaching new science syllabus for standard VII in Andhra Pradesh and their impact on pupil's achievement Ph.D., Edu. Sri Venkateswara Univ. Fifth Survey of Educational research, Vol.II, NCERT, New Delhi.*
- Biswas, N. B. (1986). Educational planning in India. *Indian Journal of Educational Research*, 5(2), 15–25.

- Black, P., & Wiliam, D. (2009). *Developing the theory of formative assessment*. Educational Testing Service.
- Caldas, S. J., & Bankston, C. L. (1997). Effect of school population socioeconomic status on individual student academic achievement. *The Journal of Educational Research*, 90(5), 269–277. <https://doi.org/10.1080/00220671.1997.10544583>
- Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *European Journal of Teacher Education*, 40(3), 291–309. <https://doi.org/10.1080/02619768.2017.1315399>.
- Encyclopedia of Indian Education, (2004), Volume II, NCERT, New Delhi.
- Fulmer, G. W., Ma, H., & Liang, L. L. (2019). *Middle school student attitudes toward science, and their relationships with instructional practices: A survey of Chinese students preferred versus actual instruction*. *Asia-Pacific Science Education*, 5, Article 9. <https://apse-journal.springeropen.com/articles/10.1186/s41029-019-0037-8>
- Jena, P. C. (2000). Study of factors related to high and low academic achievement at the junior high school level. *Journal of Indian Education*, 26(1), 55–63. New Delhi: NCERT.
- Kar, D. K. (1990). *A study of the relationship between attitude towards science and achievement in general science among Class IX students of Cuttack city* (Doctoral dissertation, Utkal University). In NCERT (Ed.), *Fifth Survey of Educational Research* (Vol. II). New Delhi: National Council of Educational Research and Training.
- Kibga, et al. (2025). *The mediating role of student–teacher relationships, assertiveness, and curiosity in science achievement*. *Frontiers in Education*. <https://www.frontiersin.org/articles/10.3389/educ.2025.1694074/full>
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
- Mandila, S. S. (1988). *The teaching of general science and the development of scientific attitude in secondary school students in relation to achievement in general science* (M.Phil. dissertation, Annamalai University). In NCERT (Ed.), *Fifth Survey of Educational Research* (Vol. II). New Delhi: National Council of Educational Research and Training.
- National Council of Educational Research and Training. (2019). *Science textbook for Class VIII*. NCERT.
- National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. National Academies Press.
- National Policy on Education (1986); Ministry of the Human Resources Development, Govt. of India, Deptt. Of Education, May 1986.
- Padhi, J. S. (1993). The home: Effects on pupil academic self-concept and achievement in Science. *Research Bulletin – Maharashtra State Council of Educational Research and Training*, Vol. XXIII, 4–8.
- Piaget, J. (1972). *The psychology of the child*. Basic Books.
- Ragusa, G., Huang, S., & Levonisova, S. (2023). *Improving middle school science achievement, literacy and motivation: A longitudinal study of a teacher professional development program*. *Journal of STEM Education: Innovations and Research*, 23(4). <https://jstem.org/jstem/index.php/JSTEM/article/view/2587>
- Sen, S. (2002). Causes of Academic under achievement at the primary stage as viewed by Teachers and parents of Puri town, *Journal of Indian Education*, Vol. XXI (1), p.26-30, NCERT, New Delhi.

- Tatar, E., Cengiz, T., Cemal, T., & Nail, I. (2016). Investigation of factors affecting students' science achievement according to student science teachers. *International Journal of Instruction*, 9(2), 153–166.
- TIMSS2019 Research* (2024). *Synergistic effects of students' mathematics and science motivational beliefs on achievement, and their determinants*. *International Journal of STEM Education*. <https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-024-00509-z>
- UNESCO. (2015). *Education for all 2000–2015: Achievements and challenges*. UNESCO Publishing.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
