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PROFILE OF THE STUDY AREA AND QUALITY OF MATHEMATICS LEARNING IN NAYAGARH DISTRICT

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ABSTRACT

This study presents a profile of the educational context in Nayagarh district of Odisha, with a particular focus on the quality of mathematics learning at the upper primary (U.P.) level. The chapter highlights the socio-educational background of the district, the prevailing teaching–learning practices in mathematics, and the performance levels of students. Although enrolment and access to schooling have improved, the quality of mathematics learning remains inconsistent, with many students struggling to achieve conceptual clarity. A key determinant of learning outcomes is the content knowledge of teachers. In Nayagarh district, while some teachers demonstrate adequate subject proficiency, a significant proportion face challenges in addressing complex mathematical concepts, which in turn affects classroom pedagogy and student achievement. To explore this issue, the study tests two hypotheses: first, that satisfactory student performance is linked to teachers' good content knowledge; and second, that gaps in teacher content knowledge negatively influence teaching quality and student performance. The findings from this study will provide insight into how teacher preparedness shapes mathematics learning outcomes in the district.

KEYWORDS: ***Nayagarh district Upper primary education Mathematics learning Student performance Teacher content knowledge Teaching–learning process Quality of education***

INTRODUCTION

Education is widely recognized as a key driver of individual empowerment and societal development. Within the school curriculum, mathematics occupies a central role because it cultivates logical reasoning, analytical thinking, problem-solving skills, and the ability to understand complex relationships. At the upper primary (U.P.) stage (classes VI–VIII), mathematics serves as a bridge between foundational numeracy developed in the primary grades and the advanced concepts encountered at the secondary level. The quality of learning at this stage, therefore, has long-term implications for students' academic success, cognitive development, and future career opportunities.

In Nayagarh district of Odisha, the process of mathematics learning is influenced by a range of interrelated factors. Socio-economic conditions, such as income levels, parental education, and access to learning resources, significantly shape students' engagement and achievement. The availability of school infrastructure, teaching–learning materials, and supportive learning environments further affects the quality of classroom instruction. Most importantly, the content knowledge and pedagogical skills of teachers play a decisive role in determining whether students develop a deep conceptual understanding or merely acquire procedural skills.

Despite significant improvements in enrolment, attendance, and access to educational resources due to government initiatives such as the Sarva Shiksha Abhiyan (SSA) and Samagra Shiksha Abhiyan, concerns persist regarding the actual learning outcomes in mathematics. Assessment surveys at the state and national levels indicate that many upper primary students struggle with key mathematical concepts such as fractions, decimals, geometry, and problem-solving, often reflecting gaps in the teaching–learning process.

Research across India has consistently highlighted the critical role of teacher knowledge in student achievement. Teachers with strong subject expertise are better able to:

- Explain abstract concepts clearly and effectively,
- Address student misconceptions proactively,
- Use varied pedagogical strategies that encourage critical thinking, and
- Foster student engagement through practical applications and problem-solving activities.

Conversely, teachers with limited content knowledge often rely on rote teaching methods, which can restrict students' conceptual understanding and diminish their problem-solving abilities. This reliance on mechanical

procedures may result in students performing calculations correctly without truly understanding the underlying mathematical principles.

This chapter, therefore, presents a comprehensive profile of Nayagarh district and critically examines the state of mathematics learning at the upper primary level. It investigates classroom teaching practices, teacher preparedness, and the availability of resources, highlighting how these factors collectively influence student performance. The chapter also frames the hypotheses for the study:

1. Student performance in mathematics is satisfactory due to good teacher content knowledge.
2. Gaps in teachers' content knowledge negatively impact teaching quality and lead to poor student performance in mathematics.

PROFILE OF NAYAGARH DISTRICT

Nayagarh district is situated in the eastern part of Odisha and is surrounded by Khurda, Boudh, Ganjam, Kandhamal, and Cuttack districts. It covers a geographical area of around 3,890 square kilometers and is predominantly rural, with agriculture and allied activities forming the backbone of the local economy. The district is characterized by undulating terrain, forest cover in certain regions, and scattered habitations. The socio-economic conditions of the people vary widely, with a significant proportion belonging to scheduled castes (SC) and scheduled tribes (ST). These groups often face challenges of poverty, limited access to resources, and educational disadvantage.

Demographic and Socio-Economic Features

The population of Nayagarh is largely dependent on agriculture, supplemented by small-scale trade and traditional crafts. Literacy rates in the district have shown steady improvement over the last two decades, but gender disparity in literacy levels still persists, particularly in rural and tribal-dominated areas. The socio-economic profile of the district reflects both progress and challenges, with sections of the community continuing to struggle with low income levels and limited educational support at home.

Educational Scenario

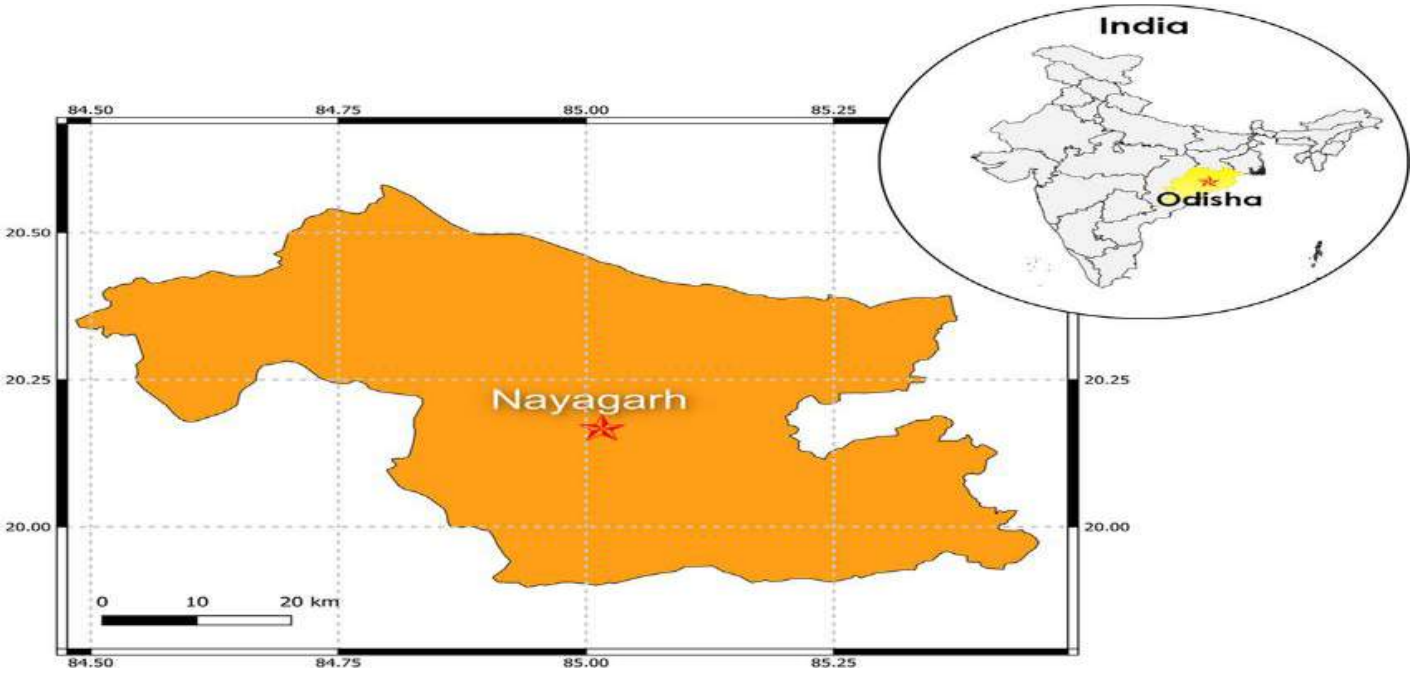
The educational landscape of Nayagarh district has undergone substantial changes in the past decade. Efforts under national and state-level programmes such as Sarva Shiksha Abhiyan (SSA), Mid-Day Meal (MDM) scheme, and Samagra Shiksha have contributed to near-universal enrolment in elementary education. The

provision of free textbooks, uniforms, scholarships, and residential schools for disadvantaged groups has further encouraged participation.

The district has a network of government and aided schools at the primary and upper primary levels. Upper primary schools (classes VI–VIII) function as a crucial stage where students make the transition from foundational learning to more abstract and conceptual subjects such as algebra, geometry, and mensuration. Teacher deployment has been streamlined to an extent, but challenges remain in ensuring subject-specific teachers for mathematics at all schools, particularly in remote areas.

Challenges in Mathematics Learning

While access and enrolment indicators reflect progress, the quality of learning outcomes in mathematics is still a concern. Achievement surveys and school-level assessments show that many students in Nayagarh struggle with basic mathematical operations and higher-order problem-solving tasks. This learning gap can be attributed to multiple factors: lack of adequate exposure to activity-based learning, minimal parental support in rural households, irregular attendance in some pockets, and, most importantly, the limited subject expertise of teachers in mathematics.



Statistical Profile Table for Nayagarh District (2011)

Indicator	Value	Male	Female	Notes / Commentary
Total Population	962,789	502,636	460,153	Census 2011 figure. Census 2011 India+2Indiastat Publications 2
Geographical Area	3,890 sq km	—	—	Indiastat Publications 1
Population Density	248 persons per sq km	—	—	Census 2011 India 1
Literacy Rate (Total)	80.42%	88.16%	72.05%	Census 2011 India 2 Indiastat Publications 2
Literacy Rate — Urban / Rural	Urban: 87.76% Rural: 79.75%	Urban male 92.90% Rural male 87.72%	Urban female 82.21% Rural female 71.12%	www.censusindia.co.in 2 Census 2011 India 2
Sex Ratio (females per 1000 males)	915	—	—	Census 2011 India 2 Indiastat Publications2
Child Population (Age 0-6)	106,871 (11.1% of total pop.)	57,599	49,272	Census 2011 India2www.censusindia.co.in2
Pupil–Teacher Ratio (PTR)	23.41	—	—	As per District Survey Report (DSR) for Nayagarh. Nayagarh Odisha

Recent Data for Nayagarh & Odisha (U.P. Level etc.)

Indicator	Latest Data Available	Source
Pupil-Teacher Ratio (PTR) in U.P. Schools (Upper Primary, Classes VI-VIII)	For Odisha state, PTR in upper primary **30:1** (or slightly less) in many districts; average Odisha PTR for primary + upper primary in rural areas shows varying numbers.	UDISE 2022-23 / Odisha Education stats dashboards UDISE Plus Dashboard2UDISE Plus Dashboard2
Enrolment in U.P. (Classes VI-VIII)	Odisha state continues to have high enrolment in elementary & upper primary under UDISE ; but district-wise data for Nayagarh is either aggregated or not broken out in public reports in the sources I checked. UDISE Plus Dashboard 2 UDISE Plus Dashboard 2	UDISE 2022-23 Reporting Booklets (Existing Infrastructure / Enrolment reports) UDISE Plus Dashboard1
Teacher Subject Specialization in Mathematics	Data not available in public	N/A
NER / Enrolment Ratios (Upper Primary)	Odisha's Net Enrolment Ratio (NER) for upper primary has been fairly high, generally above 90% for the relevant age group in recent years. UDISE Plus Dashboard 2 UDISE Plus Dashboard+2	UDISE 2022-23 & Odisha "Education at a Glance" and UDISE reports UDISE Plus Dashboard 2OSEPA2

TEACHING LEARNING PROCESS IN MATHEMATICS

Mathematics is widely regarded as one of the most challenging subjects at the upper primary (U.P.) stage, as students transition from basic arithmetic in the primary grades to more abstract concepts such as algebra, geometry, fractions, and mensuration. In Nayagarh district, the teaching–learning process of mathematics is largely traditional in nature.

Predominant Methods of Instruction

Most classrooms follow a teacher-centered approach, where the teacher explains rules, demonstrates procedures on the blackboard, and assigns exercises from the textbook. Students are expected to memorize steps and reproduce them during practice and examinations. This method ensures syllabus coverage but does not always

facilitate deep understanding. Rote memorization often takes precedence over reasoning, exploration, and problem-solving.

Teachers rely heavily on the state-prescribed textbooks, which are designed to be comprehensive but may not always cater to the varied learning needs of students. Classroom questioning is often limited to recall-based responses, with minimal opportunities for open-ended problem-solving or peer discussion.

Use of Teaching Aids and Technology

Although the government has provided mathematics kits, charts, and digital resources in some schools, their utilization remains sporadic. Teachers often lack adequate training or confidence to effectively integrate these tools into daily classroom activities. For instance, geometry boxes, fraction kits, or number cards are sometimes used during training demonstrations but are rarely employed in regular teaching. Similarly, digital aids such as smart boards or projectors, where available, are underutilized due to inadequate technical support or lack of teacher preparedness.

Teacher Training and Capacity Building

Training programmes under Sarva Shiksha Abhiyan (SSA) and later Samagra Shiksha aim to enhance teachers' pedagogical skills and promote activity-based learning. Workshops encourage interactive teaching strategies such as group work, mathematical games, and problem-solving activities. However, the translation of these ideas into classroom practice is limited. Several factors contribute to this gap:

- **Teacher workload** with administrative duties reduces time for innovative practices.
- **Comfort with traditional methods**, as many teachers themselves were educated through rote-based systems.
- **Inadequate subject expertise**, making teachers hesitant to experiment with new strategies.

Student Engagement and Learning Outcomes

As a result of the above factors, students often engage in mechanical problem-solving without grasping the underlying concepts. For example, while many students can perform operations with fractions or decimals, they struggle to apply these skills in real-life contexts or higher-level problem-solving tasks. Word problems, geometry proofs, and application-based questions remain particularly challenging.

This leads to gaps in conceptual understanding, reduced confidence, and, in some cases, mathematics anxiety among students. The absence of activity-based learning also hinders the development of critical thinking and reasoning skills, which are central to the aims of mathematics education.

Overall Scenario

Thus, while structural support in terms of resources, training, and policy exists in Nayagarh district, the teaching learning process in mathematics remains predominantly traditional. Without effective use of teaching aids, sufficient content knowledge, and pedagogical innovation, the quality of mathematics learning continues to lag, contributing to the unsatisfactory performance levels observed in student assessments.

STATUS OF STUDENT PERFORMANCE IN MATHEMATICS

The academic performance of upper primary (U.P.) school students in Nayagarh district reflects a mixed picture: while enrolment, attendance, and participation have improved over the years, the actual learning outcomes in mathematics continue to lag behind the desired standards.

Learning Levels in Core Areas

Assessment surveys and classroom observations reveal that a considerable number of students struggle with **basic** mathematical operations, such as addition, subtraction, multiplication, and division, particularly when applied in word problems. Fractions, decimals, measurement, and introductory algebra are areas where misconceptions are frequent. Even when students are able to carry out computations, they often lack the ability to explain the reasoning behind their solutions.

- **Number operations**: Many students can perform calculations in isolation but falter when required to apply operations in problem contexts.
- **Fractions and decimals**: Difficulties arise in understanding equivalence, conversion, and operations with fractions, reflecting a lack of conceptual clarity.
- **Geometry and measurement**: Students face challenges in visualizing shapes, applying formulae, and solving problems involving perimeter, area, and volume.
- **Word problems**: The application of mathematics to real-life situations, such as money, time, and distance, remains one of the weakest areas.

Procedural vs. Conceptual Learning

Although students often demonstrate **procedural competence**, their **conceptual understanding** remains weak. For example, they may successfully follow a set procedure to solve an equation but struggle to explain why the procedure works. This overreliance on rote methods indicates that classroom practices focus more on mechanical problem-solving than on nurturing reasoning and critical thinking.

Rural, Urban Disparities

The performance gap between students in rural and semi-urban schools is noticeable. Semi-urban schools, which are relatively better resourced and often staffed with subject-specific teachers, show comparatively higher levels of proficiency. In contrast, rural schools, especially those located in remote areas, face greater challenges due to limited exposure to trained mathematics teachers, fewer learning materials, and low parental support at home.

Transition from Primary to Upper Primary

One of the significant issues in student performance is the learning gap during transition from primary (classes I–V) to upper primary (classes VI–VIII). Students entering Class VI often have weak foundations in basic numeracy, which hampers their ability to cope with more abstract and complex concepts. Without remedial support or bridging interventions, this gap widens as students progress through the grades, leading to cumulative learning deficits.

Assessment Trends

School-level examinations and assessments conducted under government programmes such as Continuous and Comprehensive Evaluation (CCE) and National Achievement Surveys (NAS**)** indicate that a substantial proportion of U.P. students in Nayagarh perform below grade-level expectations. For instance, while many students manage to secure passing marks, fewer are able to demonstrate mastery of the competencies outlined in the curriculum. This reflects a mismatch between completion of the syllabus **and** actual learning outcomes**.**

Implications for Learning Quality

Overall, the performance of U.P. students in mathematics in Nayagarh district underscores a **quality deficit in learning**. The reliance on rote methods, limited exposure to innovative teaching strategies, and gaps in foundational skills collectively hinder students from achieving higher levels of mathematical proficiency. This

situation has long-term implications, as students with weak mathematics skills at the U.P. stage are less likely to succeed in mathematics and science subjects at the secondary level, thereby limiting future academic and career opportunities.

TEACHER CONTENT KNOWLEDGE AND ITS IMPACT

The effectiveness of mathematics teaching depends largely on the teacher's mastery of subject matter and the ability to translate that knowledge into meaningful learning experiences for students. In Nayagarh district, while most upper primary (U.P.) school teachers are qualified and committed, a considerable proportion lack specialized training in mathematics. Many of them are general graduates or trained in other disciplines such as arts or social sciences, and they teach mathematics as part of their broader teaching responsibilities.

Depth of Subject Knowledge

Although these teachers are generally able to cover the syllabus and guide students through textbook exercises, gaps appear when more complex or abstract concepts are introduced. Topics such as algebraic expressions, geometry theorems, mensuration, and higher arithmetic often expose limitations in teacher confidence and mastery. For instance, some teachers are hesitant to go beyond textbook examples to provide alternative explanations, real-life applications, or problem-solving strategies.

Impact on Pedagogical Practices

The limited content knowledge directly influences pedagogy:

- Teachers may skip or simplify difficult topics, resulting in incomplete conceptual development among students.
- Lessons tend to be procedural and exam-oriented, focusing on solving problems mechanically rather than fostering understanding.
- Teachers rarely explore multiple methods of solution, which restricts students' exposure to diverse problem-solving approaches.
- Misconceptions are sometimes left unaddressed, as teachers themselves are not fully confident about the underlying concepts.

Student Learning Consequences

When teachers lack depth in mathematics content, students face several challenges:

- **Conceptual gaps**: Students learn "rules" without understanding their logic, leading to rote learning.
- **Application difficulties**: Learners struggle to connect mathematics to real-life contexts, such as measurement in daily activities or interpretation of data.
- **Reduced confidence**: Confused explanations or unresolved misconceptions lower student confidence and contribute to mathematics anxiety.
- **Performance decline**: Over time, these challenges manifest as poor performance in both school-level assessments and external achievement surveys.

Influence on Motivation and Attitudes

Teacher content knowledge also shapes students' attitudes toward mathematics. Confident, knowledgeable teachers who present mathematics as logical and engaging tend to inspire curiosity and motivation. Conversely, when teachers show hesitation, avoid difficult areas, or convey mathematics as a subject to be memorized, students often develop negative perceptions and a fear of mathematics.

Need for Professional Development

The situation underscores the need for continuous professional development and subject-specific training for teachers in Nayagarh district. In-service training programmes, peer-learning workshops, and mentoring can strengthen teachers' mathematical knowledge and boost their pedagogical confidence. Bridging this gap is essential not only for improving classroom practices but also for ensuring that students acquire a sound and lasting understanding of mathematics.

HYPOTHESES TO BE TESTED

Based on the above analysis, the following hypotheses guide the study:

1. **Hypothesis I**: In Nayagarh district, performance of U.P. school students in mathematics is satisfactory due to good content knowledge of teachers in mathematics.

2. **Hypothesis II**: The content knowledge of upper primary teachers in Nayagarh district lags in some aspects, which affects the quality of teaching, subsequently leading to poor performance of students in mathematics.

These hypotheses seek to examine the contradictory perspectivesnon one hand, the assumption that teachers' knowledge is adequate to ensure satisfactory performance, and on the other, the possibility that gaps in teacher content knowledge negatively influence student learning outcomes.

CONCLUSION AND IMPLICATIONS

The analysis of the study area reveals a dual reality in the educational scenario of Nayagarh district. On one hand, significant progress has been achieved in terms of **access, enrolment, and infrastructural support** at the upper primary level, largely due to government initiatives such as Sarva Shiksha Abhiyan, Samagra Shiksha, mid-day meals, free textbooks, and uniforms, along with active community participation. On the other hand, the **quality of mathematics learning** continues to pose serious challenges, as reflected in students' uneven achievement levels, conceptual difficulties, and limited problem-solving skills.

A key determinant of this situation is the **content knowledge of teachers**. While many teachers are committed and capable of delivering the prescribed curriculum, gaps in subject mastery—especially in abstract areas such as algebra, geometry, and higher arithmetic—hinder effective pedagogy. This limitation not only affects classroom delivery but also shapes students' learning trajectories, contributing to misconceptions, lack of confidence, and mathematics anxiety. Rural–urban disparities and learning gaps during the transition from primary to upper primary further compound the problem.

The discussion underscores that **quality education is not only about access** but also about what and how students learn. Improving mathematics learning outcomes in Nayagarh district therefore requires a **multi-pronged approach**:

1. **Strengthening Teacher Capacity:** Regular in-service training, workshops, and mentoring programs should focus on enhancing teachers' content knowledge and pedagogical skills, particularly in areas where gaps exist. Teachers should be equipped to deliver lessons that promote conceptual understanding and problem-solving abilities.
2. **Enhancing Teaching–Learning Practices:** Moving from predominantly teacher-centered instruction to **student-centered, activity-based learning** can foster deeper understanding. Effective use of mathematics

kits, visual aids, and digital resources should be promoted, supported by guidance and training for teachers.

3. **Remedial and Bridging Programs:** To address learning gaps arising during the transition from primary to upper primary, targeted interventions, early identification of struggling learners, and continuous assessment are essential. Consolidating foundational skills ensures that students are better prepared for advanced mathematical concepts.
4. **Addressing Rural–Urban Disparities:** Equitable resource allocation, targeted teacher deployment, and support for schools in remote areas are critical to reducing disparities. Community and parental involvement can further strengthen students' learning experiences.
5. **Monitoring and Evaluation:** Systematic monitoring of student performance through classroom assessments, standardized tests, and data analysis can provide feedback on both teaching effectiveness and student progress, facilitating evidence-based decision-making and continuous improvement.

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