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Lokganitika: An Ethnomathematics Curriculum for Bhil and Pawara Students in Jalgaon

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Abstract

This study examined school attendance and mathematics learning among Bhil and Pawara students in Jalgaon, and tested a curriculum named Lokganitika, which teaches mathematics through the students' own culture. A survey of 570 students (Bhil 73.0%, Pawara 27.0%) found that only 256 students (44.9%) were attending school. Attendance was lowest in Grades 1–2 and in Grades 11–12, where older students were engaged in labour in other people's fields. Lokganitika was taught through five methods: painting-based visual learning (Chitra-Drisya Vidhi), shape learning through real objects (Aakar-Avlokan Vidhi), finger calculation (Anguli-Ganana Vidhi), whiteboard rote practice (Patti-Abhyas Vidhi) and learning through surroundings and daily life (Parivesh-Jeevan Vidhi). Students rated Parivesh-Jeevan highest (mean 4.86 out of 5), followed by Aakar-Avlokan (4.70), Chitra-Drisya (4.62), Anguli-Ganana (4.12) and Patti-Abhyas (3.39). In an oral test of 136 students of Grades 8–12, the average score rose from 5.62 before the seminar to 7.96 after the seminar. Three months later, students attending school had risen from 44.9% to 80.7%, and the average attendance of attending students had risen from 64.83% to 78.33%. The results show that the curriculum was accepted by the students, their mathematics scores improved, and their participation in school increased after the intervention.

Key words: Lokganitika; Ethnomathematics; Bhil; Pawara; Tribal Education; School Attendance; Child Labour; Mathematics Teaching

I. Introduction

On the first author's family farm, one Bhil family worked in the fields. The family was given a concrete home, food, health care and wages on time, and their children went to school. That was the experience of one family. It could not describe every Bhil family. It raised one question: why was school less reachable for children in other settlements?

To answer this question, the authors visited areas in Jalgaon where Bhil and Pawara families live. A survey of 570 students was conducted. The survey asked whether the student attended school, how regular the attendance was, and whether the student did any work. The survey found that only 44.9% of the students attended school. In the early grades, parents did not send young children to school. In the higher grades, students above 15 years of age worked in the fields of other landowners and missed school.

The problem was not only attendance. Students who were in school also found mathematics difficult. In an oral test conducted before the teaching programme, students scored lowest in mensuration and were weak in multiplication, division and sums with larger numbers. Mathematics in the classroom is normally taught by writing sums on the board. For students who have missed school, or who speak a different language at home, this method alone does not connect with what they already know.

This study therefore developed a curriculum named Lokganitika (from lok, meaning people, and ganit, meaning mathematics). Lokganitika teaches mathematics through the students' own culture: their paintings, their houses, their farm work and their surroundings. The aim of the study is to show whether this curriculum is effective in teaching mathematics to tribal students, so that their participation in education can increase and they can gain literacy and independence.

The paper is arranged as follows. Section 2 reviews earlier work. Section 3 states the objectives. Section 4 describes the method of the study and the five teaching methods of Lokganitika. Section 5 presents the data and its analysis. Section 6 discusses the results. Sections 7 and 8 give the conclusions and the limitations of the study.

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II. Literature Review

2.1 School Education, Attendance and Child Labour among Tribal Students

The Constitution of India and the Right of Children to Free and Compulsory Education Act, 2009 give every child between 6 and 14 years the right to free and compulsory education in a neighbourhood school. The Child Labour (Prohibition and Regulation) Amendment Act, 2016 prohibits the employment of children below 14 years in any occupation and prohibits adolescents from hazardous work. National Education Policy 2020 also states that the education system must respect the language, culture and knowledge of every community, and gives special attention to Scheduled Tribes and other disadvantaged groups.

In practice, the position of tribal students remains weak. The Census of India 2011 recorded the literacy rate of Scheduled Tribes at 59.0%, against 73.0% for the total population. UDISE+ reports of the Ministry of Education show that dropout increases sharply at the secondary stage, and the increase is higher for Scheduled Tribe students. The National Family Health Survey (NFHS-5, 2019–21) also shows lower school attendance in rural and tribal households. These figures describe the national position. They do not explain what happens inside one settlement.

Studies on child labour give one clear reason for this gap. When a family depends on daily wages, the work of an older child has an immediate value, while the value of school is seen only after many years. Seasonal and migrant farm work breaks the school year, and a student who returns after a gap finds the class ahead of him. In the study areas of the present work, the same pattern was reported directly by families: children above 15 years worked in the fields of other landowners. Earlier studies therefore establish the problem — poverty, seasonal work, distance and language — but most of them are surveys. They measure how many children are out of school. They do not test what kind of teaching can bring such a child back into learning.

2.2 Language, Culture and Learning

A tribal child learns first in the language spoken at home. In the study areas these languages include Ahirani, Khandeshi and the languages spoken in Bhil and Pawara homes. School teaching is conducted mainly in the state language, through a textbook. Gay (2010) calls teaching that uses the culture, language and experience of the student culturally responsive teaching, and shows that such teaching improves participation because the student does not have to leave his identity outside the classroom. Ladson-Billings (1995) makes the same point: teaching succeeds when it accepts the culture of the student as a resource, not as a defect. For a first-generation learner, this acceptance is not a decoration added to teaching. It decides whether the student speaks in class at all.

This is directly relevant to mathematics. In many classrooms, mathematics is taught as writing on the board: the teacher writes a sum, the student copies it and repeats the same type of sum. A student who has missed school, or who is afraid of the subject, gets no entry point into such a lesson. He copies without understanding, fails in the test, and concludes that mathematics is not for him. The pre-seminar test in the present study shows exactly this result: students were weakest in mensuration and in multiplication and division, although many of them used measurement and price calculation correctly in farm work.

2.3 Ethnomathematics

Ethnomathematics is the study of mathematics as it is practised in a culture. D'Ambrosio (1985), who gave this field its name, argued that every community develops its own ways of counting, measuring, comparing, classifying and designing, and that school mathematics is only one such system. Rosa and Orey (2011) developed this into a method of teaching: the teacher first identifies the mathematics present in the daily life of the students, then connects it to the formal mathematics of the syllabus. Bishop (1988) identified six activities found in every culture — counting, locating, measuring, designing, playing and explaining — and each of these activities is present in the homes, fields, houses and paintings of Bhil and Pawara communities.

Research in this field gives two warnings, and both were followed in the present study. First, ethnomathematics is not the use of a tribal picture to decorate a normal lesson. The cultural form must carry the mathematics itself: the shape must be in the house, the counting must be in the product, the measurement must be in the field. Second, one community's culture cannot be used for another community. Gerdes (1999), working with African communities, and Barton (1994), in his review of the field, both stress that mathematics belongs to a specific people, place and practice. A method that ignores this becomes a general claim about 'tribal culture', which no community can recognise as its own.

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2.4 Bhil and Pawara Cultural Forms and Their Mathematical Content

The Bhil house gives a complete lesson in shape and structure. A study of the cultural ecology of the Bhil house type describes the house called tapra: four strong forked corner posts, called dharan or thamla, are fixed on the four corners, two bigger posts are placed in the middle of the side walls, and three ridge poles, called urial or hara, are placed above them; the walls are made of split bamboo and the roof is two-gabled. The plan of the house is rectangular, the bamboo splits form repeated parallel lines, and the gabled roof forms triangles and angles. A student can therefore be taught rectangle, parallel lines, triangle, angle and structural strength from a house he has himself seen being built.

Bhil painting gives a lesson in counting, shape and pattern. Bhuri Bai, the Bhil artist from Madhya Pradesh who received the Padma Shri in 2021, painted Magar Aur Bandar Ki Kahani (The Tale of the Crocodile and the Monkey, c. 2011, Museum of Art and Photography, Bengaluru), which shows a monkey on a crocodile in water below a large tree with birds and animals. The painting can be used to count figures and to find shapes and repetition inside them. Contemporary Bhil painting is also known for figures built out of dots and clear shapes.

Pithora must be described correctly. Pithora is a ritual wall painting made for the deity Pithora, practised by Rathwa, Bhil and Bhilala communities in parts of Gujarat and Madhya Pradesh. In the Madhya Pradesh tradition described by the MAP Academy, the border, called heem, is drawn first, followed by the entrance, called jhanpo, and the human and animal figures show similarities with rock art in their use of triangles joined at the apex. Pithora is therefore not a common name for all Bhil art, and it should not be taught as such. Warli painting, practised mainly in the northern Konkan region of Maharashtra, is a separate tradition that uses lines, triangles, squares and circles; it was discussed separately in the outreach talks and was not used as a Bhil or Pawara example.

For Pawara students, no example was borrowed from Bhil painting. The Pawara (also written Pawra) are a Scheduled Tribe community living mainly in the Satpuda region of north-western Maharashtra and adjoining Madhya Pradesh, including the Shirpur–Shahada belt near the study region. In the Pawara settlements visited, teaching used the forms present there: the shapes of their own houses, rectangular farm plots, circular baskets and cart wheels, and counting of seeds, sticks and farm produce. This follows the rule stated above: the mathematics was taken from the settlement in which the lesson was taught.

2.5 Research Gap

Three gaps remain in the literature reviewed. First, studies on tribal education in India mostly count attendance, dropout and literacy; they rarely test a teaching method in the settlement and then measure attendance again. Second, ethnomathematics research mostly describes the mathematics present in a culture; classroom studies with pre-test and post-test scores among Indian tribal students are few. Third, no study located by the authors teaches the same mathematics through several distinct cultural methods and then compares the response of tribal students to each method. The present study addresses these three gaps: it surveys attendance, teaches through five named methods of the Lokganitika curriculum, measures test scores before and after, records the rating of each method, and measures attendance again after three months.

III. Objectives of the Study

1. To study the level of school attendance among Bhil and Pawara students in the study areas.
2. To study the mathematics level of the students before the teaching programme.
3. To teach mathematics through the five methods of Lokganitika and to record the response of the students to each method.
4. To compare mathematics scores before and after the programme.
5. To compare school attendance before the programme and three months after the programme.

IV. Research Methodology

4.1 Study Area and Sample

Data was collected in seven settlements of the Jalgaon region: Tekwade, Kajgaon, Samner, Nhave, Pachora, Mhasawad and Asoda. The authors went to the areas where Bhil and Pawara families live and conducted the study there. The fieldwork was carried out between June–July 2025, December 2025 and April–May 2026, and the teaching seminars were conducted for at least one week in each region. The survey covered 570 students from Grade 1 to Grade 12. Of these, 416 students (73.0%) were Bhil and 154 students (27.0%) were Pawara.

4.2 Tools Used

1. A survey schedule to record gender, age, grade, community, school attendance and work.
2. An oral mathematics test, personalised to the grade of the student, covering basic

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arithmetic and mensuration. The test was marked out of 10. It was conducted orally because many students were not willing to take a written test.

3. A five-point rating scale for each teaching method (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). Students of Grades 1 to 6 did not give ratings, because they might not be able to give accurate ratings. For these grades, only the change in attendance was calculated.
4. Attendance records, collected again three months after the seminar.

4.3 The Lokganitika Curriculum

Lokganitika is the curriculum used in this study to teach tribal students mathematics through their own culture. It has five methods. In all five methods, a familiar form was shown first, its mathematical property was explained second, and its written form was introduced last.

1. Chitra-Drisya Vidhi (Pictorial Visual Demonstration Method)

- The teacher shows a painting before writing anything on the board.
- The children count animals, birds and trees in the painting.
- The children identify circles, triangles and squares in the figures.
- This method teaches counting, shapes, pattern and symmetry.
- Bhuri Bai's Magar Aur Bandar Ki Kahani was used for Bhil children, and the monkey, crocodile, birds and animals in the water and under the tree were counted.
- In the documented Bhil/Bhilala tradition, figures are formed by joining triangles at their tips; the border is called heem and the gateway is called jhanpo.
- For Pawara children, their own drawings and scenes from their own settlement were used.

2. Aakar-Avlokan Vidhi (Real-Object Shape and Property Method)

- The teacher shows a real object from the settlement before drawing it.
- The children touch the object and name its shape.
- The teacher explains its sides, corners, angles and equal or parallel lines.
- This method teaches rectangle, triangle, square, circle and angles.
- For Bhil children, the tapra house was used — its rectangular plan, split-bamboo walls, two-gabled roof, forked posts dharan/thamla and ridge poles urial/hara were shown.
- For Pawara children, their own houses, rectangular farm plots, circular baskets and cart wheels were used.

3. Anguli-Ganana Vidhi (Finger-Based Calculation Method)

- The teacher teaches addition by joining fingers and subtraction by folding fingers.
- The children group fingers in twos, fives and tens to learn tables.
- This method teaches addition, subtraction, tables, and tens and units.
- Bhil and Pawara children counted bamboo sticks, seeds and farm produce on their fingers.
- The sticks were then tied in bundles of ten, as bundles are made in their homes and fields.

4. Patti-Abhyas Vidhi (Whiteboard Drill-and-Practice Method)

- The teacher writes the sum step by step on the whiteboard with a marker, only after the concept has been shown visually.
- The children copy the sum, read it aloud together and solve the same type of sum repeatedly.
- This method teaches number writing, tables, the symbols +, −, ×, ÷ and the textbook method of solving sums.
- The triangle first seen in the roof of a tapra was redrawn on the whiteboard, and its three sides and three corners were written and repeated.
- Rote practice was used only for revision, never as the first step.

5. Parivesh-Jeevan Vidhi (Environmental Experiential Learning Method)

- The teacher teaches at the river, in the field and on the village path.
- The children measure distance, compare quantity and estimate size in real situations.
- This method teaches measurement, distance, estimation and more-and-less.
- Bhil and Pawara children compared clean and polluted stretches of the river and counted waste collected from its bank.
- This method also taught conservation and pollution management.
- Teaching was conducted in Ahirani, Khandeshi or the home language spoken in that settlement.

4.4 Method of Analysis

Frequencies and percentages were calculated for the survey data. For the rating data, the mean rating of each method was calculated from the five-point scale. Pre-seminar and post-seminar test scores were compared grade-wise. Attendance was compared

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before the seminar and three months after the seminar.

V. Data Analysis

5.1 Demographic Profile of the Respondents

Table 1: Demographic Profile of the Respondents (N = 570)

Demographic Variable	Category	Frequency	Valid Percent (%)
Student's Gender	Male	340	59.6
	Female	230	40.4
Student's Age	Below 15 years	427	74.9
	15–18 years	143	25.1
Student's Grade	1st Grade	15	2.6
	2nd Grade	36	6.3
	3rd Grade	54	9.5
	4th Grade	59	10.4
	5th Grade	61	10.7
	6th Grade	47	8.2
	7th Grade	52	9.1
	8th Grade	60	10.5
	9th Grade	43	7.5
	10th Grade	34	6.0
	11th Grade	64	11.2
	12th Grade	45	7.9
Community	Bhil	416	73.0
	Pawara	154	27.0
Total		570	100.0

The sample comprised 570 students. Of these, 59.6% were male and 40.4% were female. 74.9% of the students were below 15 years of age and 25.1% were between 15 and 18 years. The students belonged to Grades 1 to 12. The largest group was in Grade 11 (11.2%) and the smallest group was in Grade 1 (2.6%). By community, 73.0% of the students were Bhil and 27.0% were Pawara.

5.2 School Attendance before the Seminar

Table 2: Grade-Wise School Attendance before the Seminar (N = 570)

Grade	Students	Attend School	Do Not Attend	Attending (%)	Average Attendance of Attending Students (%)
1st	15	2	13	13.3	84
2nd	36	5	31	13.9	89
3rd	54	21	33	38.9	79
4th	59	23	36	39.0	78
5th	61	29	32	47.5	74
6th	47	38	9	80.9	82
7th	52	39	13	75.0	72
8th	60	45	15	75.0	40
9th	43	20	23	46.5	42
10th	34	12	22	35.3	52
11th	64	13	51	20.3	48
12th	45	9	36	20.0	38
Total / Mean	570	256	314	44.9	64.83

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Only 256 out of 570 students (44.9%) were attending school, and 314 students (55.1%) were not attending school. In Grades 1 and 2, only 13.3% and 13.9% of the students attended school. Parents said that the children were too young for school, and some families did not have money to pay for school supplies. The few young children who attended school attended regularly, and their average attendance was 84% in Grade 1 and 89% in Grade 2. These families were earning relatively better.

Attendance increased in the middle grades. It was 80.9% in Grade 6, 75.0% in Grade 7 and 75.0% in Grade 8. After Grade 8, attendance fell. It was 46.5% in Grade 9, 35.3% in Grade 10, 20.3% in Grade 11 and 20.0% in Grade 12. The average attendance of attending students also fell, from 82% in Grade 6 to 38% in Grade 12. As students got older, they engaged in child labour and often missed school. Bhil and Pawara teenagers above the age of 15 years were mostly engaged in labour work in the fields of other landowners.

5.3 Pre-Seminar and Post-Seminar Test

The test was conducted orally and was personalised according to the grade of the student. It included basic arithmetic calculations and questions on mensuration.

Table 3: Pre-Seminar and Post-Seminar Test Scores (Out of 10)

Grade	Test Candidates	Pre-Seminar	Post-Seminar	Increase
8th Grade	32	4.0	7.0	+3.0
9th Grade	22	5.1	7.5	+2.4
10th Grade	18	6.8	8.5	+1.7
11th Grade	34	6.0	8.2	+2.2
12th Grade	30	6.2	8.6	+2.4
Mean	136	5.62	7.96	+2.34

Before the seminar, the average score was lowest in Grade 8 (4.0) and highest in Grade 10 (6.8). In all grades, students received the least scores in mensuration questions. In arithmetic, most students struggled with multiplication and division, and they neglected sums involving higher digits.

The sample for testing (136 students) was smaller than the survey sample (570 students), because most students were not eager to give a test. They were encouraged by conducting the test orally, but many were not interested in learning mathematics. The low number and low score of Grade 8 students shows that these students were deprived of basic mathematics education. Students of higher grades managed some calculations because they used them in daily life, in measuring and in calculating the cost of fruits and other produce, which is the measurement required in farming practice.

After the seminar, the score increased in every grade. The average score increased from 5.62 to 7.96, an increase of 2.34 marks out of 10. The increase was largest in Grade 8 (+3.0), which had started from the lowest score, and smallest in Grade 10 (+1.7), which had started from the highest score.

5.4 Response of Students to the Five Methods

Ratings were not taken from students of Grades 1 to 6, because they might not be able to give accurate ratings. Chitra-Drisya Vidhi and Aakar-Avlokan Vidhi were rated by students of Grades 7 to 12 (n = 298). Anguli-Ganana Vidhi, Patti-Abhyas Vidhi and Parivesh-Jeevan Vidhi were rated by students of Grades 10 to 12 (n = 143). Rating scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

Table 4: Response to Chitra-Drisya Vidhi (n = 298)

Grade		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
7th	Frequency	1	1	7	12	31
	Percentage	1.9	1.9	13.5	23.1	59.6
8th	Frequency	0	0	8	16	36
	Percentage	0.0	0.0	13.3	26.7	60.0
9th	Frequency	1	0	0	2	40
	Percentage	2.3	0.0	0.0	4.7	93.0
10th	Frequency	0	0	2	4	28
	Percentage	0.0	0.0	5.9	11.8	82.4

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11th	Frequency	0	0	6	6	52
	Percentage	0.0	0.0	9.4	9.4	81.2
12th	Frequency	0	2	2	5	36
	Percentage	0.0	4.4	4.4	11.1	80.0

For Chitra-Drisya Vidhi, 74.8% of the students strongly agreed and 15.1% agreed. Only 1.7% disagreed or strongly disagreed. The mean rating of this method was 4.62 out of 5. The younger grades did not like this method as much as the higher grades. The mean rating was 4.37 in Grade 7 and 4.47 in Grade 8, and it rose to 4.86 in Grade 9. The younger students were not able to engage properly with the paintings and images shown. They wanted a more interactive session than a lecture about images and paintings. The higher grades were able to relate to the images because they had seen them earlier. When new mathematical aspects of the same images were introduced, they were more interested and rated the method higher.

Table 5: Response to Aakar-Avlokan Vidhi (n = 298)

Grade		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
7th	Frequency	1	1	7	10	33
	Percentage	1.9	1.9	13.5	19.2	63.5
8th	Frequency	0	0	7	13	40
	Percentage	0.0	0.0	11.7	21.7	66.7
9th	Frequency	2	0	1	2	38
	Percentage	4.7	0.0	2.3	4.7	88.4
10th	Frequency	0	0	1	5	28
	Percentage	0.0	0.0	2.9	14.7	82.4
11th	Frequency	0	0	1	3	60
	Percentage	0.0	0.0	1.6	4.7	93.8
12th	Frequency	0	1	1	2	41
	Percentage	0.0	2.2	2.2	4.4	91.1

For Aakar-Avlokan Vidhi, 80.5% of the students strongly agreed and 11.7% agreed. The mean rating was 4.70 out of 5, which is higher than Chitra-Drisya Vidhi. The higher grades liked this method more than the lower grades. The mean rating was 4.40 in Grade 7 and 4.92 in Grade 11. The lower grades were unaware of the elementary basics of shapes. Real-life examples of shapes and structures were included in this method. The higher grades related to these examples more, because they could relate them to farming tools, bridges and structures they had seen.

Table 6: Response to Anguli-Ganana Vidhi, Grades 10–12 (n = 143)

Grade		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
10th	Frequency	2	2	6	6	18
	Percentage	5.9	5.9	17.6	17.6	52.9
11th	Frequency	4	6	3	10	41
	Percentage	6.2	9.4	4.7	15.6	64.1
12th	Frequency	6	2	1	12	24
	Percentage	13.3	4.4	2.2	26.7	53.3

For Anguli-Ganana Vidhi, 58.0% of the students strongly agreed and 19.6% agreed. The mean rating was 4.12 out of 5. 15.4% of the students disagreed or strongly disagreed, which is higher than in the first two methods. This method was used for students who did not understand basic arithmetic. It helped them in calculation, but some older students did not accept finger counting at their age.

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Table 7: Response to Patti-Abhyas Vidhi, Grades 10–12 (n = 143)

Grade		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
10th	Frequency	2	2	17	7	6
	Percentage	5.9	5.9	50.0	20.6	17.6
11th	Frequency	4	9	28	11	12
	Percentage	6.2	14.1	43.8	17.2	18.8
12th	Frequency	6	2	13	10	14
	Percentage	13.3	4.4	28.9	22.2	31.1

Patti-Abhyas Vidhi received the lowest response. Only 22.4% of the students strongly agreed and 19.6% agreed. The mean rating was 3.39 out of 5. 40.6% of the students were neutral. This shows that most students did not reject this method, but they also did not find it useful or new. This method is the same as the normal method of classroom teaching, in which sums are written on the board and repeated.

Table 8: Response to Parivesh-Jeevan Vidhi, Grades 10–12 (n = 143)

Grade		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
10th	Frequency	0	0	0	2	32
	Percentage	0.0	0.0	0.0	5.9	94.1
11th	Frequency	0	1	2	5	56
	Percentage	0.0	1.6	3.1	7.8	87.5
12th	Frequency	0	1	0	3	41
	Percentage	0.0	2.2	0.0	6.7	91.1

Parivesh-Jeevan Vidhi received the highest response. 90.2% of the students strongly agreed and 7.0% agreed. Only 1.4% disagreed, and no student strongly disagreed. The mean rating was 4.86 out of 5, the highest among the five methods. This method was conducted in the Ahirani language and included topics of environmental conservation and hygiene. The students were familiar with these topics from their daily life, and they were able to learn from them.

Table 9: Mean Rating of the Five Methods of Lokganitika

Method	Students	Mean Rating (out of 5)	Strongly Agree (%)	Agree + Strongly Agree (%)
Parivesh-Jeevan Vidhi	143	4.86	90.2	97.2
Aakar-Avlokan Vidhi	298	4.70	80.5	92.3
Chitra-Drisya Vidhi	298	4.62	74.8	89.9
Anguli-Ganana Vidhi	143	4.12	58.0	77.6
Patti-Abhyas Vidhi	143	3.39	22.4	42.0

The methods are ranked as follows: Parivesh-Jeevan Vidhi (4.86), Aakar-Avlokan Vidhi (4.70), Chitra-Drisya Vidhi (4.62), Anguli-Ganana Vidhi (4.12) and Patti-Abhyas Vidhi (3.39). The three methods that used familiar and real things — surroundings, real objects and paintings — were rated higher than finger calculation. The board method, which is used in normal classrooms, was rated the lowest.

5.5 School Attendance Three Months after the Seminar

Table 10: Grade-Wise School Attendance Three Months after the Seminar (N = 570)

Grade	Students	Attend School	Do Not Attend	Attending (%)	Average Attendance of Attending Students (%)
1st	15	14	1	93.3	90
2nd	36	21	15	58.3	91
3rd	54	44	10	81.5	84
4th	59	47	12	79.7	80

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5th	61	46	15	75.4	79
6th	47	40	7	85.1	82
7th	52	44	8	84.6	85
8th	60	51	9	85.0	68
9th	43	36	7	83.7	65
10th	34	31	3	91.2	70
11th	64	52	12	81.2	75
12th	45	34	11	75.6	71
Total / Mean	570	460	110	80.7	78.33

Three months after the seminar, 460 out of 570 students (80.7%) were attending school. Before the seminar, this figure was 44.9%. The number of students attending school increased by 204, from 256 to 460. The average attendance of attending students increased from 64.83% to 78.33%, an increase of 13.5 percentage points.

The increase was largest in the grades where attendance was lowest before the seminar. In Grade 1, students attending school increased from 13.3% to 93.3%. In Grade 11, it increased from 20.3% to 81.2%, and in Grade 12 from 20.0% to 75.6%. In Grade 6, where attendance was already 80.9%, the increase was small (85.1%).

VI. Discussion

The study found three main results.

First, attendance was low at both ends of schooling. Young children were not sent to school because parents considered them too young and because some families could not pay for school supplies. Older students left school because they worked in the fields of other landowners. Any programme that wants to increase attendance must therefore speak to parents of young children and must also give older students a reason to return.

Second, students accepted learning through their own culture. The highest rated method was Parivesh-Jeevan Vidhi (4.86), in which teaching was done in the home language, outside the classroom, on the river, the field and the village path. The next two methods also used familiar things: real objects and structures (4.70) and paintings (4.62). The lowest rated method was Patti-Abhyas Vidhi (3.39), which is the method normally used in classrooms. In this method, 40.6% of the students remained neutral. The students did not reject board work, but it did not engage them in the way the other methods did.

Third, learning improved. The average test score increased from 5.62 to 7.96 out of 10. The increase took place in every grade from Grade 8 to Grade 12. Before the seminar, students were weakest in measurement. This weakness is important because mensuration is used in farming. The methods that taught shapes and measurement through real objects and surroundings were also the methods rated highest by the students.

The results of attendance, ratings and test scores are in the same direction. After the Lokganitika programme, more students attended school (44.9% to 80.7%), attending students were more regular (64.83% to 78.33%), and test scores increased (5.62 to 7.96). Looking at the averages, it can be said that the ethnomathematics curriculum was adopted by the tribal students.

7. Implications of the Study

1. Teachers of tribal students should begin a mathematics topic with a familiar object, painting or place, and should introduce the written sum after the concept is understood.
2. Teaching in the home language of the students increases participation. This was seen most clearly in Parivesh-Jeevan Vidhi.
3. Rote practice on the board should be used for revision only. It should not be the only method of teaching.
4. Schools should speak with parents of young children about admission and should help families that cannot pay for school supplies.
5. For students above 15 years who work in fields, schools need flexible support, otherwise these students will leave school again.

8. Limitations of the Study

1. The study was conducted in Jalgaon only. The results cannot be applied to all tribal students.
2. There was no comparison group of settlements where the seminar was not conducted. Therefore, the study shows that attendance and scores increased after the programme. It cannot prove that the programme alone caused the full increase. In three months, other factors, such as

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admission drives, teachers and the season of farm work, may also have changed.

3. The test sample (136 students) was smaller than the survey sample (570 students), because many students were not willing to take a test.
4. Students of Grades 1 to 6 did not give ratings. Their response was measured only through attendance.
5. Anguli-Ganana, Patti-Abhyas and Parivesh-Jeevan were rated only by students of Grades 10 to 12. Their mean ratings cannot be compared directly with the other two methods for younger students.

9. Conclusion

This study was conducted among 570 Bhil and Pawara students in Jalgaon. Before the study, only 44.9% of the students attended school. Young children were kept at home, and students above 15 years of age left school for labour work.

The Lokganitika curriculum taught mathematics through the students' own culture, using five methods: Chitra-Drisya Vidhi, Aakar-Avlokan Vidhi, Anguli-Ganana Vidhi, Patti-Abhyas Vidhi and Parivesh-Jeevan Vidhi. Students rated the methods based on their surroundings and daily life the highest (4.86), followed by real objects (4.70) and paintings (4.62). The normal board method was rated the lowest (3.39).

The average mathematics score of the students increased from 5.62 to 7.96 out of 10. Three months after the seminar, students attending school increased from 44.9% to 80.7%, and the average attendance of attending students increased from 64.83% to 78.33%.

The study shows that when mathematics is taught through the culture and daily life of tribal students, students participate more in learning, their mathematics improves, and their participation in school increases. This can support their literacy and their emancipation.

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Ethics Statement

The study was conducted with consent. Permission was taken from the village panchayats and from the families before the survey, the tests and the teaching sessions were conducted. Parents and guardians gave their consent for their children to take part, and the children themselves agreed to participate. The purpose of the study was explained to the families in the language spoken by them. No student was forced to take a test or to attend a session. The names of individual students are not reported in this paper, and the results are presented only as group totals and averages. The data was used only for this study.

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