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Research Article

A Comparative Study on Academic Achievement of Mathematics and English with Other Subjects of Secondary Level in BTR of Assam, India, Using Mahalanobis Distance

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The present work is a comparative study of four different subjects' achievements such as mathematics, English, general sciences, and social studies between two student groups in the Bodoland Territorial Region (BTR) in Assam, India. Three different types of groups are considered viz., tribal and nontribal, boys and girls, and rural and urban from different secondary and higher schools of BTR. Mahalanobis Distance (MD) is used to calculate the difference in dynamical nature of achievement between two groups of students in four subjects. The result revealed that there is no significant difference between boys and girls; students from tribal and nontribal communities, students belonging to the rural and urban schools, tribal boys and nontribal boys, and tribal girls and nontribal girls in the dynamical character of achievement of different groups are taken into account.

1. Introduction

Tribal groups in India must work hard to maintain and develop their existence. Because they have a large population, their development is critical to the general development of our subcontinent. They are coveted for a variety of chances, which may result in intellectual inferiority [1, 2]. Although the term "tribal" is not stated in our Constitution, Article 342, Scheduled Tribes (STs) represent tribes or tribal communities that are notified by the President.

The Bodo (also Boro) ethnic group is found in northeastern Assam, India, and is part of the wider Bodo-Kachari ethnolinguistic family. They are mostly found in the Bodoland Territorial Region (BTR), which consists of four Assam districts; however, Boros can be found in all of Assam's districts. They are classified as a Boro or Borokachari scheduled tribe in the Indian constitution. The Boro people are designated as a plain's tribe in the Indian Constitution's Sixth Schedule. According to Andrabi [3], the government of India has been working hard since independence to close the socioeconomic gap between privileged and underprivileged groups, but Scheduled Tribes have remained economically, socially, culturally, and educationally backward due to their unique occupational and geographical location. The current study attempted to evaluate if tribal and nontribal students in terms of sex and location dichotomy predict academic performance in mathematics and English with other secondary level subjects in the Bodoland Territorial Region (BTR) of Assam, India.

2. Literature Review

The role of statistical distances when dealing with problems such as hypothesis testing, goodness of fit tests, classification techniques, clustering analysis, outlier detection, and density estimation methods is of great importance. Using distance measures (or similarities) enables us to quantify the closeness between two statistical objects. There exist many statistical distance measures [4, 5]; among them, the Mahalanobis Distance has the advantage of its ability to detect multivariate outliers. Mahalanobis Distance is a popular and useful measure of "closeness" of multivariate observations that was invented by Mahalanobis [6, 7]. This was a seminal contribution and much has been written about it statistically and theoretically [8–11]. Entropy (and Kullback-Leibler as a generalization) and other divergence measures are closely related to Mahalanobis Distance. In turn, Mahalanobis [12] discussed the maxent or minimum divergence (relative entropy) concept in econometrics for creating measures of dependency, hypothesis testing of a parametric null against an omnibus alternative, estimate of conditional moments, and specification testing [13–16]. In fact, Mahalanobis Distance and similar notions have been shown to be effective tools for modelling nonstationarity and dependence in time series and spatial data [17–20]. Balakrishna et al. [21] undertook a study wherein he developed omnibus tests of a parametric linear autoregressive time series model with multiplicative errors. Cai et al. [22] developed a Lasso-based model selection methodology for dependent data using Mahalanobis Distance. Lee et al. [23] and Alosaimi [24] made a theoretical contribution to higher order asymptotic of an asymmetric least square estimator. This is actually used for risk management. However, it has a connection to Mahalanobis Distance in its ordinary use of identifying outliers. For the last few decades, Mahalanobis Distance and its application have been used in a variety of areas such as anthropology, classification, clustering, image processing, physics, neuro-computing, and precision medicine. Rubin [25–27] and Cochran and Rubin [28] used Mahalanobis Distance in matching and discussed the variance covariance matrix. Mclachlan [29] used Mahalanobis Distance in classification problems among many groups, and the study examined the resemblances between groups. Bedrick et al. [30] stated that the Mahalanobis Distance is the typical measure for distance among populations if the data are quantitative. Xiang et al. (2008) observed that the Mahalanobis Distance is a calculation between two data points in the space explained by pertinent features. Rosenbaum [31] undertook an investigation with a view to detecting the most reasonable concealed biases. Diedrichsen et al. [32] studied analytical expressions for the means and the covariances of sample distribution using the Mahalanobis Distance. Cristani and Murino [33] used it and applied it on reidentification of problems. Toma [34] investigated motor fan radiated sound and vibration waveform applying the Mahalanobis Distance. Imani [35] studied and suggested a difference-based target detection method by using the Mahalanobis Distance. In an investigation, Etherington [36] used the Mahalanobis Distance to calculate, and it is shown how to accurately yield probabilities by way of a virtual ecology experiment.

In the field of education, Ahmed et al. [37, 38] used Mahalanobis Distance to address the nature of achievement in mathematics for two groups of secondary and higher secondary level students. In most of the cases, they found significant differences between achievements in different grades for two groups of students in the secondary and higher secondary level. However, no such difference was found by them on the achievement in different subjects in higher secondary level students. Sen and Pal [39] studied the achievement in unit test based on the work of Sen and Kar [40]. Their work is dealt with the study of the achievements in unit test (formative) and annual examination (summative) for seventh and eighth-grade students for three different types of schools viz, boys, girls, and coeducational in Kalna, a subdivision of Purba Bardhaman, West Bengal, India. Some statistical measures like the coefficient of correlation and t-test are used by them to analyze the data. They used Mahalanobis Distance to address the dynamical nature of the achievement in three subjects—mathematics, Physical Science, and Life Science. These subjects have been taken together as a bunch of achievements and found a substantial difference in most of the cases. Mahato and Sen [41] carried out a study on educational psychology where Mahalanobis Distance is applied to measure the difference among dependent variables self-efficacy in mathematics, academic stress, and anxiety in mathematics for two groups of higher secondary level students. For different groups of independent variables, it is found that there is no significant difference in dynamical nature of three dependent variables. Gorain et al. [42] undertook a study on comparison among different psychological aspects of postgraduate level students with the help of Mahalanobis Distance. Five different factors of personality, Internet dependency, and social isolation are considered for this study. Different groups like science and arts, male and female are formed for this study [43–46]. Several variables like extraversion, agreeableness, conscientiousness, neuroticism and openness, Internet dependency, and social isolation are taken as a branch for sex (male and female), and stream (arts and science) is considered to measure Mahalanobis Distances. It concluded that there are no significant differences in dynamical nature between male and female students and arts and science students.

Present work is the analysis of achievement in four subjects viz, mathematics, English, general science, and social studies have taken together as a branch of achievement by using Mahalanobis Distance (MD) of tribal and nontribal, boys and girls, and rural and urban secondary level students of BTR, Assam, India.

3. Objectives

The following are the main research objectives of this investigation.

(1) To study and compare the level of achievement between tribal and nontribal students in the subjects mathematics, English, general science, and social studies of the tenth grade

(2) To study and compare the level of achievement between boy and girl students in the subjects mathematics, English, general science, and social studies of the tenth grade

(3) To study and compare the level of achievement between rural and urban students in the subjects mathematics, English, general science, and social studies of the tenth grade

(4) To study and compare the level of achievement between tribal boy and nontribal boy students in the subjects mathematics, English, general science, and social studies of the tenth grade

(5) To study and compare the level of achievement between tribal girl and nontribal girl students in the subjects mathematics, English, general science, and social studies of the tenth grade

4. Research Hypotheses

The current study tested the following null hypotheses:

H_{01}: there is no significant difference in dynamical nature for a group of subjects regarding achievement between tribal and nontribal students of tenth grade

H_{02}: there is no significant difference in dynamical nature for a group of subjects regarding achievement between boy and girl students of tenth grade

H_{03}: there is no significant difference in dynamical nature for a group of subjects regarding achievement between rural and urban students of tenth grade

H_{04}: there is no significant difference in dynamical nature for a group of subjects regarding achievement between tribal boy and nontribal boy students of tenth grade

H_{05}: there is no significant difference in dynamical nature for a group of subjects regarding achievement between tribal girl and nontribal girl students of tenth grade

Here, the group of subjects indicates mathematics, English, general science, and social studies of the secondary level.

5. Methodology

5.1. Population. The population of the study is made up of students in tenth grade from various government and private high and higher secondary schools (rural and urban) in Assam's Bodoland Territorial Region (BTR), who are connected with the State Board of Assam, India.

5.2. Sample. In the Bodoland Territorial Region (BTR), which is made up of four districts (Kokrajhar, Baksa, Udalguri, and Chirang) of Assam, a sample of 2008 tenth grade students who has taken mathematics, English, general science, and social studies subjects and passed in the year 2019 were randomly selected for the study, and marks of secondary examination in mathematics, English, general science, and social studies were collected. On the other hand, 21 secondary and higher secondary schools (12 rural and 9 urban) have been selected randomly from different parts of BTR. The distribution of the sample is depicted in Figure 1.

5.3. Data Arrangement. Two sets of data are prepared for calculating the distance. The first set of data considers the marks of tribal students in mathematics, English, general science, and social studies, respectively. The second set of data is made for nontribal students for the same subjects mentioned above. Further groupings such as boys and girls and rural and urban are done to compare the group achievements.

5.4. Information Schedule. Investigators created an information schedule to determine the location of the institution and the academic achievement of secondary and higher secondary schools' students of tenth grade. Some academic score of sample subjects was gathered from official records, some from individual respondents, and some from a reliable website and was measured by aggregate marks achieved by the State Board Examination of Assam.

5.5. Statistics Used. Descriptive statistics like mean, covariance, and standard deviation are calculated because these are initial requirements for Mahalanobis Distance.

5.6. Mathematical Formula. Mahalanobis Distance is calculated by the following equation:

$$\Delta^2 = (X - Y)^T \sum^{-1} (X - Y), \tag{1}$$

where $X_{\text{and}} Y$ are column vectors of respective means and Σ is pooled covariance matrix of two groups of data.

$$\text{MahalanobisDisatance(MD)} = \left[(X - Y)^T \sum^{-1} (X - Y) \right]^{1/2}. \tag{2}$$

Pooled covariance matrix is given by

$$\sum \frac{N_1 \sum_1 + N_2 \sum_2}{N}, \tag{3}$$

where $\sum_1$ and $\sum_2$ be the covariance matrices, N_1 and N_2 are the sample sizes for first and second group, respectively, and $N = N_1 + N_2$.

As the covariances and pooled covariances are used to calculate Mahalanobis Distance (MD), it is more effective and also valid measure to compare two groups of data. The distance is represented by a single dimensionless number.

From the distribution, we can assume as follows:

(i) If $0 < \text{MD} < 1$, distance does not matter. It can be concluded that there is no significant difference in the dynamic characteristics of the groups. Here, a group refers to a collection of data on a variety of subjects

(ii) If $1 \leq \text{MD} < 2$, the distance is significant. This means that there are significant differences between the dynamic characteristics of the groups

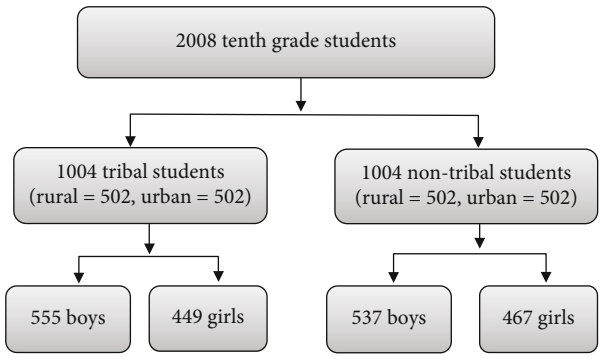

Figure 1: Sample frame of tenth grade.

(iii) MD ≥ 2 indicates that distance is strongly significant. These results show that there is a very large difference between the dynamic characteristics of the groups

6. Results

The study results are presented in methodological and hypothetical form in Table 1.

Descriptive statistics for total students, including both tribal and nontribal students (Table 1), show that there is slightly better performance of nontribal students compared to tribal students. But whether this difference in dynamical nature is really significant may be tested by applying Mahalanobis Distance. To do so, we must compute the covariances for all tribal and nontribal students. The covariances for total tribal and nontribal students are provided in Tables 2 and 3, respectively.

Using equation (3), we can compute the pooled covariance matrix from Tables 2 and 3, and the pooled covariance matrix for total tribal and nontribal students is given

$$\begin{bmatrix} 303.4860 & 189.5235 & 162.0450 & 187.9700 \\ 189.5235 & 205.0565 & 149.4870 & 156.1810 \\ 162.0450 & 149.4870 & 208.4550 & 155.0270 \\ 187.9700 & 156.1810 & 155.0270 & 253.7790 \end{bmatrix}. \quad (4)$$

The value of Mahalanobis Distance for all four subjects considered together between tribal and nontribal students by using equation (2) is 0.2960. Since the value of Mahalanobis Distance is less than 1, therefore, there is no significant difference in dynamical nature for a group of subjects regarding achievement between tribal and nontribal students of tenth grade. Hence, the null hypothesis H_{01} is accepted.

Descriptive statistics for total students (Table 4), including boys and girls, shows that boy students do marginally better than girl students. However, Mahalanobis Distance can be used to determine whether this difference in dynamical characteristics is indeed significant or not significant. For this, we have to find the covariances for total boy and girl students. The covariances for total boy and girl students are reflected in Tables 5 and 6, respectively.

Table 1: The descriptive statistics for total tribal and nontribal students.

Category	Statistics	Mathematics	General science	Social studies	English
Total	$N = N_1 + N_2$	2008	2008	2008	2008
	Mean	47.09	47.31	53.12	47.48
	SD	17.541	14.418	14.574	16.054
	SE	0.391	0.322	0.325	0.358
Tribal	N_1	1004	1004	1004	1004
	Mean	45.01	45.60	51.11	45.47
	SD	14.814	12.690	12.955	14.648
	SE	0.468	0.400	0.409	0.462
Nontribal	N_2	1004	1004	1004	1004
	Mean	49.18	49.02	55.14	49.50
	SD	19.686	15.782	15.782	17.117
	SE	0.621	0.498	0.498	0.540

We can compute the pooled covariance matrix for total boys and girls from Tables 5 and 6 by using equation (3), and the pooled covariance matrix for total boy and girl students is given by

$$\begin{bmatrix} 306.4286 & 192.9228 & 166.3669 & 192.9487 \\ 192.9228 & 207.9549 & 152.9394 & 159.7172 \\ 166.3669 & 152.9394 & 212.4978 & 159.0252 \\ 192.9487 & 159.7172 & 159.0252 & 257.4355 \end{bmatrix}. \quad (5)$$

The value of Mahalanobis Distance by using equation (2) for all four subjects considered together between boy and girl students is 0.2812. Since the value of Mahalanobis Distance is less than 1, there is no significant difference in dynamical nature for a group of subjects regarding achievement between boy and girl students of tenth grade. Hence, the null hypothesis H_{02} is accepted.

Descriptive statistics for total students (Table 7) suggest that urban students do marginally better than rural students. The Mahalanobis Distance, on the other hand, can be used to determine whether this difference in dynamical response is indeed significant. For this, we must first compute the covariances for all rural and urban students. Tables 8 and 9 show the covariances for total rural and urban students, respectively.

We can compute the pooled covariance matrix for total rural and urban students using equation (3), and the pooled covariance matrix for total rural and urban students is provided by

$$\begin{bmatrix} 288.1130 & 176.4585 & 154.0445 & 170.8935 \\ 176.4585 & 193.9570 & 142.6390 & 141.6840 \\ 154.0445 & 142.6390 & 204.9585 & 145.9210 \\ 170.8935 & 141.6840 & 145.9210 & 234.8815 \end{bmatrix}. \quad (6)$$

The value of Mahalanobis Distance by using equation (2) for all four subjects considered together between rural and urban

Table 2: The covariance for total tribal students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	219.447	130.727	106.190	133.336
General science	130.727	161.035	102.459	109.009
Social studies	106.190	102.459	167.845	112.267
English	133.336	109.009	112.267	214.562

Table 3: The covariance for total nontribal students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	387.525	248.320	217.900	242.604
General science	248.320	249.078	196.515	203.353
Social studies	217.900	196.515	249.065	197.787
English	242.604	203.353	197.787	292.996

Table 4: The descriptive statistics for total boy and girl students.

Category	Statistics	Mathematics	General science	Social studies	English
Total	$N = N_1 + N_2$	2008	2008	2008	2008
	Mean	47.09	47.31	53.12	47.48
	SD	17.541	14.418	14.574	16.054
	SE	0.391	0.322	0.325	0.358
Boys	N_1	1092	1092	1092	1092
	Mean	48.18	47.44	53.03	46.89
	SD	17.813	14.250	14.435	15.516
	SE	0.539	0.431	0.437	0.470
Girls	N_2	916	916	916	916
	Mean	45.79	47.16	53.23	48.18
	SD	17.131	14.621	14.745	16.654
	SE	0.566	0.483	0.487	0.550

Table 5: The covariance for total boy students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	317.291	196.179	169.437	190.921
General science	196.179	203.072	149.634	153.198
Social studies	169.437	149.634	208.374	148.191
English	190.921	153.198	148.191	240.734

students is 0.6671. Since the value of Mahalanobis Distance is less than 1, therefore, there is no significant difference in dynamical nature for a group of subjects regarding achievement between rural and urban students of tenth grade. So, the null hypothesis H_{03} is accepted.

Table 6: The covariance for total girl students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	293.479	189.041	162.707	195.366
General science	189.041	213.776	156.880	167.489
Social studies	162.707	156.880	217.414	171.941
English	195.366	167.489	171.941	277.346

Nontribal boy students do marginally better than tribal boy students, according to descriptive statistics for total students (Table 10) that include both tribal and nontribal boy students. However, Mahalanobis Distance can be used to determine whether this difference in dynamical characteristics is truly substantial. For this, we have to find the covariances for total tribal boy and nontribal boy students. The covariances for total tribal boy and nontribal boy students are reflected in Tables 11 and 12, respectively.

Using equation (3), we can compute the pooled covariance matrix for tribal boy and nontribal boy students from Tables 11 and 12, and the pooled covariance matrix for tribal boy and nontribal boy students is given by

$$\begin{bmatrix} 313.8100 & 193.5284 & 164.6367 & 187.8142 \\ 193.5284 & 201.1346 & 146.0532 & 150.8764 \\ 164.6367 & 146.0532 & 202.0548 & 144.0163 \\ 187.8142 & 150.8764 & 144.0163 & 238.1010 \end{bmatrix}. \quad (7)$$

The value of Mahalanobis Distance for all four subjects considered together between tribal boy and nontribal boy students by using equation (2) is 0.3687. Since the value of Mahalanobis Distance is less than 1, therefore, there is no significant difference in dynamical nature for a group of subjects regarding achievement between tribal boys and nontribal boys of tenth grade. Hence, the null hypothesis H_{04} is accepted.

Descriptive statistics for total students (Table 13), which include both tribal and nontribal females, demonstrate that nontribal girl students do marginally better than tribal girl students. But whether this difference in dynamical nature is really significant may be tested by Mahalanobis Distance. To do so, we must compute the covariances for tribal and nontribal girl students. Tables 14 and 15 illustrate the covariance's matrices for tribal girls and nontribal girls, respectively.

We can compute the pooled covariance matrix for tribal girl and nontribal girl students using equation (3), and the pooled covariance matrix for tribal girl and nontribal girl students is given by

$$\begin{bmatrix} 288.4468 & 184.5853 & 159.7149 & 190.0617 \\ 184.5853 & 209.9490 & 154.2909 & 162.8646 \\ 159.7149 & 154.2909 & 215.7747 & 168.8609 \\ 190.0617 & 162.8646 & 168.8609 & 271.9603 \end{bmatrix}. \quad (8)$$

Table 7: The descriptive statistics for total rural and urban students.

Category	Statistics	Mathematics	General science	Social studies	English
Total	$N = N_1 + N_2$	2008	2008	2008	2008
	Mean	47.09	47.31	53.12	47.48
	SD	17.541	14.418	14.574	16.054
	SE	0.391	0.322	0.325	0.358
Rural	N_1	1004	1004	1004	1004
	Mean	42.65	43.57	50.38	42.69
	SD	13.513	11.818	13.140	13.154
	SE	0.426	0.373	0.415	0.415
Urban	N_2	1004	1004	1004	1004
	Mean	51.53	51.05	55.87	52.27
	SD	19.840	15.756	15.403	17.226
	SE	0.626	0.497	0.486	0.544

Table 8: The covariance for total rural students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	182.605	109.949	99.264	114.886
General science	109.949	139.673	103.810	97.976
Social studies	99.264	103.810	172.662	119.408
English	114.886	97.976	119.408	173.024

Table 9: The covariance for total urban students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	393.621	242.968	208.825	226.901
General science	242.968	248.241	181.468	185.392
Social studies	208.825	181.468	237.255	172.434
English	226.901	185.392	172.434	296.739

Table 10: The descriptive statistics for tribal boy and nontribal boy students.

Category	Statistics	Mathematics	General science	Social studies	English
Total	$N = N_1 + N_2$	1092	1092	1092	1092
	Mean	48.18	47.44	53.03	46.89
	SD	17.813	14.250	14.435	15.516
	SE	0.539	0.431	0.437	0.470
Tribal boys	N_1	555	555	555	555
	Mean	46.28	46.01	50.53	45.23
	SD	15.739	12.822	12.552	14.437
	SE	0.668	0.544	0.533	0.613
Nontribal boys	N_2	537	537	537	537
	Mean	50.16	48.92	55.63	48.61
	SD	19.547	15.462	15.749	16.395
	SE	0.844	0.667	0.680	0.707

The value of Mahalanobis Distance for all four subjects considered together between tribal girl and nontribal girl students by using equation (2) is 0.3262. Since the value of Mahalanobis Distance is less than 1, therefore, there is no significant difference in dynamical nature for a group of subjects regarding achievement between tribal girls and nontribal girls of tenth grade. Hence, the null hypothesis H_{05} is accepted.

Table 11: The covariance for total tribal boy students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	247.731	143.402	112.826	144.058
General science	143.402	164.415	100.781	116.682
Social studies	112.826	100.781	157.560	106.028
English	144.058	116.682	106.028	208.414

Table 12: The covariance for total nontribal boy students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	382.104	245.335	218.184	233.037
General science	245.335	239.085	192.843	186.217
Social studies	218.184	192.843	248.041	183.278
English	233.037	186.217	183.278	268.783

Table 13: The descriptive statistics for tribal girl and nontribal girl students.

Category	Statistics	Mathematics	General science	Social studies	English
Total	$N = N_1 + N_2$	916	916	916	916
	Mean	45.79	47.16	53.23	48.18
	SD	17.131	14.621	14.745	16.654
	SE	0.566	0.483	0.487	0.550
Tribal girls	N_1	449	449	449	449
	Mean	43.44	45.10	51.84	45.76
	SD	13.435	12.521	13.416	14.916
	SE	0.634	0.591	0.633	0.704
Nontribal girls	N_2	467	467	467	467
	Mean	48.06	49.13	54.57	50.52
	SD	19.805	16.158	15.817	17.875
	SE	0.916	0.748	0.732	0.827

Table 14: The covariance for total tribal girl students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	180.501	113.925	100.281	121.193
General science	113.925	156.764	105.419	100.023
Social studies	100.281	105.419	179.985	119.855
English	121.193	100.023	119.855	222.493

Table 15: The covariance for total nontribal girl students.

Covariance	Mathematics	General science	Social studies	English
Mathematics	392.232	252.522	216.858	256.276
General science	252.522	261.084	201.279	223.284
Social studies	216.858	201.279	250.185	215.978
English	256.276	223.284	215.978	319.521

7. Discussion

For total tribal and nontribal students, Mahalanobis Distance is 0.2960, which is less than 1. It implies that dynamical nature for a group of subjects, viz., mathematics, general science, Social Science, and English, regarding achievement between tribal and nontribal students of tenth grade is equivalent. Similar results are also found by Ahmed et al. [37, 38] in achievement in mathematics and Mahato and Sen [41] in academic stress, self-efficacy in mathematics,

and anxiety in mathematics. Mahalanobis Distance between boy and girl students is 0.2812, which is less than 1. So, there is no considerable difference in dynamical nature for a group of subjects (mathematics, general science, Social Science, and English) regarding achievement between boy and girl students of tenth grade which is supported by Ahmed et al. [37, 38] in achievement in mathematics and Mahato and Sen [41] in academic stress, self-efficacy in mathematics, and anxiety in mathematics.

For same set of subjects, Mahalanobis Distance between rural and urban students is 0.6671, which indicates that there is no significant difference in dynamical nature for the group of subjects regarding achievement between rural and urban students of tenth grade. A comparison between tribal boy and nontribal boy students by using Mahalanobis Distance is carried out. Since the value of Mahalanobis Distance is less than 1 (actually 0.3687), it confirms that there is no significant difference in dynamical nature in performance regarding achievement between tribal boys and nontribal boys of tenth grade. A comparison between tribal girl and nontribal girl students by using Mahalanobis Distance shows that there is no significant difference in dynamical nature in achievement, which is supported by Ahmed et al. [37, 38] and Sen and Pal [39]. Actually if achievement is considered as a group of performance, then we get the overall performance for a set of students, and we can measure the difference. Here, subject-wise difference may be considered but measure that is more effective is Mahalanobis Distance.

8. Findings of the Study

The following results were obtained using Mahalanobis Distance on the data:

(i) There is no significant difference in dynamical character between achievement in four subjects between tribal and nontribal students

(ii) There is no significant difference in dynamical character between achievement in four subjects between boy and girl students

(iii) There is no significant difference in dynamical character between achievement in four subjects between rural and urban students

(iv) There is no significant difference in dynamical character between achievement in four subjects between tribal boy and nontribal boy students

(v) There is no significant difference in dynamical character between achievement in four subjects between tribal girl and nontribal girl students

9. Research Implications of the Findings

The sample considered in this investigation was delimited to students belonging to tribal and nontribal communities of the State Board affiliated schools in the State of Assam, India. Another sample should be used in upcoming challenges to emulate and extend the findings of the investigation, e.g., students belonging to the tribal and nontribal backgrounds from other boards, other States, other educational institutions like lower and upper primary school students, and also from college students. Also, nothing was known about the socio-economic status of the students in the sample and their parents, and parents' educational level has not been considered, and therefore, its effect on the academic achievement could not be measured. The results of this investigation also point to the direction for future researchers. For example, researchers may further investigate such questions as follows:

(i) How do the tribal and nontribal pupils in terms of sex and location formulate their performance in accordance with their culture?

(ii) How do cultural factors subsidize the development of personality?

(iii) In order to make a comparative study, it should investigate the personal profiles of students from the tribal communities of every corner of the country

(iv) A study for determining the different strata-wise differences in the academic achievement of minorities viz., tribe, scheduled caste, and other backward community may be conducted

(v) Family structure, parental behavior, and conservatism study among the students belonging to tribal and nontribal communities in college level of BTR may be attempted

10. Conclusion

In BTR, the literacy rate of males is quite higher than females, and the majority of the tribal population is Bodo according to the census 2011. Although the opportunity of study is greater in urban areas, the performances of the students in different social groups with respect to sex, location, and community are not significantly different.

This work demonstrates how to compute MD and how to use this distance in terms of achievement. The distance can be used by researchers to determine the difference between two groups of recorded bunches of responses. MD has a significant advantage in this regard. For present study when the four subjects mathematics, English, general science, and social studies are examined as a group of academic disciplines, there is no substantial difference between the groups tribal and nontribal pupils in terms of sex and location. This test yields a single number that adequately describes the group's dynamic character. As a result, when distinct sets of variables are viewed as a unit, this test can be used as a generalized measure of the dynamical character of the group.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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