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RESEARCH ARTICLE

INFLUENCES OF EDUCATIONAL ENVIRONMENT IN MATHEMATICS PERFORMANCE: A CASE STUDY IN SOME SECONDARY SCHOOLS IN ASSAM (INDIA)

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ABSTRACT

High school mathematics is considered as potential subject in secondary level of education, sound learning of which could make them competent for future career. Assessment and analysis of mathematics performance in some selected secondary schools of Assam (India) through a uniform test and "educational environment model". The educational environment subjected to an individual learner was modeled using three distinct groups of parameters *viz.*, school, teacher, and domestic status. Each of these parameters is further delineated into some representative factors. Finally, educational environment of the learners was quantitatively assessed through appropriate quantification of the factors. Influences of school, teacher and domestic status on mathematics performance are significant and require attention in the study area.

INTRODUCTION

India is a developing country with vast chunk of human resources. The Indian Government has realized the importance of educational development and therefore, provides required importance in education. A multi-level, structured education system prevails in India (Table 1) managed by various educational governing bodies (Table 2). There have been several plans such as *'Sarva Siksha Abhiyan* (SSA), District Primary Education Program (DPEP), Operation Blackboard, Mid Day Meal etc, executed by Government of India mainly to improve the level of primary education and to reduce illiteracy. Government also makes plan and policy to address issues related to upper levels of education including secondary education. The national policy of education (NPE, 1986) and program of action (PA, 1992) states that the curriculum of secondary education should expose the students to differentiated roles of science, the humanities, and social sciences. The roles of teacher and infrastructure facility for effective education are also realized and mentioned in the policy documents. The importance of mathematics subject has also been reflected in Government's policy. Indian Education Commission, 1964-66 had recommended that mathematics should be taught on a compulsory basis to all pupils as a part of general education during the first 10 years of schooling.

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The appropriate linkage between science and mathematics to the immediate environment of the child was emphasized even later, as reflected by the report of 9th Five year plan on education (1997-2000). The requirement of appropriate books to promote teaching of mathematics and science at the secondary stage was also mentioned in the plan documents. Progress in education scenario is remarkable in India probably due to Government policy and programmes. However, some areas still require attention. The quality of secondary education is such an area which needs special intervention and attention. There are several subjects taught at school *e.g*. language, literature, social studies, science and mathematics. Subject wise performance variations are generally reported.

Amongst the subjects taught in schools, mathematics is considered as one of the toughest subjects with poor performances of students. The lower level of pass percentage has been a matter of serious concern. Thus, science subject in general and mathematics in particular has been a problem area for majority of secondary schools in India. There exist regional variations of education vis-à-vis societal development amongst the states of India. The state of Assam is one of the economically backward states located in north-eastern region of India. The state of Assam has witnessed several socio-political disturbances in recent past. Imperfect development of human resources coupled with lack of employment opportunity in the region is pointed as major reasons of such disturbance. It is often reported that academic climate of Assam has become of matter of great concern. Critics pointed

out several discouraging factors *viz*., (a) high percentage of failure in 10th standard examination, (b)acute unemployment, (c) growing indiscipline, (d) colonial pattern of course curriculum and administration, (e) lack of mutual trust between teacher and students, (f) unplanned growth of educational institutes, (g)inadequate financial resources, (h) lack of proper mechanism for teacher employment and (i) lack of proper monitoring mechanism as some of the major factors related to Assam education. The validity of such views cannot be totally disagreed from the prevailing scenario of education. The state has witnessed several socio-political turmoil in recent past centering on the younger population. An investigation based solution is imperative to address the problems related to the educational scenario of Assam. Provision for appropriate employment, through improvement in education system, could distract the younger generation from on-going disturbing activities. The entire north-eastern region of India has agricultural dominancy with lower economical and industrial activities. The oil and tea are two major industries absorbing manpower based on certain level of academic skill. Similarly, appointments in other local and national sectors also demand competitive academic skill.

Secondary school curriculum is prepared to impart necessary academic training for higher education as well as for development of such academic skill. There are academic environmental factors influencing the success of secondary education to achieve its goal. If socio-political disturbances involving youth of this region are considered as a yardstick of educational performance, then analysis of the existing education system prevailing in this region is imperative. Secondary education in Assam is managed by one regional state government board named SEBA (Secondary Board of Education, Assam) besides central boards. SEBA conducts 10th standard test for students of schools affiliated to it. The secondary education of Assam can be considered as backbone of Assam education due to the volume of students associated with it and importance of level of learning. Numbers of investigations aiming improvement of school education have been reported form different corners of the globe. Some of the recent educational issues addressed by researchers are

(i) methodology of mathematics teaching and role of teacher (Tsamir et al, 2009; Desoetea, 2009; Hackenberg and Tillema, 2009); (ii) justification of imparting special reasoning skill to students (Kuhn, 2009); (iii) performance and impact of school improvement programme specific to some schools (Lockheed, 2010; Gross, 2009); (iv) effect of student–teacher ratio on cost effectiveness vis-à-vis students achievements (Yeh, 2009; Desai, 1999); (v) effect of several academic and socio-economic factors on pupil achievements (Riddell, 2008; Hungi and Thuku, 2010); (vi) choices between private and state funded education. Many useful outcomes could be obtained form these works, particularly to the areas and issues relevant to these studies. The delineation of the factors prevailing in the environment of the learners in order to assess performances of learners has been found as an effective technique. Though some of the factors concerning parents, teachers and learners are interlinked, investigation could pin-point delineated responsibilities. Mathematical skill is essential, not only for the higher education aspiring section, but also success in several competitive examinations for jobs depends upon the basic understanding in mathematics.

Thus, perfect teaching-learning in secondary schools in all subjects in general and mathematics subject in particular has been a serious issue needing investigation. A site specific investigation concerning the state of Assam (India) becomes imperative. Therefore, present investigation is undertaken to assess educational environment and its influence on learners' performances on mathematics subject in secondary school in the state of Assam (India).

Description of study area and schools

Study Area

The study covers some selected schools of Nalbari, a rural dominated district of Assam (India). The selected schools follow the course curriculum of a state government managed academic organization called Board of Secondary Education, Assam (SEBA). The Nalbari is one of the 28 districts of Assam located between 26°N and 27° N latitude and 91°E and 97°E longitude. The northern side of the district is bounded by the Indo-Bhutan International boundary and the southern side by the mighty Brahmaputra. The district with 2.88% area of the state shelters about 4.27 % of the state's total population. The population density of the district is 504 persons per square km as against 340 persons per square km for the state as a whole. Nearly, 97.59% of the total populations (0.67 million) of the district live in villages. The literacy rate of Nalbari is 68.08% which is marginally higher than that of the State (64.28%). There are 223 secondary schools with variations of managerial status and socio-economic conditions in the District. Schools of Nalbari district is considered to be representative of schools of Assam and therefore, selected for the present study.

Selection of School

List of schools with SEBA (Board of Secondary Education, Assam) curriculum of Nalbari district is collected from the official record of Government education department. The prevailing classification criteria of schools are based on the financial and managerial assistance of the Government or private initiative. According to such criteria the schools are categorized into five distinct groups *viz*., (i) Government (GO: fully managed by Government), (ii) Provincialized (PZ: partially managed by Government), (iii) Recognized (RG: Government has recognized for provincialization, but has not come under government management/assistance), (iv) Non–recognized (NR: established by private effort and only with permission of Government) (v) Private (PR: established and run by private party). Again, location of the schools is also considered as one of the criteria for grouping. Accordingly schools are classified into urban (U) and rural (R). High School Leaving Certificate Examination (HSLCE) pass percentage in Nalbari district was found to vary between 29% and 93% amongst the 51 HSLC examination canters in the year 2006. Considering average pass percentage of 61% (expected frequency of 29% as the worst possible case) and applying Epi-info sample size calculation procedure with a population of 223 schools, a sample of 21 schools are selected corresponding to 99% level of confidence. The only one Govt. school is automatically got selected as there is no other school in that category. The sample size of other categories proportionately selected as shown in Table 3

Selected schools are coded for convenient and meaningful identification with reference to category and age of establishment of School. For evaluation and performance analysis, 25% of the total pupil of class X of each school is selected.

Design and assessment of educational environment (EE)

Variation of performances in mathematics of the schools under study is anticipated. One of the objectives of the present investigation is to measure such variable performances. However, investigation of the causes of such varying degree of performances would be more meaningful. Standard methodology is needed for investigating cause and effect relationships. Several social, economic, academic as well as technical factors which influence academic performance seem to influence mathematics performance. Procedures are available for studying such multifaceted social issues which are mostly situation specific. However, it is felt that the present investigation would require special treatment and specific procedure. Therefore, it is attempted to design a parameter named educational environment (EE) which could comprehensively consider all the relevant factors influencing the performance of a learner. The design of EE involves (i) conceptualization of the situation to which learners are exposed; (ii) delineation of situation into group of common factors; (iii) further division of the delineated groups into measurable factors and (iv) assigning proportionate values to the factors. Finally, EE is estimated based on assumed functional relationship. The detail procedure is discussed below.

Functional relationship to define educational environment

Three broad factors are identified which influence the academic performance. Educational environment (EE) is defined using the three characteristic factors with a functional relationship as given below:

$$EE = f(SC, TC, DS) \quad \ldots\ldots (1)$$

where, *SC* is the school characteristics; *TC* is the teacher characteristic and *DS* is the learners domestic status. These broad factors could be further delineated into some distinct factors. Thus, *SC*, *TC* and *DS* are expressed using relationship given below:

$$SC = f_1(I, M, ST, AA, PI) \quad \ldots\ldots (1a)$$

$$TC = f_2(TQ, TT, TW, TM, PS) \quad \ldots\ldots (1b)$$

and

$$DS(i) = f_3(FC, PE, PA, M, F) \quad \ldots\ldots (1c)$$

where, the symbols in the right hand side of Eqs. 1a to 1c represents factors such as infrastructure, *I*; management, *M*; student teacher ratio, *ST*; academic activities, *AA*; parents involvement, *PI*; level of teacher qualification, *TQ*; level of teacher training, *TT*; work load of teacher, *TW*; teaching methods, *TM*; perception on the subject, *PS*; financial condition, *FC*; parents educational background, *PE*: parents awareness, *PA*; motivation, *M*; and facilities, *F*.

Thus, EE is described by 15 distinct factors in three groups. Questionnaires were prepared to record precisely the information required for assessment of these 15 factors.

Assigning proportionate weightage to factors

Some of the factors mentioned in Eqs. 1a, 1b and 1c could be quantitatively measured, whereas some others could be assessed qualitatively. Standard method was used to convert the recorded information (both quantitative and qualitative) into representative score values of each of the factors. The criteria of assigning scores based on some descriptive attributes are provided in Tables 4, 5 and 6. The sum total of the individual scores pertaining to the prevailing attributes of given schools were estimated to obtain the values of *SC* and *TC* of the schools under study. Similarly, *DS(i)* was estimated totaling the scores of recorded factors concerning the i^{th} student of a given school. *DS*(*i*) of the student of a given school was averaged to obtain the *DS* of the school. Finally, weighted average of scores pertaining to *SC*, *TC* and *DS* were considered as *EE* score. Required information is collected from each of the study schools using standard pro-forma. Year of establishment, total number students, number of total teachers, number of mathematics teachers, basic infrastructure including library, playground etc. were collected. Moreover, as mentioned earlier, all the required information as per the definition of school characteristics, teacher characteristic and domestic status of the learners was collected using relevant questionnaires.

Assessment of performance in mathematics and dependency of EE

Mathematical Ability Test (MAT)

A question paper on mathematics was designed for assessing mathematics performance of selected students of each school. The specially designed question paper assesses students' performance in different topics of secondary school mathematics viz., (i) number sense; (ii) idea of set; (iii) square formula, cubic formulae and their application; (iv) HCF and LCM; (v) algebric fraction; (vi) variation; (vii) linear simultaneous and quadratic equation; (viii) graph; (ix) ratio and proportion; (x) statistics; (xi) trigonometry; (xii) geometry and (xiii) interest and discount. The mathematical ability test (MAT) was conducted under direct physical supervision of the investigator for each school. The selected group of students was considered as representative of their respective schools. Thus, average MAT score of a group of learners belonging to a particular school was considered as the measure of mathematics performance of that school.

Investigation of the effect of EE on mathematics performance

Investigations of the effect of educational environment (*EE*) on mathematics performance (*MP*) of the schools under study were also made. The significance of the effect of *EE* on *MP* was tested through appropriate statistical procedure. Four hypotheses were postulated to investigate the effect of components of *EE* on *MP* as given below.

Hypothesis 1: Learner's performance (*MP*) is not affected by school characteristic (*SC*)

Hypothesis 2: Learner's performance (*MP*) is not affected by teacher characteristic (*TC*)

Hypothesis 3: Learner's performance (*MP*) is not affected by domestic status (*DS*)

Hypothesis 4: Learner's performance (*MP*) is not affected by educational environment (*EE*)

For testing all the above mentioned hypotheses, Karl Pearson coefficient of correlation was used as given below:

$$r(x,y) = \frac{\mathrm{cov}(x,y)}{\sum x_i \sum y_i} \quad \ldots\ldots (2)$$

where (x_i, y_i) , i=1,2,…. N is a bivariate data pertaining to parameter x and y.

The value of correlation coefficient $r(x, y)$ varies from -1 (perfect negative relationship) through 0 (no relationship) to +1 (perfect positive relationship). Depending upon how close the values are to ±1.00, correlation will be "high" or "low". If the value of correlation coefficient is zero then hypothesis is accepted. On the other hand if the value is different from zero then hypothesis is rejected.

RESULTS

Prevailing conditions of the schools under study

Age of establishment of school, type of management, location and teacher-student ratio are some of the influencing parameters of academic environment of a school. Information collected from the schools relating to these parameters is presented in Table 7. The overall academic environment with reference to these selected parameters of the schools under study are considered relevant for the present study and discussed below. The study schools are coded with descriptions of managerial status (GO, PZ, PR, RG and NR), location (U and R) and age of establishment (number in years till 2008). Amongst the schools, there is one Government school and eleven schools are provincialized. Six schools obtained the Government recognition to operate, whereas, two other have not yet recognized. There is only one private school in the selected sample. Rural dominance is noticed as there are only three schools ($S_{GO\_U\_119}$, $S_{PR\_U\_021}$ and $S_{PZ\_U\_078}$) located in urban area.

There is school as old as 119 years ($S_{GO\_U\_119}$) amongst the selected schools. Altogether, there are nine schools ($S_{GO\_U\_119}$, $S_{PZ\_U\_078}$, $S_{PZ\_R\_059}$, $S_{PZ\_R\_053}$, $S_{PZ\_R\_050}$, $S_{PZ\_R\_048}$, $S_{PZ\_R\_045}$, $S_{PZ\_R\_044}$ and $S_{PZ\_R\_044}$) more than 40 years old. Six schools ($S_{RG\_R\_019}$, $S_{RG\_R\_019}$, $S_{RG\_R\_017a}$, $S_{RG\_R\_017b}$, $S_{NR\_R\_015}$ and $S_{NR\_R\_009}$) are less than 20 years old. Overall, the selected schools may be considered as fully established. The largest school (970 enrolled students) is a private school located in urban area and relatively a new school established in 1985. On an average, for every 27 students there is one teacher in this private school and almost about one third of total teachers are mathematics teacher. Amongst the provincialized schools, student-teacher ratio (*S*:*T*) varies between 10 and 48. Comparatively, recognized category of schools have better *S*:*T* ratio with a variation between 7 and 19 mainly due to lower student population. The ratios of student to mathematics teacher (*S*:*M*) have also been estimated and presented in Table 7. There are altogether 8 schools with more than 100 students for each mathematics teacher. The condition seems to be critical for two schools ($S_{PZ\_R\_059}$ and $S_{PZ\_R\_045}$), where there is only one mathematics teacher for each 807 and 483 enrolled students of these schools, respectively.

Prevailing Educational Environment

Unity score of *EE* resulted by such scores of *SC*, *TC* and *DS* would be considered as an ideal education environment. Deviation of score from unity indicates deviation of school education environment from such ideal condition. The estimated scores of all the parameters reflecting the prevailing educational environment are presented in Table 8 and discussed below.

School characteristics

Factors attributed to school characteristics are (a) infrastructure comprising school building, library, electricity and play ground; (b) management of school and class room; (c) student and teachers ratio; (d) arrangement for academic meetings and interaction with other academic institutions and (e) parents' involvement in academic matter of school. Appropriately converted numerical equivalents of these attributes for all the selected schools are estimated by *SC* scores and presented in Table 8. There exists a wide variation of *SC* scores, the highest being 0.813 and the lowest *SC* score is 0.250. If 0.5 is considered as an average score of school characteristics, only five schools are found to have better than average score. All the three urban schools *viz*., $S_{PZ\_U\_078}$ (0.813), $S_{PR\_U\_021}$ (0.725) and $S_{GO\_U\_119}$ (0.650) along with two rural schools *viz*., $S_{PZ\_R\_024}$ (0.675), and $S_{PZ\_R\_048}$ (0.550) are better than average. From the scoring pattern it is also observed that urban located schools provide better environments compared to rural schools. Moreover, recognized and non-recognized categories of schools are found to exhibit poor environment compared to government, private and provincialized schools.

Teacher characteristics

Five attributes were used to assess *TC* (Teacher Characteristics) concerning mathematics teacher of schools. The attributes are qualification, training, work load, teaching method, and perception leading to effective teaching. A provincialized category, rural school ($S_{PZ\_R\_024}$) exhibited the highest *TC* score (0.650) followed by two urban schools ($S_{PR\_U\_021}$ and $S_{PZ\_U\_078}$) and one provincialized rural school ($S_{PZ\_R\_053}$) with respective scores as 0.600, 0.550 and 0.500, respectively. The scores of the remaining 17 schools are below 0.5. Moreover, the average score of 21 schools is 0.386 and far below from the ideal score *i.e.* one. Thus, requirement of adequate emphasis to improve teaching quality through improvement of teachers attribute to desired level is indicated by this result.

Table 1. Levels of Indian education system

Sl. No	Level	Description
1	Pre- Primary	It consists of children of 3-5 years of age studying in nursery, lower kindergarten and upper kindergarten.
2	Primary	It includes the age group of children of 6-11 years studying in classes from 1st first to 5th
3	Middle	It consists of children studying in classes from 6th to 8th
4	Secondary	it includes students studying in classes 9th and 10th
5	Higher Secondary	Includes students studying in 11th and 12th classes
6	Undergraduate	Here, a student goes through higher education, which is completed in college. The duration of undergraduate course may vary according to the subject pursued by the student.
7	Postgraduate	After completing graduation a student may opt for post graduation

Table 2. Education Governing bodies in India

Sl No	Level	Description
1	The Central Board of Secondary Education (CBSE)	This is the official governing body of education system in India. It conducts examination and looks after the functioning of schools accredited to central education system from primary to higher secondary level.
2	The State Government Boards	Apart from CBSE and CISCE each state in India has its own State Board of education, which looks after the educational issues up to higher secondary level. Some states have separate board for secondary and higher secondary levels.
3	The Council of Indian School Certificate Examination (CISCE)	It is a board for Anglo Indian Studies in India. It conducts two examinations 'Indian Certificate of Secondary Education' and 'Indian School Certificate'. Indian Certificate of secondary education is a k-10 examination for those Indian students who have just completed class 10th and Indian school certificate is a k-12 public examination conducted for those studying in class 12th.
4	The National Open School	It is also known as National Institute of Open Schooling. It was established by the Government of India in 1989. It is for those students who cannot attend formal schools.
5	The International School	It controls the schools, which are accredited to curriculum of international standard.

Table 3. Statistics of total schools and selected schools in Nalbari District

Category	Total schools		Selected schools	
	Urban	Rural	Urban	Rural
Government	1	Nil	1	Nil
Provincialized	9	115	1	10
Recognized	Nil	67	Nil	6
Non-recognized	Nil	18	Nil	2
Private	7	6	1	Nil
Total	17	206	3	18
Grand Total	223		21	

Table 4. Scoring pattern for teacher characteristics and description of attributes

Attributes	Maximum scores				
	1.00	0.75	0.50	0.25	0.00
Qualification	Master degree with B. Ed. degree	Bachelor degree with B. Ed. degree	Master degree	Bachelor degree	Under graduate
Training	Related training more than 90 days	Related training more than 60 days	Related training more than 30 days	Related training more than 7 days	No training
Work load	SM up to 40	SM: 41 to 80	SM: 81 to 120	SM: 121 to 160	SM greater than 160
Teaching method	Flexible as per the need of all section of learners, regular feedback assessed	Flexible as per the need of all section of learners	Flexible, not sensitive to passive learners	Flexible, not sensitive to any one, no feed back evaluation	Monotonous teaching
Perception leading to effective teaching	Most effective teaching	Effective teaching	Teaching (less sensitivity)	Teaching (lack of sensitivity)	Teaching (improper)

SM indicates student : mathematics teacher ratio

Domestic status of learners

The attributes considered for evaluating *DS* score are (a) financial condition, (b) parents educational background, (c) parents awareness about learners' performance, (d) parents action to motivate learners and (e) arrangement of additional facility for addressing academic difficulties. The *DS* score ranges between 0.684 ($S_{PR\_U\_021}$) and 0.286 ($S_{NR\_R\_009}$) with an average value of 0.444. Moreover, only six schools (*viz*., $S_{GO\_U\_119}$, $S_{PZ\_R\_044a}$, $S_{PZ\_R\_024}$, $S_{PZ\_U\_078}$, $S_{RG\_R\_022}$ and $S_{PR\_U\_021}$) scored more than 0.5 demonstrating adequate scope for improvement of learners' domestic status congenial for better performances.

In general, learners' domestic status in urban schools and private schools are better than the rural and recognized and non-recognized categories of schools.

Educational Environment of learners

Educational environment (*EE*) of learners expressed as the aggregate of *SC*, *TC* and *DS* are also found to vary amongst the schools within the range of 0.296 to 0.670 with average being 0.422. Four schools with more than 0.5 score, in descending order of their *EE* score are $S_{PR\_U\_021}$ (0.670), $S_{PZ\_U\_078}$ (0.661), $S_{PZ\_R\_024}$ (0.618) and $S_{GO\_U\_119}$ (0.539). *EE* score of the remaining 17 schools are below 0.5 indicating

Table 5. Scoring pattern for school characteristics (*SC*) and description of attributes

Attributes	Description of facility etc	Maximum score				
		1.00	0.75	0.50	0.25	0.00
Infrastructure	School Building	very good	good	bad	very bad	non existent
	Library	adequate	exists, partially satisfactory	exists, limited books	Exists, very limited books	Does not exist
	Electricity	fully connected	partially connected (few remains out of connection)	limited connection (few remains connected)	only office is connected	No connection
	Play ground	very good	good	bad	very bad	non existent
Management	Class room	Very well managed	Well managed	Managed	Poorly managed	Not cared
	Out of class room within the school	Very well managed	well Managed	Managed	Poorly managed	Not cared
Student-teacher ratio (relative score based on existing ratios which are ranked in increasing order)	Student-total teacher ratio	within 5th rank	6th to 10th rank	11th to 15th rank	higher than 16th rank	
	Student-math teacher ratio	within 5th rank	6th to 10th rank	11th to 15th rank	higher than 16th rank, less than 500 SM	more than 500 SM
Academic activities	Academic meetings	Frequent & meaningful	Less frequent & satisfactory participation	Less frequent	Not Frequent	No meeting
	Interaction with other academic institution	Frequent & meaningful	Less frequent & satisfactory participation	Less frequent	Very rare	No interaction
Arrangement of parents involvement by school		Regular & meaningful parents meetings	Less frequent & satisfactory	Less frequent	Very rare	No involvement

Table 6. Scoring pattern for learner's domestic status (*DS*) and description of attributes

Attributes	Maximum score				
	1.00	0.75	0.50	0.25	0.00
Financial condition, based on monthly income	More than Rs. 16000	Rs. 11000 to Rs. 16000	Rs. 6000 to Rs. 11000	Rs. 1000 to Rs. 6000	less than Rs. 1000
Parents educational background	Above graduation	Above 12th standard below graduation	Below 12th above 10th	Below 10th above 8th	Below 8th
Parents awareness	(a) Parents teacher meeting attended; (b) Meeting teacher to discuss academic progress of students regularly and (c) Regular interaction with learner to learn status of learning at schools	Any two of (a), (b) and (c) certainly	Any one of (a), (b) and (c) certainly	Any one of (a), (b) and (c); not certain	None of (a), (b) and (c)
Parents action to motivate learners	Regularly keeping in touch and positive encouragement	Attending learner when asked for and positive encouragement	Attending learner when asked for; encouraging sometimes	Attending learner when asked for	In different, No positive encouragement
Provision for addressing academic difficulties through additional facility	Very particular in fulfilling all academic needs of learner	Fulfills academic needs of learner as per the convenience	Fulfills academic needs of learner on the basis of priority	Fulfills academic needs of learner rarely	Cannot fulfill

Table 7. Some parameters of the schools considered under study

School Code	Age as on 2008, years	S:T	S:M	Description
$S_{GO\_U\_119}$	119	18	63	Government, urban
$S_{PR\_U\_021}$	21	27	97	Private, urban
$S_{PZ\_U\_078}$	78	16	58	Provincialized, urban
$S_{PZ\_R\_059}$	59	27	807	
$S_{PZ\_R\_053}$	53	28	112	
$S_{PZ\_R\_050}$	50	29	132	
$S_{PZ\_R\_048}$	48	20	116	
$S_{PZ\_R\_045}$	45	48	483	Provincialized, rural
$S_{PZ\_R\_044a}$	44	41	110	
$S_{PZ\_R\_044b}$	44	22	84	
$S_{PZ\_R\_039}$	39	10	36	
$S_{PZ\_R\_028}$	28	15	160	
$S_{PZ\_R\_024}$	24	22	79	
$S_{RG\_R\_029}$	29	10	60	
$S_{RG\_R\_022}$	22	11	63	
$S_{RG\_R\_019a}$	19	19	104	Recognized, rural
$S_{RG\_R\_019b}$	19	7	33	
$S_{RG\_R\_017a}$	17	9	34	
$S_{RG\_R\_017b}$	17	13	46	
$S_{NR\_R\_015}$	15	11	55	Non-recognized, rural

S:T denote ratio of student to total teacher and S:M denote ratio of student to mathematics teacher of school
The subscripts S of school codes are used to denote (i) five types of managerial status *viz.,* GO, PR, PZ, RG and NR for Government, Private, Provincialized, Recognized and Non-recognized categories, respectively; (ii) two types of locations viz., U and R for urban and rural, respectively and (iii) age of school establishment in years. The subscripts also contain alphabets a and b to distinguish schools with identical types and age of establishment.

Table 8. Scores of Educational Environment (EE) and its components along with mathematics performance

Sl No.	School Code	SC	TC	DS	EE	MP
1	$S_{GO\_U\_119}$	0.650	0.400	0.566	0.539	54.25
2	$S_{PZ\_R\_044a}$	0.488	0.350	0.500	0.446	44.67
3	$S_{PZ\_R\_039}$	0.475	0.400	0.405	0.427	30.91
4	$S_{PZ\_R\_048}$	0.550	0.400	0.458	0.469	42.50
5	$S_{PZ\_R\_028}$	0.450	0.250	0.379	0.360	48.27
6	$S_{PZ\_R\_024}$	0.675	0.650	0.528	0.618	42.44
7	$S_{PZ\_R\_045}$	0.425	0.300	0.377	0.367	33.20
8	$S_{PZ\_R\_053}$	0.450	0.500	0.480	0.477	39.30
9	$S_{PZ\_R\_044b}$	0.425	0.300	0.433	0.386	30.00
10	$S_{PZ\_R\_050}$	0.400	0.300	0.395	0.365	47.60
11	$S_{PZ\_R\_059}$	0.288	0.200	0.400	0.296	38.46
12	$S_{PZ\_U\_078}$	0.813	0.550	0.621	0.661	56.00
13	$S_{RG\_R\_017a}$	0.313	0.350	0.419	0.361	25.33
14	$S_{RG\_R\_017b}$	0.250	0.400	0.350	0.333	32.25
15	$S_{RG\_R\_019a}$	0.263	0.300	0.406	0.323	32.25
16	$S_{RG\_R\_022}$	0.400	0.350	0.536	0.429	32.29
17	$S_{RG\_R\_029}$	0.255	0.350	0.293	0.299	24.86
18	$S_{RG\_R\_019b}$	0.300	0.400	0.330	0.343	36.40
19	$S_{NR\_R\_015}$	0.338	0.350	0.469	0.385	31.00
20	$S_{NR\_R\_009}$	0.250	0.400	0.286	0.312	31.14
21	$S_{PR\_U\_021}$	0.725	0.600	0.684	0.670	76.11
Average		0.437	0.386	0.444	0.422	39.487
Maximum		0.813	0.650	0.684	0.670	76.110
Minimum		0.250	0.200	0.286	0.296	24.860
SD		0.165	0.111	0.103	0.114	12.136

Table 9. Correlation between mathematics performance and delineated factors of educational environment

Pearson Correlation coefficient between MP and				
SC	TC	DS	EE	MP
0.777**	0.478*	0.736**	0.752**	1

** Significant at 0.01 level (2-tailed)
* Significant at 0.05 level (2-tailed)

improvement requirements for majority of the schools. Better educational environment prevails in urban areas compared to rural areas, as scores of all the three urban schools are more than average.

Mathematics performance as a function of educational environment

Performances in mathematics subject assessed through MAT for all the 21 schools are also provided in Table 8.

The MAT score varies between 76.11 ($S_{PR\_U\_021}$) and 24.86 ($S_{RG\_R\_029}$) amongst the schools with an average 39.49. The varying patterns of mathematics performance have been investigated through factors such as *TC*, *SC* and *DS*. Dependency of *MP* on *TC*, *SC* and *DS* score was investigated by fitting a regression equation to the data and following equation with a maximum value of coefficient of determination ($R^2 = 0.6250$) is obtained

$$MP = 0.076 + 0.399\ SC + 0.324\ DS \quad \ldots (3)$$

It may be noted that teacher characteristics (*TC*) does not appear in the regression equation with positive coefficient.

Mathematics performance as affected by components of educational environment

The results of hypothesis testing are provided in Table 9. It is seen from the Table 9 that all the four hypotheses considered for the present analysis are rejected implying that learner's performance (*MP*) is affected by school characteristic (*SC*), teacher characteristics (*TC*), domestic status (*DS*) and also affected by overall educational environment (*EE*). It is further seen that the correlation coefficient, *r* between mathematics performance (*MP*) and teacher characteristics (*TC*) is significant at 0.05% level. On the other hand, *r* between MP and other two factors namely *SC* and *DS* are highly significant even at 0.01 level. Comprehensively, *r* between *MP* and *EE* is also highly significant. Thus, all the four hypotheses are rejected and mathematics performances of learners are found to be affected by school, teacher and domestic characteristics. However, the degree of correlation, as revealed by the correlation results, differs amongst the parameters. Attributes related to school are found to have highest influence followed by domestic environment and teacher.

DISCUSSION

The development of school education has been a major concern almost in all nations. This is also an important agenda in states of India. It is expected that proper education would solve many on-going problems having socio-economic roots in regions like Assam (India). Generally learners' performance is considered as a yardstick of the success of the education. Mathematics is considered one of the important subjects in school education. The present investigation concerning learners' performance in mathematics subject has been carried out to identify the influencing factors. Variability in prevailing secondary school education in Assam is prominent with reference to several factors which has influence on learners' performance. Attempt to make a quantified assessment of these factors and to test their influence on performance in mathematics subject have supported this fact. Academic reform is a continuous process carried out for its improvement. The results of the present investigation could be useful for such reform programmes and therefore, discussed below.

Rural vs. Urban scenarios

The state of Assam is rural dominant. Majority of the population lives in rural areas. Therefore, the development of human resources in rural areas cannot be ignored. The results of present investigation revealed unsatisfactory performances of students belonging to majority of rural schools compared to their urban counterpart. Desirable ideal environment for the pupil concerning school, teacher and domestic factors has been conceptualized to investigate the reasons of differentiated performance. Poor performances in mathematics of pupil studying in rural areas are due to exposure to non-ideal academic environment. School environment as assessed by *SC* score of sixteen rural schools (out of 18 rural schools) are found below average. There are several attributes in *SC*, improvement of which need financial and managerial inputs such as infrastructural facility, class room management, parents' involvement and academic meeting in school. The lacks of infrastructural facilities such as school building, library, playground, power connection are characteristic features of rural schools. Similarly, majority of the parents of rural areas remain unaware about academic affairs of their children. There may be several reasons for such behaviour of parents including their poor educational background and lower level of income. Thus, appropriate target oriented actions are required for improvement of school environment vis-à-vis performance in mathematics in rural areas. The role of Government accompanied by the appropriete actions of the social elements can only bring changes in school environment in rural areas. Major attributes related to mathematics teacher charactersitics (*TC*) modeled to influence learners mathematics performance are educational background, training and work load. There are less variations of this parameter between rural and urban schools.

For example, the highest *TC* score (0.65) is obtained by a rural school ($S_{PZ\_R\_024}$). Moreover, seven rural schools obtained more than average *TC* score (0.386). Workload of teachers in rural schools, as assessed by student and mathematics teacher ratio, are found low due to lower student enrolement in majority of non-government rural schools. This might be the reason of comparatively better *TC* score in rural school. However, positive influence of this factor on learners' performnace might have overpowered by poor scores of *SC* and *DS*. Domestic statuses of learners in rural schools are poor in compared to urban schools. As mentioned earlier, parents academic and economic background are the prime reasons of such conditions. Urban parents are in better positions in both fonts. Parents' financial condition, academic background and their awareness about the learners' performance are mostly interrelated. Moreover, direct solution cannot be obtained for a given socio-economic conditions.

However, schools can take effective steps for such category of learners, where weaknesses in domestic fonts are inevitable. Such weak domestic situations are the inherent characteristics of the rural areas. Therefore, appropriate attention for improvement of conditions of teachers and domestic environment of learners are required for majority of the schools. Thus, appropriate strategy should be evolved either to improve the laernrs domestic environment in rural areas or to strengthen the SC and TC charactersitics concerning rural schools so as to improve learners' performance in mathematics. It has been observed that some rural sectors such as rural health and rural communication are getting attention form the Government and results are reflected with proportionate improvement of these sectors in rural India including in Assam. However, educational sector in general and rural education in particular are not getting appropriate attention in Assam.

Managerial disparity

Five categories of schools having different levels of managerial inputs are considered in the present study. Government (GO) schools which are fully managed by Government and Provincialized (PZ) schools which are partially managed by Government have betterd the performance compared to Recognized (RG) and Non–recognized (NR) categories of schools. Financial conditions of

both RG and NR schools are poor and these schools are located in rural areas. RG schools are running with permission from the government education department. On the other hand, NR schools have been established and running with hope to get recognision and hence provincialization of the government. However, there is no provision of financial assistance to these categories of schools from Government. Thus, most of the RG and NR schools face financial crisis. There exists management committee run by local people for each of these schools. The managerial inputs provided by such committee are not sufficient which have been reflected by poor scores of educational environment in these schools. Moreover, for the obvious reason mostly weaker section of the society has the access to these schools as reflected by poor DS score. The performance of private school (PR) is better than the other categories of school. Though PR schools also do not get government assistance, the financial and managerial health of PR school is better. The fixation of higher fee competed these school to remain alert for higher performance so as to attract more students. Moreover, only wealthy parents can afford PR schools.

PR schools are mostly run by individual or group and ensures better academic environment as reflected in this study. Analysinig the perfroamnce in mathematics subject of the pupil of some secondary schools in Assam, it is observed that serious and immediate steps must be initiated to address the issues which has resulted poor performance in majority of the schools. Though the present investigation considers only mathematics subject, similar scenario might also prevail in other subjects. In general, the difference level of performances could be seen in line with the difference in location (rural vs. urban) and management (Government, non-government and private). Poor educational environments and hence poor performance in mathematics have been the characterstics of rural schools and non-private schools which are not getting government assistance. The perfoamnece in mathematics are found to be positively corelated with all the three characteristics viz., teacher, school and domestics. However, the present investigation revealed that school and domestic statuses have more influences than teacher. Appropriate intervention is required to improve the academic performance of majority of secondary schools in Assam.

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