Relation between School Environment Variables and Mathematics Achievement among School Students in Bongaigaon District

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Abstract

This article focuses on differences in mathematics achievement among school students in Bongaigaon district of Assam. The researchers conducted a comparative study between the groups of students divided on basis of different school environment variables in order to study the variation of achievement in mathematics. Data came from the test scores of 580 secondary school children in Bongaigaon district. An analysis of data indicates that the school environment does have an impact on mathematics achievement. This indicates the important responsibility of schools towards providing equitable education to all sections of children especially in developing countries.

Introduction

Mathematics has always been an integral part of any school curriculum. The importance of mathematics as a tool in various subjects and an instrument for developing discipline of thought and logical reasoning cannot be undermined. The purpose of this study was to examine the possible associations between the school environment and the mathematics achievement of students.

Schools provide students coming from different backgrounds with similar opportunities for learning. Traub (1972) was of the opinion that if children are to develop their intellectual potential they must be provided with an intellectually stimulating environment. Lack of proper

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infrastructure has been a major concern area for many years. For effective teaching to take place, a good method must be adopted by a teacher. The teacher today has to face the difficult task of arranging suitable learning experiences by utilising suitable and interesting learning techniques (Taori S, 2001). The impact of the teacher-student ratio on student performance is another factor that has been explored in this paper. When the classrooms are crowded, they present a particular burden to teachers who are not able to relate to individual pupils. Research into homework and its effect on mathematics is examined as part of this study on the school environment. As a general rule, textbooks remain the principal instructional material in the classroom. School students face problems due to non-availability of textbooks in the market in the beginning of the session. In a paper Heyneman (1978) reviewed studies from twelve less-industrialised countries on the relationship between textbook availability and academic achievement. He concluded that the availability of books was the most consistent school factor in predicting academic achievement.

In the light of the above consideration, this study was conducted to investigate the school factors related to mathematics achievement among the school students of Bongaigaon district where such is not available.

Method

Sample

Bongaigaon district of Assam was the field area for the study. In order to cover the different strata of population in the study area, a stratified random sampling of schools has been taken from the list of schools in the district. The total number of schools surveyed was 30. For the purposes of this study, students from Classes VII and IX were chosen. Using simple random sampling and lottery method ten students each from Classes VII and IX from each school were selected. The total number of samples in Class VII was 290 and Class IX was 290. The gender division among the students was 155 boys, 135 girls in Class VII and 163 boys and 127 girls in Class IX.

Tools

To test the mathematics achievement of students a single mathematics score was devised from two sources. i) Mathematics marks of previous year's annual examination collected from school records and scores achieved by students in a test ii) Investigator prepared on mathematics knowledge which included knowledge of the basic concepts, pattern recognition, spatial skills, and logical reasoning.

The scores were combined into a single score as a weighted mean of the variables which represented mathematics achievement of the student. A pilot test of the study was conducted before administration of the final test. The tests administered to the students were checked for internal consistency through reliability analysis. Cronbach alpha (á =.948) for Class IX and Cronbach alpha (á =.931) for Class VII showed high reliability co-efficient.

For purposes of this study, the attributes for school environment have been taken as:

(a) School management (b) School area (c) Physical facilities like infra-structure and text book availibility (d) Teacher-student ratio (e) Teaching methods used (f) Daily homework (g) Specific training for teachers.

Analysis

A comparative study between the groups of students divided on the basis of their school management, school area, physical facilities, teacher – student ratio, teaching methods, daily homework and specific training for teachers was conducted. The data was entered into a SPSS spreadsheet and was analysed accordingly. The tests administered to the students were checked for internal consistency through reliability analysis.The mean and standard deviation of the combined scores were calculated, t-test has been used to test the variance in the mean of the combined score for the different classes based on different groupings. Values having different superscripts (a,b) differ significantly (P<0.05) between groups/ levels in a class.

School Management

The grouping under school management was made on the basis of government schools and private schools. Government schools are those which are funded and managed by the state government while the private schools were those set up by a society or group of individuals with no government funding.

Table 1

Mean Scores of Students divided on basis of School Management

Class		*School Management Group*							
		Government			*Private*			*t*	
VII	Mean+SD	25.31	± 11.58	a	41.07	± 13.37	b	-9.078	**
	N	230			60				
IX	Mean+SD	26.23	± 13.50	a	48.31	± 14.19	b	-11.165	**
	N	230			60				

In case of school management the results of both classes VII and IX were of a similar nature. For both cases the *t* value was less than the critical value of t (-1.96) at 5 per cent level of confidence. This implied that the null hypothesis should be rejected in both the cases and there were significant differences in the means of the two groups for both Class VII and Class IX. This leads to the implication that the school management did affect the combined score of the students for the sample under investigation.

In India, the schooling offered by the state government has minimal fees. The other categories of schools are those run and partly funded by private individuals, private organisations and religious groups, especially by the Christian missionaries. Given that public schools are free of cost and private schools charge fees we would expect that the students attending private schools come from more socio-economically privileged backgrounds. While 94 per cent of the private schools reported that they got

adequate support from parents and guardians, it was reverse in case of government schools. Parents whose children studied in government schools especially in rural areas were unaware of their roles and responsibilities in improving the school environment.

Very few government schools can show that their children's learning is commensurate with their age or grade. These schools may guarantee schooling by increasing student attendance substantially, especially as a result of mid-day meals. However, the quality of education received in these schools is also of vital importance. Facilities in private schools are better and teachers have greater access to them than in government schools. Effective utilisation of teaching-learning resources, however, remains limited to a small number of schools.

Related studies along this line have reported analogous findings (Bashir 1994, 1997; Govinda and Varghese 1993; Kingdon 1994, 1996b; Tooley and Dixon 2003). The conclusions in these studies were of similar nature and show that children in private schools have higher test scores and higher attendance rates. Recently, Muralidharan and Kremer (2006) corroborate the findings in earlier studies with nationally representative data on rural primary schools where it is shown that students from private schools do better than their government school counterparts.

India needs proper government intervention in the area of education because education driven by profit motive cannot benefit the masses. The children in these schools come from the poorest of families — those who cannot afford to send their kids to private schools elsewhere.

School Area

Here the schools were divided as to whether they were located in an urban or rural area.

Table 2

Mean Scores of Students divided on basis of School Area

Class		*School Area Group*									
		Urban				*Rural*				*t*	
VII	Mean+SD	32.50	±	13.60	a	23	±	11.41	b	6.44	**
	N	170				120					
IX	Mean+SD	37.02	±	16.24	a	23.14	±	12.76	b	8.14	**
	N	160				130					

There were significant differences in the means of the two groups for both Classes VII and IX. This leads to the implication that the school area did affect the combined score of the students for the sample under investigation.

Education in rural areas are characterised by low income levels and poor quality of life with regard to infrastructure, transportation facilities, health care , school accessibility and also a low level of parental education. Rural

family incomes are lower than urban family incomes and rural youth are more likely to leave school than their urban counterparts and find work to make up for shortfalls in their family budgets.

During the survey, it was found that the level of school attendance in urban areas was higher (above 75 per cent) as compared to rural areas (50 per cent-75 per cent). Low attendance was recorded in rural areas particularly during harvest and festival season .The lowest level of parental education in rural areas is not conducive to education in general and mathematics education in particular. Specifically with regard to mathematics education it was seen that 69.3 per cent of school students from urban areas indicated engineering, bio-technology and other career choices which required the study of mathematics as against only 25.3 per cent of children from rural areas. Thus the importance of mathematics as a subject requirement was felt by the students residing in the urban areas. Other factors as seen were lack of qualified and committed teachers and irregular attendance of teachers. The teachers in rural areas (63 per cent) resided in the nearest town and commuted to their place of work resulting in a negative effect on school mathematics education in rural areas.

Studies on rural education (Roberts, 2005; Vinson, 2002) have identified several areas like effects of teacher shortages, a lack of opportunity to access professional development, and difficulties in providing resources for their students similar to the above result accounts for the geographical divide.

Physical Facility

Infrastructure facilities

Here the study took into consideration the overall condition of the school buildings.

Table 3

Mean Scores of Students divided on basis of School Infrastructure

Class		*Infrastructure*									
		Infrastructure Problem				*No Infrastructure Problem*				*t*	
VII	Mean+SD	25.30	±	11.97	a	38.86	±	13.17	b	-7.65	**
	N	220				70					
IXN	Mean+SD	28.02	±	13.63	a	39.52	±	20.52	b	-5.37	**
	N	220				70					

*Note: ** Significant at 95 per cent*

Significant differences existed (as seen in Table 3) in the means of the combined scores for schools with and without infrastructural problems. Poorer performance was recorded in schools where infrastructural problems were present.

Quality standards of schools in terms of infrastructure, often do not meet the parameters laid down in the Education

Bill of the government. Proper facilities were available mostly in private schools located in urban areas. Government schools especially in rural areas were found to be shabby and not repaired for years. Overcrowded classrooms, with a thin bamboo partition between different classes made up for a noisy atmosphere that impeded mathematics teaching. Other infrastructural problems that were listed were inadequate classrooms, classrooms not furnished properly, inadequate ventilation and lack of teaching materials.

The study revealed 73 per cent of schools had insufficient number of classrooms; 57.5 per cent schools did not have ceiling; 54 per cent schools used flimsy bamboo partition to divide the classroom into two sections; 62 per cent did not have proper ventilation; 76 per cent schools had insufficient number of benches. No government school had a well stocked separate library room.

The schools where teachers and students interact in individual classrooms constitute the core of the education system. Studies conducted along these lines. (Earthman 1998, Phillips, R. 1997) record that the infrastructure of schools is positively linked to improved achievement.

A vital component for teaching mathematics is the mathematics laboratory. This is a place where the student can learn and explore different mathematics concept by doing a variety of activities. The Central Board of Secondary Education(CBSE) has made it compulsory for all schools to have their own mathematics laboratory for all classes up to secondary level. This laboratory should be introduced for all schools.

Availability of Textbooks

Textbooks play a vital role in school education in developing countries. They are one of the fundamental factors in quality education at school level. The importance of textbook availability is highlighted by the fact that they are often the only teaching resource available particularly in rural areas. Also there are no school libraries in these areas from which a pupil may use a book which contains the subject matter necessary in his curriculum. Additionally, the school mathematics textbook is particularly important for children who

Table 4

Mean Scores of Students divided on basis of Textbook Availability

Class		*Availibility of textbooks*									
		Availability of textbooks in beginning of session				*Non-availability of textbooks in beginning session*				*t*	
VII	Mean+SD	35.04	±	20.61	a	20.61	±	9.85	b	10.61	**
	N	160				130					
IX	Mean+SD	38.90	±	15.66	a	22.24	±	12.06	b	10.10	**
	N	150				140					

come from weak socio-economic background.

The factor studied here was whether the prescribed mathematics textbook was readily available in the beginning of the session.

Table 4 shows the variation in performance among the two groups. Studies by Hanushek EA (1996), Heneyman SP (1984) Jamison et al (1981) have reported similar findings.

Teacher-Student Ratio

Teacher-Student ratio refers to the number of teachers in a school with respect to the number of students who attend the institution. Here the comparison was made between groups divided on the basis of whether the teacher-student ratio was below or greater than 1:40.

Table 5

Mean Scores of Students divided on basis of Teacher Student Ratio

Class		*Teacher Student Ratio*									
		1.40				*Greater than 1.40*				*t*	
VII	Mean+SD	31.46	±	13.82	a	25.88	±	12.78	b	3.57	**
	N	160				130					
IX	Mean+SD	36.08	±	16.35	a	25.86	±	14.67	b	5.61	**
	N	140				150					

The class size in 54 per cent of the schools surveyed was larger than the recommended ratio of 1.40. Significant differences were seen along groups divided on the basis of teacher-student ratio. Groups which had a high teacher student ratio showed poorer performance. This is because of difference in the interaction level between student and teachers. A class with too many students proves to be disruptive. The teacher has to spend time controlling the large classes, also there in a diverse field of students with varying degrees of learning ability and information uptake which also slows down the learning process.

Variation in mean was seen in groups divided along teacher student ratio. The mean was higher where the above ratio was smaller. The premise is that the teaching was more effective when the teacher could spend time with each student. Adequate attention received by the student is important in understanding mathematics. In a large classroom with a high teacher student ratio there is obvious high variance in students' learning abilities and imbalance in the teaching offered. When the classrooms are crowded, they become a burden to teachers who are unable to relate to individual pupils.

However, in countries with a high population there continues to be large classroom sizes. This was seen especially in rural areas where there is an insufficient number of teachers. In course of the survey, 58 per cent of the

Table 6

Mean Scores of Students divided on basis of Teaching Methods

Class		*Training Methods*									
		Blackboard and chalk, lecture				*Additional methods to blackboard and chalk, lecture*				*t*	
VII	Mean+SD	23.19	±	10.74	a	37.39	±	13.08	b	–9.57	**
	N	180				110					
IX	Mean+SD	27.34	±	13.05	a	36.46	±	19.30	b	–7.71	**
	N	180				110					

schools in rural areas reported inadequate number of teachers. To solve this difficulty two sections were combined with the result that the teacher had to spend a majority of his time controlling the students, instead of teaching and provide opportunities.

Research has shown that effective teacher-student ratio should be between 1:25 to 1:35. The current average ratio in India is 1:42. The high teacher-student ratio has a negative impact on the quality of education in India. In the present study the teacher student ratio is found to have significant effect on the combined scores in mathematics of the students.

Teaching Method Used

Teaching methods refer to the various ways in which the teacher teaches mathematics. The most common methods that are used are the lecture method supplemented by blackboard and chalk. Only 24 per cent of the teachers reported that they use methods like group discussion, quiz, audio-visual aids and mathematics laboratory for teaching mathematics.

The common teaching method observed was lecture and use of blackboard. Thirty seven per cent of the schools surveyed used other methods like quiz, group discussion, use of audio-visual aids additionally. There were significant differences in the means of the combined scores for the two groups.

Simply lecturing the students resulted in passive listeners. They display an unquestioning reverence of the teacher without any objective analysis on their teaching methods. They are not able to acquire an in-depth understanding of the subject. There is a long history of research, going back to the work of Brownell (1945, 1947), on the effects of teaching for meaning and understanding, where the teaching methods positively influence student learning of mathematics.

Daily Homework

The combined scores of the students were examined for the two sets of students who reported that daily homework was allotted and corrected in their schools and those who do not have the practice of regular homework assignments.

Table 7
Mean Scores of Students divided on basis of Assignment of Daily Homework

Class		*Daily Homework*									
		Daily homework given				*Daily homework not given*					*t*
VII	Mean+SD	36.28	±	12.70	a	22.31	±	9.85	b	10.14	**
	N	130				160					
IX	Mean+SD	35.32	±	18.34	a	27.12	±	13.40	b	4.39	**
	N	130				160					

Variations in means were seen among the children who were given daily homework and those who were not. Though there are critics who do not support the assigning of daily compulsory homework, in this case mathematics achievement favoured the group that was assigned daily home work. Mathematics as a subject is improved by repetition of tasks. This is because mastery of some basics is required for competent performance of more demanding tasks. Additionally, practice in working out mathematics problems leads to mastering the underlying algorithm as well as the student gaining speed in his work eventually leading to increase in conceptual knowledge also.

However, homework as a factor cannot be studied in isolation. An examination into the schools which assigned and checked homework revealed that 100 per cent private schools in urban areas, 64 per cent government schools in urban areas and no government schools in rural areas reported the assigning and correcting of daily homework. Also in case of homework the home environment plays a role. Thus factors like school management, school area, parental education, family income are interrelated to homework.

Specific Training for Teachers

All teachers included in the survey had at least a graduate degree. Apart from this, however, training of teachers is an essential component of mathematics education and consists of both pre-service and in-service programmes. Specific training in mathematics teaching refers to the knowledge that a mathematics teacher has to acquire in order to teach mathematics effectively. Mathematics teachers need to promote an active interest in learning among the pupils rather than rote learning and memorisation. They need to analyse students solutions, provide explanations for errors and also to solutions of a problem and make use of pictures, paper cutting activities, diagrams and perform mathematical experiments for the purpose of discovering some mathematical principle, pattern, or process.

Table 8
Mean Scores of Students divided on the basis of Training received by their Teachers Teaching in Mathematics

Class		*Specific training in teaching mathematics*									
		Training received				*Training not received*				*t*	
VII	Mean+SD	31.94	±	12.85	a	24.97	±	13.40	b	4.52	**
	N	150				140					
IX	Mean+SD	32.23	±	15.74	a	29.26	±	16.79	b	1.55	**
	N	150				140					

Statistical analysis revealed that the results of classes IX and VII were of dissimilar nature. The t value for Class IX was less than the critical value of t (1.96) at 5 per cent level of confidence and hence there were no statistically significant differences between the two groups in Class IX. However in case of Class VII the result indicated significant variations in the means of the two groups.

The explanation may be that the effects of training are not translated into effective teaching during the teaching-learning experience of the classrooms in certain cases. The duration, intensity and nature of the training as well as teacher motivation are factors that have also to be considered.

The outcome of this linking of the training of teachers to the achievement of the students they teach, are in line with other similar studies which have demonstrated a mixed effect. The results of the NCERT report 1995 indicate that the association of in-service teachers training to student achievement across states is unstable and does not provide a definite trend. Researchers like Kennedy (1998), Brian A. Jacob (2002) have found that in-service teacher training has no statistically or academically significant effect on either reading or mathematics achievement. However Wiley and Yoon (1995), Cohen and Hill(2000) are others who find teacher training programmes to have at least small impacts on student performance. Again researchers like Angrist and Lavy (2001) have found strong effects of teacher training on student achievement.

Though the results of different studies are varied, teacher training remains a vital factor in improving mathematics education. Researchers like Dove (1986) and Raj Rani (2005) have advocated the need for professional development on a continuous basis can improve teaching skills. This is especially true in mathematics education where the syllabi have considerably changed over the years and systematic and continuing education programmes for teachers is necessary for acquiring fundamentals in many concept areas. Additionally teachers need to be well-versed in using computers and technology which greatly facilitate the learning and understanding of mathematics. To address this problem, quality in-service programmes are required on a continuous basis that

engage teachers deeply with the mathematics they are teaching, upgrade their skills and give them new insights into their students' understanding of mathematics.

Discussion and Conclusion

Heyneman and Loxley (1983) had stated that in low income countries, school-level factors could account for a greater proportion of variance in student achievement as compared to student-level characteristics. The phenomenon has come to be known as the 'HL effect' and indicates the important responsibility of schools towards providing equitable education in developing countries.

The present study shows that school factors have an influence on achievement of the students. Studies by Kulkarni (1970), Aggarwal (1995), Kingdon (2008) have shown that school influence is important to students achievement in India.

This paper which deals with the influence of school environment demonstrates its relation with the mathematics achievement of the student. It is seen that in addition to socio-economic factors which influence mathematics learning of students, school factors comprising of school management, area, infrastructure, availability of textbooks, teaching methods, teacher student ratio also play a part in determining the mathematics achievement of the students. These factors, however, cannot be studied in isolation and are interrelated.

The null hypothesis assumes that there is no difference in the influence of school environment on mathematical achievements of students. However, from the tests conducted on various influencing factors related with school environment it has been seen that all the the values are highly significant. This indicates that there is evidence to reject the null hypothesis and conclude that there is a high degree of influence of the factors like school management, area, infrastructure, availability of textbooks, teaching methods, teacher student ratio etc. on the performance of the students in mathematics.

The results of this paper are consistent with previous research showing that although student background variables influence differences in achievement in mathematics, classroom and school variables also contribute substantially (Fullarton and Lamb, 2000).School effectiveness research undertaken by Bosker and Witziers (1996), that school effects account for approximately eight to ten per cent of the variation in student achievement inspite of great diversity in the background of children

This has important implications for government policy regarding the improvement of mathematics achievement. The Right to Education has been enshrined as a Fundamental Right by the Constitution of India. The education sector has been of vital importance to the Indian Government. However, there is a vast gap between policies and the reality at grass root level. It is a fact that children from poor families are faced with inferior quality school education. Children of the rich and the urban middle class are enrolled in private schools. Such schools will exacerbate inequalities by providing better opportunities to youngsters who

can afford to attend and consigning children from the poorest families to whatever the government offers.

To bridge the social, regional and gender gap, the school environment is a vital factor. By imparting quality education uniformly in all schools this gap can be addressed. This will also provide equal opportunity for higher studies and the employment to all deserving students irrespective of family background. Thus it is imperative that there should be improvement in facilities and infrastructure, teaching methods, training for teachers and other factors which influence school environment.

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