Abstract

Mathematics has tremendous contribution to the revolutionary changes of modern world. Importance of mathematics has been dramatically increased for today’s technologically driven society. Foundation of mathematics is built during school education. Sound knowledge on mathematics subject at school can lead to successful career with confidence and logical thinking. The importance of mathematics teaching at schools has been realized by the Government of India as reflected by its education policies. However, school level mathematics education in some regions of India including Assam seems to require appropriate investigation for its improvement. There has been general feeling that majority of students at secondary schools have psychological phobia towards mathematics subject. Correctness of such beliefs needs to be investigated. However, “school level mathematics education” is such a complex matter embodied with interlinked elements like (i) teacher, (ii) school, (iii) parents, (iv) syllabus, (v) society and (vi) students that a systematic methodology is essentially required for any meaningful investigation.

The present study aims to investigate the present scenario of mathematics education at school based on examination results, teacher’s competency and parent’s awareness through application of fuzzy logic and basic statistics. The thesis entitled “Application of Fuzzy Logic to Comprehensive Study of Secondary Mathematics of Assam with Special Reference to Learner’s Performance” includes five chapters, viz. Introduction (Chapter-I), Review of literature
A comprehensive introduction of the research problem is presented in Chapter-I. Importance of school education, importance of mathematics education, school education system in India with special reference to mathematics education, the education scenario in Assam are some of the major aspects discussed in Chapter-I. The present work has been further justified through a detailed discussion on issues like, process of mathematics teaching-learning, philosophy of effective learning of mathematics and roles of mathematics teacher, domestic environment, school environment syllabus and teaching materials in effective teaching-learning. Introduction of Fuzzy concept and Fuzzy logic along with its current application are presented to justify the need of such appropriate tools for investigation of school level mathematics education in Assam. Finally the objectives of the present research work viz., investigation of the present scenario of mathematics education at school through a standard procedure and investigation of factors influencing academic performance in mathematics are presented.

A number of research works have been consulted for planning and execution of the present research. Detailed discussions of earlier research works related to school education including mathematics education have been presented in Chapter-II. The review of some school level mathematics curriculum/standards of international repute has also been done. The curriculums are designed keeping in view that students require consistent, challenging
curriculums that will capture their interest and prepare them for a lifetime of learning. Literature concerning Fuzzy logic is also presented in Chapter II.

A systematic study procedure is followed to achieve the objectives of the present study. The procedure of study is elaborated in Chapter III with detail discussion on (i) selection of study area; (ii) selection of schools; (iii) coding and collection of information from selected schools; (iv) assessment of performance based on HSLCE and annual examination results; (v) assessment of performance based on Mathematical Ability Test (MAT) and annual examination results (vi) analysis of course curriculum on the background of MAT performance; (vii) design and assessment of Educational Environment (EE) and (viii) investigation of the effect of EE on mathematics performance through Fuzzy logic and statistical procedure.

The development of methodologies to investigate some distinct and essential aspects of school level mathematics education could be considered unique contribution of the present research work. Analysis of prevailing educational scenario of secondary schools of Assam with special reference to mathematics education, based on comprehensive real-time data sets, is considered another major contribution of this research work. Methodology for defining and quantification of learners' educational environment is also a unique contribution of the present work. Applications of fuzzy logic and statistical procedure to investigate dependability of some probable hypotheses concerning school level mathematics education are also useful contributions of the present investigation.

The results of the present study are discussed in Chapter IV. Necessary figures & tables are also presented in this chapter. Wide variations of academic
environment vis-à-vis performances exist amongst the schools. The variations of
general academic performance as well as performance in mathematics subject
amongst the schools are reflection of financial and managerial statuses of the
schools. Academic performances as well as mathematics performances of the
government and private schools are better than the schools belonging to non-
provincialized categories, which are not getting government’s aids.

Learners’ performances in overall subjects are also considered as a
relevant area of the present investigation. The mutual reflections of performances
in mathematics and overall subjects on the basis of HSLCE results (pass
percentages) was investigated using fuzzy logic proposition and it is observed that
the performance in mathematics subject and overall subjects are positively
correlated.

The requirement of the improvement of curriculum is felt from the results
of a specifically designed test on mathematics of 21 different groups of students
belonging to all the categories of schools viz, Government, Provincialized,
Recognized, Non-recognized and Private located in rural and urban areas of
Assam. In general, difficulties of solving problems on algebraic fraction,
variation, trigonometry, set, linear simultaneous and quadratic equations and
geometry were prominently reflected. The uniformity of performances of the
group of learners of each of the 21 selected schools was also investigated using
the test results and it was observed that the majority of the provincialized schools
showed better uniformity than non-provincialized schools. The performances of
these selected groups of learners in terms of consistency in three consecutive
academic years are also not satisfactory and require necessary attention in terms of
teachers training, parents awareness and appropriate managerial inputs. In general, academic performances as well as mathematics performances of the government, provincialized and private schools, as well as urban located schools, are better than the non-provincialized schools.

Three characteristic parameters are defined in terms of 15 distinct factors, which could influence the academic performance in mathematics. The qualitative parameters were then converted into measurable scores to establish functional relationship for statistical and fuzzy logic analysis. There exist variations in educational environment amongst the schools under study. The highest (0.670) and the lowest (0.296) educational environment scores are obtained by an urban located private school and a provincialized rural located school, respectively. In general, better educational environment is observed in urban areas compared to rural areas. Learners' mathematics performance is significantly effected by all the three measured characteristics viz, school characteristic, teacher characteristic and domestic status and hence by the overall educational environment. A linear regression “\(MP = 0.076 + 0.399\ SC + 0.324\ DS\)” could be modeled from the observed data indicating the dependency of mathematics performance on school characteristic and domestic status.

The relationships of educational environment (and its components) with mathematics performance were investigated using four Hypotheses viz., (i) Learners' performance is not affected by school characteristic (SC), (ii) Learners' performance is not affected by teacher characteristic, (iii) Learners' performance is not affected by domestic status and (iv) Learners' performance is not affected by educational environment. To test the entire hypotheses Karl
Pearson co-efficient of correlation was used. It was seen that the correlation co-efficient, \( r \) between mathematics performance \((MP)\) and teacher characteristic \((TC)\) was significant at 0.05% level. On the other hand, \( r \) between \( MP \) and other three factors viz, \( SC, DS \) and \( EE \) were highly significant even at 0.01% level. Thus, all the four hypotheses were rejected and mathematics performances of learners were 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 were found to have the highest influence followed by domestic environment and teacher.

The effect of educational environment and its three parameters on performance in mathematics were also investigated by fuzzy logic procedures. Conditional and unqualified fuzzy logic propositions (i) \( \text{If school characteristic (SC) is satisfactory then mathematics performance (MP) is high} \), (ii) \( \text{If teacher characteristic (TC) is satisfactory then mathematics performance (MP) is high} \), (iii) \( \text{If learners' domestic status (DS) is satisfactory then mathematics performance (MP) is high} \) and (iv) \( \text{If educational environment (EE) is satisfactory then mathematics performance (MP) is high} \) showed reflection of the concerned parameters on mathematics performance, however, with varying degree of reflection.

The presentation of the research work is concluded in Chapter-V with specific sections on (i) conclusions (ii) recommendations and (iii) suggestion for future works. Academic reform is a continuous process carried out for its improvement. The results of the present investigation could be useful for such reform programmes. 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. Exposure to non-ideal academic environment has been found as the reasons of poor performances in mathematics. Thus, appropriate target oriented actions are required for improvement of school environment vis-à-vis performance in mathematics. The appropriate actions of Government, the social elements (teachers, parents) and curriculum reform are expected to bring desirable changes in school level mathematics in Assam.