PREFACE

Before presenting what is included in the dissertation, we would like to emphasize what we gained from our independent field-work in connection with the effect of conceptual achievement of calculus on ability of doing problems for the students of pre-degree level in our home district Barpeta of our state. In the beginning we want to make aware our readers about the following facts:

(i) Though calculus occupies an important place in pre-degree level syllabus, the level of conceptual understanding of the learners is miserably low.

(ii) The investigation reveals the exact correlation between the conceptual achievement and ability of doing problems of calculus to be 0.818 which is a fairly strong positive relationship.

(iii) Hence, stress should be given on making a sound conception of calculus particularly of limit that appears in the context of discussing continuity, differentiation, indeterminate forms, integration etc. The difficulties in understanding limit problems cause difficulties in doing problems of limit, continuity, differentiation, integration and indeterminate forms.

(iv) Both symbolic manipulation and dynamic graphics using information technology for illustration and computation should be given equal importance on making a sensible basis for conceptual understanding.

Next, we would like to present in short, what is contained in this dissertation in connection with the proposed work.

The chapter-I consists of the importance of those governing factors and problems that are responsible for the germination of the concept of calculus, its journey throughout different periods and stages. Also, the important components of calculus and its outstanding applications by different mathematicians and physicists of high caliber have been taken into account.

In chapter-II, we have discussed the concepts and topics that led Newton and Leibniz to discover infinitesimal calculus independently. In this regard our attention goes to the fascinating problems of finding areas of curvilinear figures
faced by the Greek mathematicians, the study of the Infinite by Nicholas of Cusa who anticipated many ideas on mathematics, its impact on medieval scholars and finally leading to the development of infinitesimal calculus. Importance is given on the method of exhaustion that led mathematicians to the invention of limit procedures. Tangent construction to curves was one of the most fascinating problems since antiquity. In this regard, we take serious note of different approaches of tangent construction like geometric of the Greeks, algebraic of Descartes and infinitesimal of Fermat and Barrow. We have also discussed how the Fundamental Theorem of Calculus (FTC) was observed by Torricelli and Issac Barrow but failed to identify it as a link between differential and integral calculus.

Chapter-III contains the discoveries of infinitesimal versions of calculus founded by Newton and Leibniz, criticism of infinitesimal calculus by George Berkeley and others. We have also observed the reasons behind their criticism and the differences of their views with those of Newton and Leibniz. The chapter is also devoted to the discussion on the marvelous intuition of Newton and Leibniz in identifying the importance of FTC as a link between tangent (differential) and area (integral) problems.

Chapter-IV deals with one important aspect that was generally being neglected by the mathematicians of the west. This aspect includes how concept of calculus was developed and studied by the Hindus during 12th to 14th century. The Kerala School of Astronomy and Mathematics (KSAM) played a crucial role in developing and using various concepts of calculus in astronomical studies long before Newton and Leibniz. It is a matter of grave concern that the contributions of the great Indians like Aryabhatta, Madhava, Yesthadeva, Neelkantha etc. are not properly recognized by the western mathematicians. We have gone through different factors that govern western mathematicians to be reluctant in crediting the Indian scholars.

Chapter-V is devoted to study of the effect of conceptual understanding on ability of doing problems of calculus of students in pre-degree levels of schools and colleges of Barpeta District of Assam. Here we have investigated also some problems faced by the students while dealing with the elementary
notions of calculus like limit, continuity, derivative, graphical representation of functions etc. Our investigation establishes that the two variables are highly correlated. To enhance the conceptual understanding of learners, Calculus reform movement started in America in 1980. It was necessitated because of the poor performance of the students learning calculus in traditional lecture method. New measures to improve the quality education of calculus are the need of the hour, in our state Assam, too. Some measures in this respect have also been suggested in this chapter.

The last chapter consists of our observations and remarks from chapter-II to chapter-IV in which we have discussed the importance, differences and impacts of those concepts which are responsible for the development of the journey of calculus. Also, we note a few concepts for which some civilizations could not create calculus although their contributions towards calculus cannot be denied. We notice with grave concern that in recognizing the contributions of ancient and medieval mathematicians of India, there exists some sort of unfairness.

We would like to express our honest gratitude to those from whose learned literature we have carried out our work and dare to analyse the respective observations from our view point and been able to present necessary conclusions together with our field work in connection with our research. Readers may find necessary citations as when and where author felt it essential.
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In spite of meticulous care, some typographical mistakes might have crept in. I feel sorry for this.

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