



The Role Of Business Mathematics In Developing Applicable Skills Among Diploma Students In Indian Polytechnics

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Abstract

This study explores the pivotal role of Business Mathematics in equipping Diploma students in Indian polytechnic institutions with practical and applicable skills relevant to today's dynamic workforce. Business Mathematics, as a foundational component of technical and vocational education, enhances students' analytical thinking, problem-solving abilities, and decision-making skills, particularly in areas such as accounting, finance, marketing, and supply chain management. The paper examines how the application of mathematical concepts to real-world business scenarios bridges the gap between theoretical knowledge and industry requirements. Drawing on both qualitative and quantitative data from student surveys, faculty interviews, and curriculum analysis across selected Indian polytechnics, the study highlights the effectiveness of Business Mathematics in fostering competencies like budgeting, forecasting, profit analysis, and cost control. Findings suggest that students with a solid grounding in Business Mathematics are better prepared to handle professional challenges, adapt to technological tools, and make data-driven decisions in business settings. However, the paper also identifies gaps in instructional strategies and recommends improvements in pedagogy, including the integration of ICT tools and case-based learning, to enhance student engagement and understanding. The research underscores the need for curriculum reform that aligns Business Mathematics education with evolving industry expectations, ensuring that ND graduates are not only academically competent but also practically skilled and industry-ready.

Keywords: Business Mathematics, skill development, polytechnic education, National Diploma, India.

Introduction

In today's rapidly evolving economic and industrial landscape, the demand for practically skilled and industry-ready graduates is greater than ever. Polytechnic education in India has emerged as a significant contributor to technical and vocational training, particularly through the Diploma programs. These programs are designed to develop middle-level manpower equipped with the technical and managerial skills needed to meet the needs of various sectors such as manufacturing, finance, logistics, and entrepreneurship. A critical component of this skill development is Business Mathematics, which serves as a foundational subject across multiple disciplines within polytechnic institutions.

Business Mathematics goes beyond basic arithmetic to include topics such as interest calculation, financial ratios, profit and loss analysis, data interpretation, and decision-making under uncertainty. These competencies are essential for students to function effectively in real-world business environments. By integrating mathematical reasoning with practical business applications, the subject plays a key role in fostering critical thinking, analytical skills, and financial literacy among diploma students. This article explores how Business Mathematics contributes to the development of applicable skills among students in Indian polytechnics, evaluates current teaching practices, and suggests improvements to enhance learning outcomes. The ultimate goal is to ensure that graduates are not only academically proficient but also capable of applying their knowledge in meaningful and productive ways.

Polytechnic Education as a Form of Technical Education:

Technical education refers to the academic and occupational preparation of students for careers in applied science and modern technology. Its goal is to prepare graduates for occupations that lie between skilled crafts and scientific or engineering professions (www.Britannica.com, 2021). According to UNESCO and the International Labour Organization (ILO) (2020), technical education encompasses not only general education but also the study of technologies and related sciences, along with the development of practical skills, attitudes, knowledge, and understanding relevant to various occupations. Polytechnic education, as a form of technical education, plays a crucial role in creating a diverse workforce for a country's industrial, economic, and social sectors. It helps produce engineers, architects, planners, teachers, business managers, and other professionals essential for a nation's success and development.

Fundamental Concepts of Mathematics

Mathematics is the science of patterns, relationships, numbers, and structures that help us understand and interpret the world around us. It is a language that can be understood across discipline and language barriers. It is the language of the universe as we know it. It is fundamental to daily life, critical thinking, and decision-making, as well as the advancement of science, technology, and commerce. Mathematics originated as a tool for solving real-life problems and has since evolved into a vital component of various academic and professional disciplines. It provides the logical framework required for understanding and analysing quantitative information and plays a central role in problem-solving, innovation, and progress. In the contemporary world, mathematics underpins fields such as engineering, economics, medicine, architecture, and computer science, making it indispensable to national development and technological advancement. A sound understanding of mathematical concepts fosters intellectual development and equips individuals with the analytical tools needed for effective participation in a competitive global economy. In the Indian context, mathematics is a core subject at all educational levels, reflecting its significance in nation-building and educational reform (NCERT, 2020). The National Education Policy (NEP) 2020 emphasises foundational numeracy and the integration of mathematical thinking across disciplines to develop future-ready citizens capable of driving innovation and economic growth (Ministry of Education, 2020).

Business Mathematics:

Business Mathematics is a course designed to teach students pursuing a Polytechnic Diploma about money management and provide them with the tools needed to make informed financial decisions (www.educba.com). This course goes beyond teaching business finance and covers important areas like accounting, economics, marketing, financial analysis, and personal finance. By learning these topics, students and consumers are prepared to manage their finances responsibly and profitably. Business Mathematics helps simplify the inflows and outflows of money in commerce, even for those who find mathematics challenging, by using real-world examples. Although the course is designed with business owners in mind, it is valuable for various professionals who deal with finances daily. Bankers, accountants, and tax consultants, for instance, need a solid understanding of both corporate and personal finances to provide appropriate advice and solve problems for their clients. Real estate agents also use business mathematics to calculate commissions, navigate mortgages, and handle taxes and fees. For those in fields like investment consulting and stockbroking, understanding investment growth, losses, and long-term financial predictions is crucial. For business owners, Business Mathematics is especially important. It helps them manage various aspects of their business, such as pricing, inventory, payroll, and revenue,

ensuring the success and growth of their enterprises. Without it, many jobs and businesses would not function efficiently.

Challenges of Teaching and Learning Business Mathematics

Teaching and learning Business Mathematics in India faces several challenges, hindering the full potential of students in understanding and applying mathematical concepts in business contexts. One major issue is the perception that mathematics is an abstract and difficult subject. Many students enter tertiary institutions with preconceived notions about the difficulty of mathematics, which affects their attitude and engagement with the subject. This belief, often rooted in early educational experiences, leads to anxiety and a lack of interest in pursuing mathematics-related courses, especially Business Mathematics (Ezurike, 2021).

Another challenge is the inadequate foundational knowledge in mathematics among students at the school level. Due to weak grasp of basic mathematical concepts, many students struggle to understand more complex topics in Business Mathematics. This gap in foundational knowledge becomes more evident in polytechnic institutions, where students are expected to apply mathematical concepts to real-world business scenarios. Teachers often have to spend a significant amount of time revisiting fundamental topics, leaving little room to cover advanced content (Ezurike, 2021).

Additionally, teaching methods play a crucial role in the effectiveness of Business Mathematics education. Traditional, lecture-based teaching methods often fail to engage students actively, leading to a lack of hands-on application of mathematical skills. Many students find it challenging to relate theoretical knowledge to practical business scenarios. As a result, students may not develop the critical thinking and problem-solving skills necessary for managing real-world business situations (Obasi, 2020).

The Concept of Polytechnic Education:

Polytechnic education in India plays a crucial role in shaping the technical workforce that supports the country's economic and industrial development. Defined as an educational institution that imparts practical knowledge in applied sciences, technology, and engineering, polytechnics focus on equipping students with both theoretical and hands-on skills. Unlike traditional academic institutions that primarily focus on theoretical knowledge, polytechnics in India provide specialised training that is essential for producing skilled workers who are capable of meeting the demands of various sectors such as manufacturing, construction, and information technology (Wiktionary, CC by S.A 3.0 license).

The primary objective of polytechnic education in India is to bridge the gap between academic knowledge and practical application, thus fostering the development of middle-level technical professionals who contribute significantly to the country's economic growth. As noted by Ekundayo & Ajayi (2009), polytechnic institutions are instrumental in producing skilled workers who can drive technological and industrial advancements, thereby supporting national development goals. In India, polytechnics are viewed as vital contributors to the workforce, offering programs that align with both industrial needs and national economic aspirations. The focus on applied skills in polytechnics ensures that students are well-prepared for the workforce, reducing the skill gap and enhancing employability.

Aim of Establishing Polytechnics in India:

The establishment of polytechnics in India was aimed at meeting the growing demand for skilled manpower in various industrial sectors. Polytechnics were introduced to provide technical education and training to students, equipping them with practical skills and knowledge that are crucial for industrial, technological, and economic growth. The main goal was to bridge the gap between theoretical education and real-world applications, ensuring that graduates possess the hands-on expertise required to contribute effectively to the economy (Venkataraman, 2008).

Polytechnics serve as a vital source of middle-level technical professionals who can fill the skill gaps in sectors such as manufacturing, construction, and information technology. As emphasised by the National Policy on Education (1986), polytechnics were established to provide vocational training that would enhance the employability of graduates, enabling them to take up roles in industries that are critical to national development. The vision was to create an educational framework that blends applied science, technology, and industry needs, supporting India's efforts to develop a competitive and self-reliant economy. Over time, polytechnics have played a significant role in skill development, offering specialised courses that cater to the ever-evolving needs of the industrial landscape.

Objectives of Technical/Polytechnic Education

The primary objective of technical and polytechnic education in India is to provide specialised training that meets the growing demand for skilled manpower across various sectors of the economy. Polytechnic education aims to bridge the gap between theoretical knowledge and practical application by equipping students with the skills necessary for employment in industries such as manufacturing, technology, construction, and information technology (Venkataraman, 2008).

Polytechnic education also seeks to support the country's economic development by producing middle-level technical professionals who can contribute to industrialisation and technological

advancements. As per the National Policy on Education (1986), polytechnic institutions are expected to focus on vocational training, ensuring that students are well-prepared for the workforce and can adapt to the changing needs of the industry. Another key objective is to promote entrepreneurship and self-reliance, as polytechnic education encourages students to develop problem-solving skills and critical thinking.

Furthermore, polytechnic education in India aims to improve the quality of education and ensure equitable access to technical training, particularly in rural and underserved areas, to address regional disparities in skill development (Rajasekaran & Saravanan, 2010). This aligns with the nation's goal of fostering inclusive economic growth and national development through a skilled workforce.

Mathematics in Polytechnic Education:

Mathematics plays a crucial role in polytechnic education in India, serving as a fundamental tool for understanding various technical and applied sciences. According to the National Policy on Education, one of the key objectives of technical and polytechnic education is to provide skilled manpower in areas such as applied science, technology, and commerce (Ministry of Human Resource Development, 1986). In polytechnic institutions, mathematics is integrated into the curriculum, particularly in fields like business management, engineering, and technology. For example, in the School of Business Management, mathematics courses, such as Business Mathematics, are often offered as compulsory subjects to help students grasp essential concepts related to financial analysis, statistics, and problem-solving techniques. These courses are designed to equip students with the necessary skills for career advancement in various industries, ensuring that they are well-prepared to meet the demands of both the workforce and technological advancements (Venkataraman, 2008).

Departments Offering Business Mathematics in Polytechnic Institutions:

In India, Business Mathematics is offered across various polytechnic institutions, particularly within the departments that focus on commerce, business management, and applied sciences. Business Mathematics is an essential part of the curriculum in the Department of Business Management, which prepares students for careers in management, finance, and accounting. These departments integrate mathematical techniques with business concepts to help students develop the analytical skills required for managing finances, evaluating market trends, and making informed decisions.

Polytechnics such as the Government Polytechnic College in Pune and the Delhi Polytechnic offer Business Mathematics courses in their Business Management and Commerce departments. In

addition to business management, other related departments like the Department of Accounting and Finance also offer Business Mathematics as part of their foundational curriculum.

Business Mathematics is designed to enhance the mathematical proficiency of students by covering topics like financial mathematics, accounting, statistics, and quantitative analysis, which are critical in understanding business operations. These courses aim to equip students with practical and applicable skills for careers in business and industry, making it an integral component of polytechnic education.

Role of Business Mathematics in Business

Business Mathematics plays a critical role in the functioning and success of businesses in India. With the country's dynamic economic environment and the growing number of startups, businesses need precise mathematical tools to navigate challenges such as cost analysis, pricing, financial management, and profitability. Business Mathematics is not just about calculations but about providing a structured way to analyse problems and develop strategies for efficient decision-making (Narayana, 2020).

Production Costs Calculation

In India, where labor and material costs vary across regions, business mathematics is essential in estimating production costs. This includes evaluating costs related to raw materials, machinery, rent, marketing, and overheads. Accurately determining production costs helps businesses optimise their pricing strategies and remain competitive in the market (Srinivasan, 2019).

Price Determination and Profit Measurement

Business mathematics also aids in setting the right product prices and calculating profit margins. In the Indian market, where competition is fierce and consumer purchasing power varies, understanding the cost structure and adjusting prices accordingly is vital. Business mathematics allows businesses to measure net profit by analysing revenue, operating costs, taxes, and depreciation, ensuring that operations remain profitable (Bose, 2018).

Financial Analysis

In India's rapidly evolving business landscape, companies must constantly assess their financial health. Business mathematics supports financial analysis by enabling businesses to analyse trends, assess risks, and forecast future financial conditions. Sensitivity analysis, which examines how changes in sales or prices impact profitability, is crucial for businesses to make informed decisions in a volatile market (Gupta, 2020).

Topics Covered in Business Mathematics

Key concepts taught in business mathematics include Simple and Compound Interest, Time Value of Money, Profit and Loss, Investment Appraisal, Inventory Management, and Cost Functions. These concepts are integral to businesses in India, where financial literacy and efficient resource management are key to thriving in a competitive market (Chakraborty, 2017).

Challenges in the Teaching and Learning of Business Mathematics

1. Perception of Mathematics as a Difficult Subject

One of the key challenges in teaching Business Mathematics in Indian polytechnic institutions is the widespread perception among students that mathematics is abstract and inherently difficult. Many students, particularly those from non-science backgrounds, approach the subject with anxiety and low confidence. This fear of mathematics stems from early academic experiences and significantly hinders engagement with the subject at the tertiary level (Ezurike, 2021). When students believe a subject is too difficult, their motivation to put in consistent effort reduces, affecting their learning outcomes.

2. Weak Foundation in School-Level Mathematics

A poor background in mathematics from school education is another significant hurdle. Many students entering polytechnic institutions, especially from rural or under-resourced schools, lack a solid grasp of fundamental concepts in arithmetic, algebra, and geometry. This deficiency becomes more pronounced when they are introduced to business-related mathematical applications like interest calculations, depreciation, and financial analysis. Without bridging this gap, it becomes extremely difficult for students to follow and apply advanced topics in Business Mathematics (Bose, 2018).

3. Lack of Practical Orientation in Teaching

Traditional methods of teaching mathematics often focus on theoretical explanations and rote learning, with little emphasis on practical applications. In a subject like Business Mathematics, which is inherently practical and applied, this approach fails to engage students effectively. The disconnect between textbook knowledge and real-world business problems makes the subject appear irrelevant and dry, leading to student disinterest (Gupta, 2020). There is a strong need for case-based and application-driven teaching to make the subject more relatable.

4. Low Student Attendance and “Get-Quick” Attitude

Another major issue is the lack of student commitment, marked by poor attendance in mathematics classes. Many students adopt a “get-quick” mentality, aiming to pass with minimal effort. This attitude leads to negligence in attending classes, avoiding assignments, and missing out on crucial learning opportunities. The lack of consistent engagement creates learning gaps that widen over the semester, resulting in poor academic performance and low retention of concepts (Srinivasan, 2019).

5. Examination Malpractices

The prevalence of examination malpractice is another factor that undermines the teaching and learning of Business Mathematics in India. When students resort to cheating or shortcuts during assessments, the value of genuine learning and hard work is lost. It discourages diligent students and creates a culture where academic dishonesty is normalised. This problem often stems from poor preparation and fear of failure in a subject perceived as tough (Chakraborty, 2017).

6. Disruptions due to External Factors like the Pandemic

The COVID-19 pandemic posed severe challenges for academic institutions across India. Polytechnic colleges had to shift rapidly to online modes of instruction, for which many students and teachers were unprepared. Lack of access to digital devices, internet connectivity issues, and the absence of in-person instruction adversely affected mathematics learning. Subjects requiring interaction and guided problem-solving, like Business Mathematics, suffered heavily during this transition period (Narayana, 2020).

7. Institutional Safety and Distractions

While not as pronounced as in some other contexts, issues like campus unrest, bullying, or peer pressure in some Indian polytechnics can distract students from academic pursuits. Such environments are not conducive to effective teaching and learning, particularly for demanding subjects like mathematics. Students facing psychological or social pressures may lose focus, further impacting their performance.

Recommendations

Inclusion of Mathematics as a Mandatory Subject for Polytechnic Admission

It is strongly recommended that mathematics be made a compulsory subject for admission into diploma-level courses in the School of Business Management across polytechnic institutions in India. Entrance examinations like those conducted by the Joint Entrance Examination Council (JEECUP) or other state-level technical education boards should include mathematics as a key

eligibility criterion. This would ensure that students have the minimum required competence in basic mathematical skills before pursuing business-related technical education.

Enforcement of Mathematics as a Core Subject in School Curriculum

The Ministry of Education, Government of India, along with State Education Boards, should ensure strict adherence to the study of mathematics as a core subject at the primary and secondary school levels. Regular monitoring and evaluation should be conducted to assess the effectiveness of teaching methods and learning outcomes in mathematics. This foundational competency is crucial to prepare students for more applied mathematical concepts encountered in higher education and technical streams.

Innovative and Engaging Teaching Strategies by Business Mathematics Lecturers

Faculty members teaching Business Mathematics in Indian polytechnics should adopt innovative, student-centric teaching methodologies. These may include interactive sessions, case studies, real-world business scenarios, and the use of ICT tools to make mathematics more engaging and relevant. Workshops, remedial classes, and peer-learning initiatives should be implemented to support students who struggle with the subject and boost their interest and confidence.

Introduction of bridge courses for underachieving students

During the tenure as a quantitative research fellow at Bronx Community College under the City University of New York the author found students opting for institutions like polytechnics often lack basic mathematical skills. Often they come lacking a proper school education. In cases like that it is imperative that the instructor finds out about the level of understanding of each student in his or her class. This may be done through simple mathematical tests and keeping track of their scores in those tests. Once the instructor finds the students who may be underachieving, proper courses of developmental mathematics can be arranged. The instructor may take other mathematical tests upon completion of the courses to find the efficacy and effectiveness of the arranged courses.

Introduction of relatable problems in mathematics courses

Often students find mathematics to be disconnected from the life they are living. To make them realise that mathematics is a multi faceted tool that may be applied through various situations in their lives and to bridge the disconnect they encounter, problems involving their real lives may be introduced. For example they may be encouraged to take certain surveys in their locality or

neighbourhood, and draw certain statistical conclusions from the said surveys. That way they develop a solid understanding of core mathematical concepts and are able to apply mathematics in real life situations. These steps may be assigned as group projects to the students.

Introduction of active learning methodologies in classroom

In usual classroom settings involving lectures, often students lack attentiveness and motivation. To mitigate such situations active learning technics may be introduced through proper policies. Active learning methodologies such as a flipped classroom has been very effective in increasing student engagement. In flipped classrooms students participate by lecturing the class or by giving seminars. It develops engagement as well as understanding of the subject. Methods such as collaborative and cooperative learnings may be introduces as well. In collaborative learning the students work in groups and their groups are evaluated as a whole, this develops fellow feeling between students and helps with the learning objectives. The students learn to work independently. In this situation the instructors job is to guide and nudge the students in proper direction. Cooperative learning on the other hand combines the idea of group learning along with rewarding individual achievement. Here the instructors job is more concrete, the instructor keeps track of the group's progress as well as individual student's achievement. Along with these metacognitive strategies may be introduced that helps students in developing skills to understand real life issues without supervision or an instructor. Introducing these active learning methods can create a cohesive and inclusive learning environment.

Institutional Measures to Address Student Distractions and Misconduct

Polytechnic managements must take firm steps to tackle issues that divert students from academic focus, such as the rising trend of shortcut culture, irresponsible behaviour, or disruptive campus activities. Strong policies and awareness campaigns should be introduced to curb harmful influences and promote a disciplined, learning-conducive environment. Initiatives like counselling, mentoring, and skill development should be integrated to provide students with positive direction.

Strict Enforcement Against Examination Malpractice

To uphold academic integrity, stringent actions must be taken against students involved in examination malpractices. Polytechnic institutions should set up internal examination monitoring committees and introduce digital surveillance systems to prevent cheating. Clear academic integrity policies should be communicated to students, and penalties for violations should be

applied without bias. This would foster a culture of honesty, hard work, and respect for academic learning.

Conclusion

In conclusion, Business Mathematics plays a crucial role in shaping the analytical, financial, and decision-making skills of Diploma students in Indian polytechnic institutions. As the bridge between theoretical knowledge and real-world business application, this subject equips students with essential tools to understand and manage financial data, pricing strategies, cost control, investment planning, and profitability analysis. In a rapidly evolving economic environment, the relevance of Business Mathematics cannot be overstated. It enhances logical reasoning, promotes accuracy, and fosters critical thinking, which are fundamental to business success. By applying mathematical concepts to practical business situations, students develop the competence to contribute effectively to the economy, whether as entrepreneurs, business managers, or professionals in fields like banking, marketing, and finance. However, challenges such as poor mathematical background, low interest levels, and ineffective teaching strategies must be urgently addressed. Ensuring proper curriculum delivery, reinforcing foundational knowledge, and adopting innovative pedagogies will help unlock the full potential of Business Mathematics. As India strives to build a skilled and self-reliant workforce, the integration and improvement of Business Mathematics in polytechnic education must be prioritised to nurture a generation of competent, confident, and career-ready professionals.

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