Original Article

Enhancing Mathematics Learning For The Engineering Students: A Review

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Doi: 10.47750/pnr.2022.13. S05.262

Abstract

Mathematics education for engineers is a wide-open field for research and development. A key objective of engineering mathematics education is to provide students with the tools they'll need to use a variety of mathematical methods and concepts in their coursework and careers. But only little efforts are made to show the practical relevance of the many mathematical concepts covered in engineering curricula. The inability to grasp engineering mathematics topics might impede learning in other engineering topics. The goals of teaching mathematics to engineers can only be met by striking a balance between teaching by example and teaching the underlying concepts. This article discusses several practical (informal) methods of developing mathematics-teaching applications for engineering students. An effort is made to comprehend the current situation of mathematics education in engineering institutions. The present teaching approach's flaws and virtues are discussed.

Keywords: Mathematics Education, Mathematical Methods, Engineering Students, Practical Applications.

INTRODUCTION

Mathematics is the cornerstone of all sciences. We can't fathom engineering sciences without mathematics. Math education has a tight relationship to our contemporary culture, which is based on science and technology. As a consequence, math education is as ancient as human civilization. It's crucial for fostering GDP growth, well-being, and prosperity. The appropriate form of mathematics education and its linked technologies are vital for national development because they generate generations with lasting values of life in society, resulting in peace and tranquility among people and teaching future generations how to live up to these values, enabling the whole generation to enjoy a larger percentage of intellectual poise, mental stability, health, and social happiness.

The student must master mathematical reasoning. Principles and notions are more important than formal manipulations. Math is a methodical discipline of practical importance that depends on a limited number of basic concepts and powerful unifying tools. He/She should grasp that math is not a collection of tricks and recipes. Persuade him to apply mathematical concepts to engineering challenges, and he'll see that the theory and its applications are intertwined like a tree and its fruit. An engineering student will observe that there are fundamentally three stages to applying mathematics to an engineering problem:

a) *Modelling:* Transformation of the physical data into a mathematical form. In this way, a mathematical representation of the physical situation is obtained. This model could be a differential equation, a set of linear equations, or some other mathematical expression.
b) *Solving:* Application of mathematical techniques to the model. This will result in the mathematical resolution of the stated problem.
c) *Interpreting:* A description of the mathematical result in terms of physical principles.

SCOPE OF MATHEMATICS IN ENGINEERING

When we throw a glance over the historical development of engineering mathematics, it is divulged that it has become more important to engineering sciences, and a that this pattern will also persist in the future. It has got wide application in soil mechanics, bio-mechanics, biology, biotechnology, soil engineering, agricultural engineering and in many other conventional branches of engineering (e.g., civil, chemical, mechanical, electrical, metallurgical, ceramic etc.). In soil, agricultural, petroleum and aeronautical engineering, the concepts of fluid-mechanics are applicable. Fluid mechanics is concerned with the behavior of the fluids in motion and is based on the burning concepts of mathematical modelling and on sound footing of sophisticated mathematical techniques. It is one of the oldest branches of applied mathematics. It is also the branch in which some of the most significant advances have been made during the last six decades.

These advances have been motivated by exciting developments in science and technology and have been facilitated by the developments of sophisticated mathematical techniques. With the emergence of plastics, alloys, polymers etc. the work of fluid-mechanics has become more challenging and complex, as these materials have abnormal physical properties and empirical approach of mathematical modelling is not possible, at all. When there are high speeds, significant forces, high temperatures, or other unusual circumstances present, the work becomes even more demanding. In these cases, boundary layer concept of the fluid-mechanics renders a valuable service in mathematical modelling. Magnetohydrodynamics (MHD) is a by-product of applied mathematics and has been developed because of the astrophysical phenomena arising out of the existence of large magnetic fields in some stars and possibilities of magnetohydrodynamics generators as a new source of energy.

Likewise engineering mathematics has got tremendous importance in computeronics. Boolean algebra developed by George Boole (1815-1864) is applied now-a-days to the design of digital circuits. It remained a branch of pure mathematics until 1938, when Claude Shannon applied it to switching circuits. This algebra is based on logical statements and hence is also known as symbolic logic. It is possible to make systematic manipulations of large number of statements together with their relationships into simpler statements with the help of symbolic logic. Consequently, Boolean algebra is of prime importance in the digital computer circuits, for computer is mainly a logic machine performing large number of logical operations at very high speed. Through researches on Vedic-Mathematics, mathematicians have come to know that the 'sutras' (formulate) of seventeenth appendix of 'Atharvaveda' were much useful in the hardware technology of computers. With the help of the 'sutras', problems of addition, subtraction and division can be solved within tremor of minutes without any difficulty. Long before, a programme was televised on human-computer 'Shakuntala Devi' in which she was showing the magic game of her calculator power. At that time, she was having a thick book in her hands. One of the audiences was very much eager to know the name of the book. So, he stood up and asked the name. Shakuntala Devi told him that it was 'Atharvaveda'. From this event, the idea of application of Vedic Mathematics to computer hardware technology becomes more authentic, for she has an astonishing calculator power to her credit and can-do calculations within seconds irrespective of their size.

Mathematicians guess that she has got full command over the 'sutras' of 'Atharvaveda'. So far as mathematical techniques are concerned, the integral transforms (e.g., Laplace transform, Z-transform, Fourier transform) are used in computer digital signal processing, network synthesis and in control systems. In computer graphics, theory of matrices is used to manipulate the shape and size of any object to be displayed on computer screen. The computer is a device for processing information and can be used to store, manipulate, and correlate data. We can produce, gather, and process information on a scale that was never before possible. This information can help us make decision, understand our world, and control its operation. But as the volume of the information increases, a problem arises. How can this information be efficiently and effectively be transferred between machine and human? The machine can easily generate tables of numbers hundred pages long. But such a print-out is worthless if the human reader does not have the time to understand it. Computer graphics strikes directly at this problem. It is also a study of techniques to improve communication between human and machine. A graph may replace that huge table of numbers and allow the reader to note the relevant patterns at a glance. Computer graphics allows communication through pictures, charts and diagrams in a required fashion using the theory of multiplication of matrices. What to talk of engineering sciences, engineering mathematics is nowadays going to be employed in medical sciences also. By making mathematical modelling, the chances of the diseases like stenosis, glycoma, hypertension, diabetes, etc. being fearful and fatal can be predicted and their proper treatment can be done. The flow of blood in veins is very much similar to the flow of water through tubes of non-uniform cress-section and hence proper mathematical modelling can be done based on certain physical conditions. By solving the model and by making appropriate interpretation of the results so obtained, several hygienic problems can be cured beforehand they become decisive. Similarly, a theoretical model can be developed to explain the movement of water and salt along the long extracellular pathways that appear to be a common architectural feature of all epithelial layers found in the ciliary processes of the eye, gallbladder, and kidney. hose. Also, the transport of aquous-humor in the eyes and in the excited ciliary body can be studied and eye-diseases can be cured. Similarly, statistics is a branch of applied mathematics which specializes in data. In modern times, statistics is considered as a tool rather than just a device for collecting numerical data. Developing sound techniques for their management, analysis and drawing. Doubts from them. It is now finding applications in almost every scientific field, including the social and physical sciences like biology, psychology, education, economics, and business management. The connection between statistical methods and biological theories was first studied by Francis Galton. Prof. According to Karl Persson, the whole theory of heredity is based on statistical basis. In astronomy, the Gaussian 'normal law of errors' theory was developed using the 'principle of least squares' for the study of the motions of stars and planets. In medical science also, statistical tools are very important for the collection, presentation, analysis of observed facts regarding the causes and incidence and results of diseases obtained from the use of various drugs and medicines. Moreover, the efficacy of a manufactured drug or an injectable drug is tested using significance tests called T-test.

LITERATURE SURVEY

Adler [1] looked at the materials and how they were used in classrooms. Mathematical learning materials, he argues, are most successful when used in a formal educational setting. He has also suggested that teacher training programs for mathematics pay greater attention to resources, defining them and explaining how they might be used to supplement classroom instruction. Chrissavgi and Despina's [2] research looks at how a group of technicians' activities at a telecommunications company provide light on the function of tools in the development of mathematical practices and the building of mathematical meanings in this context. He has uncovered, categorized, and associated the technical resources that facilitated technicians' work, and he has investigated the resulting mathematical meanings. Many institutions provide mathematics drop-in centers or offer one-on-one assistance with specialized mathematics tutors to help students who aren't adequately prepared for or motivated to study mathematics at the university level (Hawkes and Savage [3]). Bridging courses, typically lasting between two and six weeks before the start of the semester, have been developed by numerous institutions for first-year engineering students (Bernstein [4], Graham [5]). Bingolbali et al., [6] followed a group of engineering students over time while they took a foundational (scientific) course designed to expose them to the material they would later require in their major. The term "techno-mathematical literacies," coined by Kent et al. [7] to characterize the interplay between mathematics and information technology skills, has been developed by Van der Wal et al. [8]. The question is how the study of engineering may help develop these skills. First-year engineering students' usage of online resources for studying calculus and linear algebra was studied by Kock and Pepin [9]. The term "applied resources" encompasses more than simply digital assets. Some students had problems in their university mathematics courses because they had carried over their knowledge and approaches from secondary school. Students' resource selection and use were found to be influenced by course structure and the degree to which course materials were aligned with learning objectives. Rensaa [10] studied the self-descriptions of learning strategies used by engineering students in a Linear Algebra course. Most students in the engineering field, contrary to popular belief, place equal if not more value on conceptual understanding than the mastery of methods, and they use their own ability to solve relevant mathematical assignments to determine whether or not they have achieved this goal. According to the author, it is important to stress the link between theory and problem design throughout the course and in the university examination. If we want to change the way certain kids think, we need to provide them opportunity to argue their conceptual assumptions about how to approach problems. Biza et al. [11] and Abou-Hayt et al. [12] conducted research on the use of mathematical modeling and engineering designs in project work, and they found that doing so helped students get a more thorough comprehension of the material. The ATD has been utilized in a wide variety of research involving mathematical modeling or the incorporation of mathematical applications into engineering education. To better comprehend the features of prevailing methods of teaching and learning that can enlighten the development and execution of future innovative practice, Pepin et al. [13] sought to consolidate and synthesize key findings from international research on innovative approaches to mathematics education. This paper's goal is to survey the current status of research in this burgeoning area at the intersection of math and engineering curricula.

STUDENTS AND THE MATHEMATICS

Actually, most of the engineering students are not acquainted with the baffling significance of the engineering mathematics in the field of modern science and technology. There is no branch of modern science and technology where mathematics is not used. With the development of sophisticated computer technology, the application of applied mathematics has risen to greater heights. In space-science, where there is consideration of very high temperature, velocity, pressure, force, etc. mathematical modelling yields generally non-linear differential equations, the analytical solutions of which are not possible at all. At that time, numerical methods are used to find their approximate solutions. Using graphics, curves can be plotted and physical interpretation of results so obtained can be done. Thus, applied mathematics paves the way for innovations in the field of science and technology which can be utilized for the emancipation of human-being. But engineering students generally take it for granted and study is only to get pass-mark. They do not aim at intensive study. As a result, perfection of the students in mathematics is meagre and far from satisfaction. Though it is capable of facing their growing demands, they are very completely unaware of these facts. Even they are very weak at fundamentals of mathematics like differentiation and integration. Because of this reason, they cannot produce the steps of any problem the solution of which is mainly based on a mathematical technique.

Although they understand the tactics involved in the solution of a particular problem, they cannot employ that tactic because of the basic difficulties arising due to differentiation and integration of certain expressions. That is why, they are unable to solve the complete problem in the examination resulting in mass failures. Also, this poor fundamentalism gives rise to lack of interest in the subject. They come to the class only for the sake of attendance. They are physically present in the class, mentally they are somewhere else. They take it as a burden. To remove this disparity, a student must try to become diligent and studious so as to have a conceptual knowledge of all the fundamentals, that is, a conceptual knowledge of all the courses of mathematics that he has studied up to his twelfth standard. Once the fundamentals are clear to him, he will be able to understand the problem completely in the class only and will be able to produce the steps involved in the solution. He will be full of confidence and an interest in mathematics will be created automatically. The second reason of poor performance of the students in mathematics is lack of practice. There is an old saying that Practice makes a man Perfect. This saying is true to mathematics to a large extent. Practice brings what is called "mathematical institution". This mathematical institution suggests a trick to tackle any particular problem. For instance, when we study the topics of gamma and beta functions, we take certain substitutions so as to change the integrals to mathematical tactable forms. These mathematically tactable forms generally resemble the integrals giving the mathematical definitions of gamma and beta functions, so as to apply direct formulae to evaluate them. Students generally enquire of the rules and regulations behind these substitutions. So, at this juncture, we wish to tell them that there is not any hard and fast rule behind these substitutions. It is the mathematical common sense which suggests the appropriate substitutions depending on the nature of the integrates (expressions to be integrated). So, to develop mathematical intuition, a regular study habit is required, so that a student can make full practice of mathematical problems. Just by cramming the problems, they cannot secure good marks in the examination. If any numerical problem has been done in the class by his teacher, he should try at least two problems of the same type on his own as a home work. This will create confidence in his mind and at the same time his mathematical calibre will be increased. Third reason for their poor performance is the problem of backlogs. This is the major factor affecting the results of mathematics in higher classes e.g. S.E.,T.E .. Once a student has taken backlog in Engineering Mathematics - I (EMI), he cannot think of Engineering Mathematics- II (EM-II). He goes to class of EM-II only for the sake of attendance. Even if the concerned teacher teaches methodologically in the class, he does not care for that. At last, he appears at the examination of EM-II only to collect the question paper, thereby, diminishing the percentage of the result of EM-II. To get rid of this 'Virus-infection' the rules of A TKT (allowed to keep terms) must be abolished. This system permits the students to go to higher classes even with backlogs.

STEPS TAKEN TO IMPROVE RESULTS

To improve the results of mathematics, the institute should adopt the following remedial steps:

a) ***Preparation of Manuals:*** Besides the regular text books, students should be provided manuals also. These manuals will provide hints to students to solve typical questions related to the subject matter. These manuals will give a comprehensive and systematic introduction to all those topics which are required by them. All the essential ideas of the subject should be explained with greater clarity. Each topic should follow important unsolved problems. In case of difficulties, students should contact the concerned teachers.

b) ***Extra Coaching Classes:*** To help the academically needy and the mediocre students, extra classes may be arranged in mathematics. These classes should be made compulsory for all those first-year students whose performance in monthly tests were miserable. These extra classes should be different from regular classes in the sense that here the teacher will brush-up only those topics which are important from university examination viewpoints.

c) ***Tutorial Classes:*** One hour more than prescribed in the course structure should be provided in the time-table for tutorial classes in mathematics. In the tutorial classes, at least three teachers should be deputed to go to a class. Some important problems related to the topics that have been taught earlier should be written on the black board and students be asked to solve them. Teachers will be there to help and supervise the students.

d) ***Monthly Examinations:*** To assess the ability and to create confidence into the minds of the students, regular monthly tests should be conducted. Questions must be set on the university pattern. After examination the checked copies should be shown to the students in the class and proper suggestions should be given to them by the concerned teachers to remove their short-comings. Then tests should be made compulsory for all the students.

CONCLUSION

Thus, we jump to the essence that the study of mathematics is a real boost to take the humanity to the realm of life full of happiness. It is the backbone of all the social and physical sciences. But it does not mean that it is perfect, for every concept in mathematics is based on certain assumptions. So, to remove these assumptions we are required to take another assumption and there comes a new picture of mathematics called meta-mathematics. Even this meta-mathematics is full of assumptions for the removal of which another mathematics called meta-meta-mathematics is required. This trend continues forever. Thus, it is a science of metamorphoses useful for the growing demands of the scientists and engineers to a great extent. May God bless it with mathematicians with innovative bent of minds.

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