

A study on Integration of Teaching Science and Mathematics

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Introduction

Owing to the phenomenal advancement of knowledge, especially in Science and Technology, the importance of Mathematics is immense today. The application of Science like Information Sciences and Information Technology, Bio-medical Engineering, Biotechnology are some of the leading pursuits in which role of Mathematics is indispensable.

Moreover, contemporary investigations on Science and mathematics education reveal that mathematics lessons are dry and lifeless in most cases because the problems of mathematics, are mostly artificial and complicated and not related to the realistic issues of science and technology. Is it possible to teach them together?

Objectives and significance of the study

The objectives of the present study are, thus, the following:

- 1) To mathematisation of technological ideas and heir understanding.
- 2) To disseminate science and technology education through teaching mathematics and
- 3) To redesign the curriculum of mathematics to bring it in line with the growth of the subject, growth of science and technology as well as the changing needs of the society.

Teaching science and mathematics separately has become extremely difficult due to enormous proliferation of content matter of each subject. Again separate treatment of teaching and learning inhibits global comprehensions of ideas and concepts of different disciplines. Integrated teaching of science and mathematics is likely to save our time and vigor in learning those subjects.

Integration of concepts of Mathematics and those of Science and Technology: Theoretical issues

Scientific and technological ideas are best understood when they are presented in mathematical ways. The mathematical form of conversion of matter into energy is the famous equation $e = mc^2$. This simple energy equation shows how a tremendous amount of energy is hidden in a small amount of matter. Mathematical forms of science are brief but the information contained in such forms is quite huge and vast.

Again, there is a reversible interrelationship among mathematisation physical reality, scientific theories, social needs and technology. The more we understand these reversibilities clearly, the more we will understand the theories of science and technology. Technology, in fact, is the applications of science related to industry and the needs of people. Science and technology can be expressed in mathematical ways. Mathematics can be utilized as 'the language for science and technology'. In order to understand the application of science related to man in a better way, we are to teach mathematical components of science and technology in classrooms in the periods of teaching science to the learners. In this case mathematical forms are to be explained through physical interpretations. In science books, also, mathematical forms with the variables of science & technology and their with the variables of science and technology and their physical interpretations are given. Sometimes students feel difficulty in understanding such mathematical treatment.

On the other hand in the course of teaching mathematical topics, relevant problems of science and technology can be presented as applications of mathematical concepts. For example, the problems related to alloys, mixture and compounds, preparation of medicines and cosmetics, etc. can be given in the exercises of ratio

and proportion taught in mathematics. Relationships among flow of current, electrochemical equivalent weight, time and amount of metal deposited can be explained in teaching 'variation'. Similarly, Linear Function of mathematics can be explained utilizing the Hooke's Law. In the same way irrational function and Trigonometric function can be experimentally verified using a pendulum. Thus, we find that a large number of problems of physics, chemistry, life science, geology, geography, economics can be presented in teaching different concepts of mathematics in different classes.

In fact, problems of science and technology can be classified and can be given in different content areas of Arithmetic, Algebra and Geometry etc. of mathematics. They are placed in the exercises of appropriate contents of mathematics. As for example, the problems of speed, velocity, mass, weight etc. are included in unitary methods while composition of mixture, compounds and chemical formula are taught during the discussion of principles of ratio, proportion and percentages. It is kept in mind that the knowledge of appropriate scientific terms and principles of science is a prerequisite in understanding those problems through mathematics.

Relationship between Mathematical concepts and relevant applications of Science and Technology is depicted in the table below.

Research Design and procedure

In the project, experiments have been conducted to teach the subjects (i.e. mathematics and physical sci-

ence and biology) separately and through integrated approach over the control and experimental groups of learners of class VIII. Three schools (each of rural, urban and semi-urban) are selected for conducting the project.

For teaching through integrated approach, in the curriculum of mathematics, the following application areas are interspersed: Archimedes principles, Newton's Law, principles of lift pump, vacuum pumps, laws relating to pulley, measurement of pollution, sugar or hemoglobin content in blood, composition of soil and bio-fertiliser, etc. The evaluation of two approaches of teaching has been made and statistical analysis showing the efficiency of the integrated method of teaching has been shown and explained.

Dissemination of science and technology ideas through teaching mathematics at class VIII grade is also tested through the use of 'comprehension test' in mathematics. In the 'comprehension Test' the concept of speed, friction, laws relating to pulley, composition of soil are given. After reading the passage twice and thrice, the learners are to answer the mathematical problems given at the end. To answer the problems, the students have to understand the principles of science and mathematics both. The theme of the passage are familiar to them and presented in a story-telling fashion. The passage and the test are designed properly keeping in view the ability levels of learners and their background knowledge about relevant science and technology ideas.

Mathematical concepts/ideas/contents	Relevant application of science and technology
Arithmetic	Physics
Mean, Ratio Proportion, Unitary method	Measurement of force, Pressure, velocity, Calorimetry, Current registration etc.
Algebra	Life Sciences
Formula, Surds & Indices, Equations	Seed germination, Growth of bacteria, Plant, photosynthesis etc.
Geometry & Mensuration	Chemistry
Triangle & quadrilateral properties, areas of square etc. Volumes of solid etc.	Relation between p.v.t.d. Electrolysis, Radioactivity Chemical & Electrochemical equivalent weight etc.
Statistical ideas	Geo. Sciences
Measures of central Tendencies & Variability, correlation etc.	Graphs, Longitude, Latitude, Aeronautical distances, Determination of time in different places
Modern ideas	Agriculture & fisheries
Sets, Elementary Calculus, flowcharts, computer language	Use of insecticides Fertilizer, Cost benefit, Horticulture & tree plantation

Findings

It is observed that experimental group has shown better performance. The differences of means of both groups of all the three schools under the project are found to be significant. It is evident from the opinion analysis that the learners will understand the solution of the problems which will help them in understanding the practical problems of industry, Commerce and business such understanding would facilitate them in their professional, vocational and day to day life situations.

The mathematical problems related to science and technology are to be given in abundance in the content of mathematics so that the integrated method of teaching may be more interesting and attractive.

Concluding remarks

In view of the above experiences and illustrations mathematical treatment of technological ideas may be interspersed in mathematical teaching for better comprehension of both mathematics and technology . At first, selection of appropriate problems and their respective placement in mathematical topics are necessary.

Such integrated approach, if judiciously planned and meticulously spelt out may lead to true comprehension and global understanding of both mathematical and scientific principles as well as application of principles, i.e. technological aspect in a global and total way.