Research Paper

Integration between Mathematics with other Subjects

Dr. KOTRA BALAYOGI

Assistant Professor, Unity College of Teacher Education, Dimapur, Nagaland – 797112

Abstract
The essence of mathematics lies in the beauty of numbers, figures, relations, etc. and there is a truth in that, but the driving force of mathematical innovation in the last centuries has been the desire to understand how nature works. As known, that for over-all development of the students, various subjects are being included in the curriculum and these subjects are not selected on ad-hoc basis, but this decision is taken after proper consideration and analysation. Generally, those subjects are included in the curriculum which is found to be complementary to each other.The term of 'correlation' is connect/to be connected and particularly 'correlation' means a mutual relation of two or more things and the relation may be inverse or direct. It is really a brainstorming activity which involves lots of efforts to be establishing relationship between subjects. According to Lathrop: "Correlation indicates a joint-relationship between two variables.". Mathematics is "Science of all Sciences" and "Art of all Arts". After understanding the basic concept of mathematics, students need to correlate the importance and concept of mathematics with other subjects, so as to understand other subjects easily and establishing relationship and mathematical knowledge plays a crucial role in understanding the contents of other subjects. The present study focus on teaching, and teachers need to relate the various subjects taught in educational institutions, therefore it becomes necessary to relate one subject with another and so in order to achieve the ultimate aim of education that is to achieve the development of an all-round personality, is possible only through unification of knowledge and not by teaching only a few subjects in isolation and results has shown that children can learn best and better when they can make connections with previous learning or with different areas of learning and 21st century students inspireto study and learn mathematics easily and effectively with correlation with all other subjects.
Keywords: Correlation, Education, Integration, Mathematics, Other Subjects, Student

I. Introduction

Mathematics is science of all sciences and art of all arts and after understanding the basic concept of mathematics, students need to correlate the importance and concept of it with other subjects, so as to understand other subjects easily and establishing relationship. Mathematical knowledge plays a crucial role in understanding the contents of other subjects. It is a fundamental part of human thought and logic, and integral to attempts at understanding the world and ourselves and provides an effective way of building mental discipline and encourages logical reasoning and mental rigor. It plays a crucial role in understanding the contents of other school subjects such as science, social studies, music, art, etc. The purpose of the present study is to discuss the integration of mathematics with other subjects and the role of mathematics in the overall curriculum. Mathematics has a transversal nature. If we reflect on the history of curriculum in general, then mathematics like geometry and algebra were two of the seven liberal arts in Greek as well as in medieval times. This historical role supports the notion that mathematics has provided the mental discipline required for other disciplines. Its literacy is a crucial attribute of individuals living more effective lives as constructive, concerned and reflective citizens and is taken to include basic computational skills, quantitative reasoning, spatial ability etc. It is applied in various fields and disciplines, like mathematical concepts and procedures are used to solve problems in science, engineering, economics. The complexity of those problems often requires relatively sophisticated mathematical concepts and procedures when compared to the mathematical literacy aforementioned. It is a part of our human cultural heritage, and we have a responsibility to develop that heritage and since mathematics provides foundational knowledge and skills for other school subjects, such as sciences, art, economy, etc., the issue of how mathematics is intertwined with other school subjects deserved to be addressed. In some curricula, mathematics is offered independently to support the study of other school subjects as an 'instrumental subject',

and in other curricula, integrated courses which combine mathematics and other fields are offered. And, we may wish to reflect on the number of hours like proportion of hours and/or courses allocated to mathematics when compared to the other school subject in the curriculum of each country. In addition to this quantitative analysis, information about the qualitative description of 21st century school mathematics in relation to other subjects also needs to be gathered.

Objectives of the Study
❖ To know the concept of mathematics and its importance
❖ To discuss about the integration between mathematics with other subjects

II. Methodology

The study has been conducted based on the method of document review in accordance with the qualitative approach of research and has been done on the basis of the secondary sources of data like books, research journals, newspaper articles and different websites towards "Integration between Mathematics with other Subjects." The methods are followed in the present study are exploratory in nature.

Mathematics
❖ The word mathematics is derived from two Greek words 'Manthanein' meaning learning
'Techne' meaning an art or technique.
❖ It means the art of learning related to intelligence (mind. brain), capabilities (potential, power), mental abilities (understanding, grasping power), etc.
➢ It is the science of number or space (area, volume).
➢ In Hindi we call mathematics as 'Ganitha'- which means the science of calculations.
❖ It is a broad term that consists many branches and parts.
❖ Hence, Mathematics is a science that involves dealing with numbers, different kinds of calculations, measurement of shapes, structures, interpretation of data, establishing relationship among variables (like x, y, z), etc.

DEFINITIONS OF MATHEMATICS
❖ "Mathematics is the essential instrument of all physical resources"- Kant
❖ "Mathematics is the gateway and key to all science"- Bacon
❖ "Mathematics is a way to settle in the mind a habit of reasoning"-Locke
❖ "Mathematics should be visualised as the vehicle to train a child to think, reason, analyse, and articulate logically. Apart from being a specific subject, it should be treated as an important to any subject involving analysis and meaning" (National Policy on Education, 1986).

Integration between Mathematics with other Subjects
Mathematics and General Science: Science without mathematics is totally meaningless, because chemical reactions, scientific theories and detail of elements are only generated/ counted with the help of mathematics. Mathematics is used in most of applications like in work, energy, electricity, motion, gravitation, magnetism etc.
Mathematics and Physics: child should have rich knowledge of mathematics to understand physics. Generally final shape to the rules of physics is given by mathematics; it presents these rules in practically workable form. Mathematical calculations occur in every step of physical science. Charle's law of expansion of gases is based upon mathematical calculations, numerical problems on liquid, pressure, frictional force, laws of motion, gravitation, momentum etc.
Mathematics and Chemistry: Molecular weights of organic compounds are calculated with mathematics. To measure the constituents of mixtures and Chemical compounds. To calculate Empirical or molecular formula. In balancing the chemical equations. In electronic configuration of atom of the element. Charle's law of expansion of gases is based upon mathematical calculations.
Mathematics and Biology: Mathematics has very high correlation with biology. The Normal Weight, Caloric value, Rate of Respiration, Nutritive Value of Food, Transpiration, is calculated by Maths. The Growth in Weight of infants' upto Nine months. To count the number of bones in human being and other different species. To measure blood pressure. To count the number of WBC & RBC in different blood groups. To count Sex chromosomes.

Examples
❖ Write the distance between the sun and each planet using exponential form.
❖ Explore the half-life of certain radioactive elements or the size of bacteria and viruses using negative exponents.

❖ Build scientific facts, such as the boiling and freezing point of liquids, the melting and freezing point of solids and the temperature of planets.

❖ Use algebra to calculate how much force a given magnet would pull on another magnet.

❖ Develop a weight bearing bridge using various household items. Create a design and reduce it to scale, prepare cost analysis and then build and test the bridge.

❖ Analyse rainfall over a time period for a specific area and create a chart or graph.

❖ Use math to prove various laws of physics.

❖ Measure and collect scientific data and use graphs, charts, lists, tables etc. to organize the data.

❖ Compare the speed of several animals on a bar graph.

❖ Track the weather or temperature and create a bar graph.

Mathematics and Social Sciences: After completion of the unit child can read, interpret, and draw the graphs for example, to compare the Population and students can draw bar graphs, Population Density of various countries, Per Capita Income etc.

Mathematics and Geography: Geographical figures are explained in the terms of numbers only like seasonal conditions, temperature, humidity, degree, measurement of rain etc. the geographical conditions also define the economy of a rich/poor country. Many countries like India have agriculturally based economy due to its climate, rainfall, rivers and weather prediction. etc. Certainly mathematics is used for constituting the map, Formation of Nights & Days, Solar & Lunar Eclipse, Longitude Latitude, Maximum and Minimum Temperature, Barometric Pressure, Height above Sea Level, Surveying, Calculation of International, Local and Standard Time, Instruments etc. And here are also many other calculations.

Mathematics and History: in history Mathematics helps in Calculation of Dates like duration of Britishers ruled in India? When Gandhi ji was born? Celebrate National Days and festivals, Cost in building of Taj-Mahal. Tenure of President in India. This gives us new information of the historical world. When the First and second world wars were fought? On account of economic considerations industrial revolution in Europe.

Mathematics and Economics: Statistical Methods are used to calculate and to know the Volume of Trade, Trend of Import and Exports, Economic Forecasts, Trade Cycles and helps in calculating various indexes like crop production inflation, etc. All economists, citizens and the businessman can get the market trends & economic conditions. Through currencies market, the Current updates of currency and through stock and commodity market the current updates of the stock and commodity of different countries. Only because of economic reasons certain empires faced liquidation. Similarly, economic events have been influenced or affected by historical circumstances. In the current scenario the economic condition of India during UPA and NDA.

Examples

❖ Write a report or complete a journal page on mathematicians.

❖ Learn about the history of clocks.

❖ Purchase some inexpensive clocks and take them apart and put them back together. Then practice telling time using the clocks.

❖ Learn how various cultures told time throughout history and write a report.

❖ Calculate the number of years between various events.

❖ Learn about the history of the scale and experiment with different types of scales.

❖ Learn about the history of currency.

❖ Learn about the French scientists and mathematicians that were placed on plaques in the Eiffel Tower more than 100 years ago.

❖ Plan a trip by land, sea or air. Map a starting point and destination, decide on appropriate transportation and determine a reasonable speed.

❖ Calculate the distance that will be travelled and the time the trip will take. Also, identify landmarks along the way and write postcards about the places visited.

❖ Calculate the distance between various cities, states or countries.

❖ Learn to read grid coordinates and find places on a map through the use of latitude and longitude.

❖ Use a map scale to determine the distances between two points on a map to learn about the connection between scale and actual distance.

❖ Use Lego bricks or blocks to create replicas of famous buildings, monuments, or structures.

❖ While building discuss mathematical concepts such as perimeter, area, and volume.

❖ Draw bar graphs comparing populations, per capita income, population density, etc. of various countries.

❖ Figure out the percentages of cultures that speak English.

❖ Learn about the different types of currency in other countries.

❖ Go through a newspaper and black out all of the numeral or number words on a page.

❖   Read the article without the numerals or number words and discuss why they are so important.
❖   Learn about the role trade and value play in economics.

Mathematics and Fine Arts: It decides size, Ratio and Proportion while constructing the Similarity, Scale appreciation, Balance and Symmetry, Postulates, Drawing images on cloth and paper, Rhythm in Music etc.

Examples
❖   Create a geometric greeting card using shapes that are congruent, similar, and equivalent.
❖   Examine works of art that incorporate geometric shapes.
❖   Create tessellations.
❖   Play with tangrams.
❖   Create a piece of artwork using perspective and proportion.
❖   Learn how these music terms rhythm, time, tone, tune, pitch, frequency, and amplitude go hand in hand with math.
❖   Create and experiment with a monochord.

Mathematics and Language
❖   Math and Reading: Students read about the discoveries or work of great mathematicians, and they can make poem on numbers.
❖   Math and Writing: A student makes the pie chart and interprets in his own words like counting of alphabet, vowel and read About the Life History of Mathematicians. Student can draw make a bar graph of time spent in school and home the whole week and can interpret like interpretation of Non-Verbal Data.
❖   Write a report/complete a journal page on mathematicians.
❖   Provide written explanations for solutions to math problems.
❖   Read a variety of books off a list then figure out the percentage of the books that were liked, disliked, etc.
❖   Read stories that include counting, math facts, etc.
❖   Create a math journal.
❖   Provide topics to write on like: write an explanation of a recently-learned concept, as if you were explaining it to a younger sibling or friend, write as many examples of a ratio that you can think of in five minutes or write a paragraph explaining a selected graph.

Mathematics and Agriculture: Agriculture has close relationship with Maths. Agriculture has correlation with maths like area of crops, which season is suitable for which crop. How much quantity of water may be used in irrigation is also calculated in concern of agriculture by the use of mathematics. Investment, expenditure and saving in sowing specific crop, Division of land, Cost of labour, seed, fertilisers, expenditure in transportation of vegetables to the market, has the use of mathematics. As due to scientific inventions, there is lot of growth of agriculture & economy takes place.

Mathematics and Commerce/Accounts: With the rich knowledge of commerce, it is possible to study the economy of the country. Only by the knowledge of mathematics, Debit, Credit process & expenditure in accounts of industry, banks firm, etc are determined. The commerce teacher of should try to teach/make understand in such a way that students may relate and explain all specific terms mathematically.

Mathematics and ICT: The ICT is strongly correlated with mathematics. Computer programmes, applications, software and different languages without mathematics are impossible to operate and follow. Students are taught computers only because of knowledge of mathematics. Computer Provides important software for calculation like SPSS software used in the long statistical calculations for research work. Many mathematical packages are used included Logo, dynamic geometry software, graph plotting etc.which are used in the teaching programmes. Example like examine the binary number system. Look at the relationship between base 2 numbers and how computer circuitry was developed.

Mathematics and Engineering: without mathematics Engineering is like sea without water. Mathematics has very strong correlation with each and every branch of engineering. Mathematics is used in every branch of engineering like Electronics, Electrical, Mechanical, Architect, Civil, Chemical, Computer etc. To get admission in any engineering stream, student must read Mathematics as a subject up to class 12.

Mathematics and Psychology: Mathematics has correlation with Psychology for measuring I.Q, S.D, coefficient of correlation, Significance of difference, Measure of central tendency (Mean, Median, and Mode). "Likert Scale" used in psychology to make questionnaire. Mathematics is used in different modes of psychology like industry, army, social etc.

Mathematics and Astronomy: Counting of Stars and Planets, No. of moon/satellite of all planets. No. of stars in galaxy and time taken in revolving at its own orbit. Formation of seasons, Life of star, galaxy etc. and Distance between two planets.

Mathematics and Physical Education: Mathematics is used to measure structure of the body, blood pressure, the height, weight, rules of the games etc. Temperature of the normal human body, Size of playground, norm and standard of game like boot-ball, hockey, cricket, volleyball, tennis, wrestling, boxing etc.

Examples
* Compute the percentage of wins and losses of a favourite sports team.
* Draw graphs to sort data for Olympic games, Super Bowls, batting averages, etc.
* Discuss the food pyramid. Then compare foods on the pyramid to foods eaten, keep a fat-counting diary, calculate the number of calories from fat eaten in a week, find the daily average of fat and compare fat intake with other family members like create a graph for comparisons.
* Learn about physics and math while having fun playing pool, baseball, or a game of bowling. Even roller skating incorporates math and physics.
* Weigh and measure several family members and create a bar graph showing the results.

Mathematics and Industry: Mathematics is used in industrial work towards weaving, knitting, making furniture, leather work, making paints and fertilisers etc. and mathematical calculations are required to calculate all work and the cost.

Everyday Life Application
* Learn the importance of financial literacy.
* Learn how to calculate sales tax, discounts, etc, on consumer goods.
* Weigh fruits and vegetables and calculate what the total cost will be.
* Learn about home loans and how to calculate sales price, interest, commission percentages and more.
* Play store, shop or business. Practice counting money, writing invoices/estimates and more.
* Bake some tasty treats or cook a meal and learn about fractions, doubling recipes, calculating weights, etc.

Educational Field Trips
* Take a trip to the playground to understand algebra.
* For example, calculate how fast a person will travel down a slide by using their weight and height of the slide.
* Examine artwork at an art museum and look for geometric shapes, perspective, etc.
* Calculate the age of artifacts at a history museum.
* Take a field trip to the Federal Reserve or a bank.
* Take a stroll in the city and discuss how math is used to construct a building.
* Calculate how many miles a car gets on a tank of gas.
* Visit a garden in a park and discuss symmetry or how much mulch it takes cover the garden area.
* Interview people in various careers to find out how they use mathematics in their career.
* They can also be asked to keep a mathematics diary to record everything mathematical they encounter in a day at their job.

III. Conclusion and Summary

Mathematics is essential for understanding other sciences like physics, chemistry, biology, and engineering. All scientific laws and principles are expressed through mathematical equations and formulas. For example, Newton's laws of motion, Boyle's law, and atomic structure are all mathematically defined and it is the mother of all disciplines such as general science, psychology, geography, political science, philosophy, industrial science, physical education etc. and mathematical science is the systematic treatment of magnitude relationships among figures, forms, quantities, etc. expressed symbolically.Mathematics correlates with almost all school subject. Sciences uses mathematics the most. Even the Fine Arts use mathematics to some extent. Mathematics has characteristics like symmetry, similarity, originality, generalization and verification. All these characteristics make mathematics very usable, practical and versatile.

References

[1]. Arrow, K. et al (eds.),"Mathematical Method in the social sciences", Stanford: Stanford University Press.
[2]. Beed,C. and O.Kane, "What Is the Critique of the Mathematization of Economics?" Kyklos 44(4), 581- 612.
[3]. Bell, E.T.," The Development of Mathematics", McGraw Hill, New York.
[4]. Gaertner,W., "A Primer in Social Choice Theory",New YORK: Oxford University Press.
[5]. Gutstein,E.," Reading and Writing the World with Mathematics", Children's agency in mathematics education. Accepted at CERME in Lyon 2009.