



Research Article

Mathematics as a Connecting Discipline: Its Relationship with Other School Subjects

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Abstract	Manuscript Information
Mathematics is commonly regarded as an independent school subject concerned with numbers, calculations, formulas, geometrical figures, equations and logical procedures. However, its educational significance extends considerably beyond these traditional boundaries. Mathematical concepts and processes are closely associated with science, social science, geography, economics, computer science, languages, arts, music, physical education, environmental education and everyday human activities. In an educational system increasingly emphasising competency-based, experiential and interdisciplinary learning, mathematics can be viewed not merely as one subject among many but as a connecting discipline that helps learners identify relationships, analyse information and understand phenomena across different fields of knowledge. The present conceptual paper examines the relationship between mathematics and other school subjects from an interdisciplinary perspective. It explores how mathematical ideas such as measurement, ratio, proportion, algebra, geometry, statistics, probability, patterns, logical reasoning and mathematical modelling contribute to learning in different disciplines. The paper discusses the connections of mathematics with science, social science, geography, economics, computer science, languages, art, music, physical education, environmental education and agriculture. It also considers the role of interdisciplinary classroom activities in developing problem-solving ability, critical thinking, mathematical communication and transfer of knowledge. The paper argues that interdisciplinary mathematics should not reduce mathematics to a mere computational instrument for other subjects. Instead, mathematical concepts and reasoning should remain explicit while being applied to meaningful contexts. Such an approach can make mathematics more relevant, improve learners' understanding of real-world problems and contribute to holistic education. The paper concludes that strengthening the relationship between mathematics and other curricular areas can help learners recognise mathematics as a powerful way of interpreting patterns, relationships, quantities and changes in the world around them.	▪ ISSN No: 2583-7397 ▪ Received: 06-01-2024 ▪ Accepted: 23-02-2024 ▪ Published: 28-02-2024 ▪ IJCRM: 3(1); 2024:288-294 ▪ ©2024, All Rights Reserved ▪ Plagiarism Checked: Yes ▪ Peer Review Process: Yes How to Cite this Manuscript Uppal B. Mathematics as a Connecting Discipline: Its Relationship with Other School Subjects. International Journal of Contemporary Research in Multidisciplinary. 2024; 3(1): 288-294.

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1. INTRODUCTION

Education in the contemporary world is increasingly concerned with the ability of learners to connect knowledge, interpret information, solve unfamiliar problems and apply concepts in real-life situations. Real-world problems rarely fit neatly within the boundaries of individual school subjects. Questions related to climate change, population growth, health, agriculture, economic development, technology, transportation and sustainable development generally require knowledge and skills drawn from several disciplines. Consequently, education systems across the world are giving increasing attention to interdisciplinary and multidisciplinary approaches to teaching and learning.

Mathematics has a particularly important position within this changing educational landscape. It is not simply a collection of numbers and computational procedures. Mathematical thinking involves identifying patterns, understanding relationships, measuring quantities, making estimates, interpreting data, constructing logical arguments, developing models and drawing conclusions from evidence. These processes are relevant to almost every area of human inquiry.

The relationship between mathematics and other disciplines has been increasingly recognised within mathematics education research. Interdisciplinary mathematics education has developed as an important area of scholarship, particularly in relation to STEM education, real-world problem solving and curriculum integration. Researchers have also pointed out that interdisciplinary work should involve meaningful connections between mathematics and other disciplines rather than merely using mathematics as an invisible computational tool.

In the Indian context, this perspective is particularly relevant because the National Education Policy 2020 advocates holistic and multidisciplinary education, flexible curricular structures and opportunities for cross-disciplinary and interdisciplinary thinking. The National Curriculum Framework for School Education 2023 also represents an important contemporary framework for school education in India.

Despite the importance of mathematics in different fields, school learning is often organised into separate subjects. Students may learn percentages in mathematics, population statistics in social science and economic data in economics without being explicitly encouraged to recognise the mathematical relationship among these topics. Similarly, students may encounter speed and distance in mathematics and physics as apparently separate ideas even though they are mathematically connected.

Such separation can limit students' perception of mathematics. Learners may begin to think that mathematics is useful mainly for solving textbook exercises and examinations. Interdisciplinary learning can challenge this perception by allowing students to encounter mathematics in meaningful situations. A map can become a context for scale and ratio; rainfall records can provide a context for statistics; a household budget can provide a context for percentages; and a scientific experiment can provide a context for measurement and graphical representation.

The purpose of the present paper is therefore to examine mathematics as a connecting discipline and to discuss its relationship with different school subjects. The paper also considers the educational value, possible challenges and practical implications of interdisciplinary mathematics education.

2. OBJECTIVES OF THE PAPER

The present paper aims to examine the relationship between mathematics and different school subjects from an interdisciplinary educational perspective. It seeks to explain how mathematical concepts and processes contribute to learning in science, social science, geography, economics, computer science, languages, arts, music, physical education, environmental education and agriculture.

The paper also aims to explore how interdisciplinary classroom experiences can make mathematical learning more meaningful and relevant to students. Another objective is to examine the potential contribution of interdisciplinary mathematics to problem-solving, critical thinking, mathematical communication, creativity and transfer of knowledge.

A further objective is to identify the major challenges that teachers may experience while implementing interdisciplinary mathematics education and to suggest practical approaches for mathematics teachers, subject teachers and teacher educators. The paper finally seeks to emphasise the importance of maintaining the identity and depth of mathematics while creating meaningful connections with other curricular areas.

3. RESEARCH METHODOLOGY

The present study adopts a conceptual and descriptive research methodology based on the review and synthesis of relevant literature. It does not involve an experimental intervention, survey or statistical comparison of participants. Instead, it analyses existing scholarship and educational policy perspectives concerning interdisciplinary learning and mathematics education.

Relevant books, research publications, scholarly discussions and official educational policy documents were consulted to develop the conceptual foundation of the paper. Particular attention was given to literature concerning interdisciplinary mathematics education, mathematical modelling, STEM education and the integration of mathematics with other disciplines. The literature indicates that interdisciplinary mathematics can take several forms, including the use of mathematics within another subject, thematic integration and problem- or project-based approaches. The paper uses a descriptive-synthetic approach to organise these ideas around major school subjects. Examples of possible classroom activities have been developed to illustrate how mathematical concepts can be connected naturally with other disciplines. These examples are conceptual and are not presented as findings from an empirical experiment.

The analysis also considers the contemporary Indian policy context. NEP 2020 explicitly promotes multidisciplinary education and interdisciplinary thinking, making the discussion relevant to current educational reforms in India.

4. Mathematics as a Connecting Discipline

Mathematics is often introduced to students through arithmetic operations, algebraic expressions, geometrical constructions and statistical procedures. However, behind these topics are broader forms of reasoning that have applications across disciplines. Measurement allows learners to quantify physical phenomena. Ratio allows them to compare quantities. Geometry provides a language for space and form. Statistics allows them to analyse variation and uncertainty. Algebra provides a means of expressing relationships, while mathematical modelling helps represent complex real-world situations.

These forms of mathematical thinking are not restricted to mathematics classrooms. A scientist measures and analyses experimental observations; a geographer works with maps and spatial data; an economist studies numerical trends; a computer scientist develops algorithms; an artist works with symmetry and proportion; and a physical education teacher may analyse performance data. The contexts are different, but mathematical reasoning contributes to each.

This makes mathematics a connecting discipline. It provides common tools through which different kinds of information can be represented and interpreted. At the same time, interdisciplinary mathematics should not imply that mathematics loses its own identity. Contemporary research has specifically raised the concern that mathematics may become merely a tool for other STEM disciplines unless mathematical concepts and practices remain visible and mathematically rich.

The most productive approach is therefore one in which mathematics and another discipline contribute to a common learning situation. Students should be able to recognise both the contextual meaning of the problem and the mathematical ideas used to investigate it.

5. Relationship Between Mathematics and Science

The relationship between mathematics and science is one of the most evident examples of interdisciplinary learning. Scientific investigation depends extensively on measurement, numerical representation, proportional reasoning, equations, graphs and data analysis. Mathematics provides a language through which scientific observations can be quantified and relationships can be represented.

Physics offers numerous examples. Concepts such as speed, acceleration, force, work, energy, pressure and electricity involve mathematical relationships. When students use the relationship between distance, time and speed, they are simultaneously applying mathematical reasoning and interpreting a physical phenomenon. Mathematical representations enable students to move from a verbal description of motion to a quantitative relationship.

Chemistry also depends on mathematical reasoning. Ratio and proportion are used when interpreting chemical equations, quantities and concentrations. Percentage calculations help students understand quantitative relationships in mixtures and other chemical contexts. Algebraic reasoning can also support the manipulation and interpretation of scientific relationships.

Biology provides another important connection through statistics and measurement. Students may analyse population data, growth patterns, experimental observations or ecological information. Mean, percentage, graphical representation and probability can help learners interpret biological data.

An interdisciplinary classroom activity could involve students recording plant growth over a period of several weeks. Science provides the biological context, while mathematics is used to organise measurements, calculate averages, compare growth and construct graphs. Such an activity makes both subjects more meaningful without reducing either discipline to the other.

6. Relationship Between Mathematics and Social Science

Social science provides extensive opportunities for mathematical interpretation. Population, literacy, employment, migration, income, voting behaviour and demographic changes are often represented through numbers, percentages, tables, charts and graphs.

For example, students studying literacy rates across different regions can calculate percentages, compare differences and represent the data through bar graphs. Social science then helps students interpret why literacy rates may vary among regions. Mathematics provides the quantitative representation, while social science provides the social and historical context.

History can also be connected with mathematics through chronology and quantitative historical data. Students can construct timelines, calculate intervals between historical events and examine changes in population or economic indicators across different periods.

Civics provides additional opportunities for mathematical reasoning. Students may analyse voting percentages, population representation or public expenditure. Such activities demonstrate that quantitative reasoning can contribute to informed understanding of social and civic issues.

The integration of mathematics with social science therefore encourages students to view numbers not merely as answers to exercises but as representations of real social conditions.

7. Relationship Between Mathematics and Geography

Geography provides a natural context for mathematical application. Maps involve scale, ratio, distance, coordinates, direction and measurement. Students can use mathematical reasoning to convert map distances into actual distances and to understand spatial relationships.

For example, if a map has a specified scale, students can calculate the actual distance between two locations. This activity develops both geographical understanding and mathematical competence in ratio and proportion.

Latitude and longitude provide another connection with coordinate geometry. Geographical data relating to rainfall, temperature, population density or elevation can be organised into tables and graphs. Students can calculate averages and identify trends from such information.

Climate studies offer particularly useful opportunities. Students may collect rainfall data over several months, calculate monthly or seasonal averages and represent the results graphically.

Geography gives meaning to the data, while mathematics provides the analytical tools.

8. Relationship Between Mathematics and Economics

Economics is closely associated with mathematical reasoning. Percentages, ratios, graphs, averages, equations, interest calculations and statistics are regularly used to describe and analyse economic situations.

At school level, students can study household budgeting, savings, discounts, simple interest, compound interest, inflation and expenditure through realistic mathematical situations. A hypothetical household budget can be used to calculate the percentage spent on food, education, transport and savings.

Such activities have significance beyond mathematics. They contribute to financial literacy by helping students understand how quantitative information influences financial decisions.

Economic graphs can also provide meaningful contexts for interpretation. Students can analyse changes in prices, expenditure or production and discuss what mathematical trends mean in economic terms.

The connection between mathematics and economics therefore demonstrates how mathematical concepts such as percentage, ratio, algebra and statistics can support decision-making in everyday life.

9. Relationship Between Mathematics and Computer Science

The relationship between mathematics and computer science is becoming increasingly important in contemporary education. Logical reasoning, algorithms, patterns, sequences, data representation and abstraction are central to computational thinking.

Mathematical sequences can be represented through algorithms and simple computer programmes. Students can investigate a numerical pattern mathematically and then express the same pattern computationally. This provides an opportunity to understand the relationship between a mathematical rule and an algorithm.

Geometry can also be connected with computer programming. Students can create geometric shapes or repeating patterns through coding instructions. Spreadsheet software provides another accessible connection because students can enter data, perform mathematical calculations and produce graphs.

Such activities help learners understand that mathematics is not only a subject of manual calculation. Mathematical structures can also be represented, manipulated and explored using digital technologies.

10. Relationship Between Mathematics and Languages

The connection between mathematics and language is often underestimated. Mathematical understanding depends substantially on students' ability to read, interpret and communicate ideas.

Word problems require students to identify relevant information, understand conditions and translate language into mathematical relationships. Terms such as "at least," "difference,"

"approximately," "greater than," "less than" and "ratio" have precise meanings that influence mathematical reasoning.

Mathematical communication also requires students to explain procedures, justify conclusions and interpret results. Asking students to explain how they solved a problem rather than simply writing the final answer can strengthen both mathematical reasoning and language skills.

Language education can therefore support mathematics through reading comprehension, vocabulary, sequencing and explanation. Mathematics, in turn, encourages precision, logical organisation and evidence-based communication.

This relationship is especially important in multilingual classrooms, where students may understand a mathematical concept but experience difficulty expressing or interpreting it in the language of instruction.

11. Relationship Between Mathematics and Art

Mathematics and art share several important concepts, including symmetry, proportion, geometric forms, patterns, transformations and tessellations. Traditional designs, rangoli, architecture and decorative patterns can provide culturally meaningful contexts for mathematical learning.

Students can analyse a design and identify lines of symmetry, rotational symmetry, geometric shapes and repeating patterns. They can subsequently create their own designs using specified mathematical conditions.

Perspective drawing can also provide an opportunity to explore geometric relationships, scale and angles. Such activities demonstrate that mathematical structure can contribute to creativity and aesthetic expression.

The connection between mathematics and art is therefore not simply about finding shapes in artwork. It can help students understand how mathematical relationships influence design, balance, repetition and visual organisation.

12. Relationship Between Mathematics and Music

Music provides another interesting context for mathematical learning. Rhythm is based on patterns, repetition and the division of time. Fractions and ratios can be used to represent rhythmic structures, while sequences can be identified in repeated musical patterns.

Teachers can design activities in which students represent rhythmic patterns mathematically. Such activities can help students understand fractions and patterns through an experience that is different from conventional textbook exercises.

The purpose should not be to reduce music to mathematics. Rather, the objective is to help learners recognise that both disciplines involve structure, repetition, relationships and patterns.

13. Relationship Between Mathematics and Physical Education

Physical education provides authentic opportunities for measurement and statistics. Students can collect suitable data such as activity duration, running time, jumping distance or other

performance measurements and analyse the resulting information.

Students can calculate averages, compare measurements, construct graphs and examine changes over time. Such activities connect mathematical concepts with physical experience.

For example, students may record the time required to complete a fixed-distance activity and then calculate mean time and percentage change. The mathematics becomes meaningful because the data have been generated through an actual activity. The educational emphasis should remain on measurement, data interpretation and learning rather than unnecessary comparison of students.

14. Relationship Between Mathematics and Environmental Education

Environmental education provides highly relevant contexts for mathematical learning. Water consumption, electricity use, rainfall, waste generation, recycling and tree counts can all be represented quantitatively.

Students can conduct a simple school water-use study, organise the observations in tables, calculate totals and percentages and construct graphs. They can then discuss how a specified reduction in consumption might affect overall usage.

Similarly, a school waste audit can involve counting different categories of waste, calculating percentages and representing the results graphically.

Such activities connect mathematics with environmental awareness and demonstrate how quantitative evidence can support responsible decision-making.

15. Relationship Between Mathematics and Agriculture

Agriculture provides another meaningful context for mathematics, particularly in regions where farming is an important part of community life. Measurement, area, ratio, proportion, estimation, statistics and financial calculations are used in agricultural activities.

Students can calculate the area of a field, estimate seed requirements, compare crop yields or analyse rainfall data. They can also examine hypothetical production costs and income.

For example, if a particular quantity of seed is required per unit area, students can use ratio and proportion to determine the requirement for a larger field. Such a problem connects mathematical reasoning with agricultural practice.

This type of learning can make mathematics locally relevant and can help students recognise its application beyond conventional occupations.

16. Mathematical Modelling as a Bridge Between Disciplines

Mathematical modelling provides one of the strongest approaches for connecting mathematics with other disciplines. A modelling process generally begins with a real situation, identifies relevant variables, makes assumptions, develops a mathematical representation, obtains results and interprets those results in the original context.

For example, students may investigate how much water a school could save by reducing unnecessary consumption. They would

need to identify quantities, collect or estimate data, perform calculations, construct representations and interpret the results.

The problem is environmental in context but mathematical in its analysis. Such tasks provide opportunities for learners to experience mathematics as a means of understanding real situations.

Research on interdisciplinary mathematics education has identified modelling and real-world problem solving as important areas in which mathematical learning can interact meaningfully with other disciplines.

17. Benefits of Interdisciplinary Mathematics Education

One of the major benefits of interdisciplinary mathematics education is increased relevance. Students are more likely to appreciate mathematical ideas when they can see how those ideas function in familiar situations and other subjects.

Interdisciplinary activities can also strengthen problem-solving ability. Real-world problems often do not provide a clearly prescribed method. Students must decide which information is relevant, select an appropriate mathematical strategy and evaluate whether their answer is reasonable.

Critical thinking can similarly be developed because students have to interpret evidence, examine assumptions and explain conclusions. Instead of simply obtaining a numerical answer, learners must consider what the answer means.

Mathematical communication can also improve. Students may need to explain a mathematical finding to a science, social science or environmental audience. This encourages them to communicate mathematical reasoning clearly.

Another important benefit is transfer of learning. Students begin to recognise that a concept learned in mathematics can be useful in another context. Ratio, percentage, statistics, geometry and measurement become transferable forms of knowledge rather than isolated textbook topics.

Interdisciplinary education can therefore contribute to a broader understanding of mathematics and its role in human life.

18. Challenges in Interdisciplinary Mathematics Education

Despite its potential, interdisciplinary mathematics education involves several challenges. The organisation of school timetables and subject-specific curriculum structures can make collaboration among teachers difficult. Teachers often work within established subject boundaries and may have limited opportunities for joint planning.

Teacher preparedness is another important issue. Interdisciplinary teaching requires teachers to understand not only their own subject but also the contexts in which mathematical ideas interact with other disciplines. Research in interdisciplinary mathematics education has emphasised the importance of teacher preparation and appropriate teaching resources.

There is also a danger that mathematics becomes secondary within an interdisciplinary project. If students merely perform calculations without understanding the underlying mathematical concepts, the activity may not provide meaningful mathematics learning. Conversely, if the mathematics is too dominant, the

activity may fail to establish a genuine connection with the other discipline.

Assessment is another challenge. Traditional examinations generally evaluate subjects separately, whereas interdisciplinary activities may involve several competencies simultaneously.

Time, resources and coordination can also create practical difficulties. Teachers may need additional planning time, suitable data, digital tools or support from colleagues.

These challenges suggest that interdisciplinary mathematics requires systematic planning rather than occasional addition of unrelated activities.

19. Suggestions for Effective Implementation

Effective interdisciplinary mathematics should begin with genuine connections rather than artificial combinations. Teachers should identify situations in which mathematical reasoning actually contributes to understanding a problem in another subject.

Project-based learning can provide an effective structure. Themes such as water conservation, population, environment, transport, agriculture, sports, household budgeting and local geography can support meaningful interdisciplinary investigations.

Collaboration among teachers can further strengthen such activities. A mathematics teacher can identify the mathematical learning objectives while a science, social science, language or computer teacher contributes disciplinary context.

Local data should be used wherever possible. School electricity consumption, rainfall records, local market prices, transport distances, agricultural information and household expenditure can provide authentic learning situations.

Technology can also support interdisciplinary mathematics. Spreadsheets, graphing applications, dynamic geometry software and simple programming tools allow students to explore data and mathematical relationships efficiently.

Teacher education institutions should prepare prospective teachers to design interdisciplinary lessons. Student-teachers can be asked to develop lesson plans connecting mathematics with science, social science, language, arts, environmental education and technology.

Most importantly, students should be encouraged to explain their mathematical reasoning. Questions such as “Which mathematical idea did you use?”, “Why was it appropriate?” and “What does the result mean in this context?” can make interdisciplinary learning intellectually richer.

20. Educational Implications

The interdisciplinary perspective has implications for curriculum design, teacher education, teaching-learning materials and assessment. Curriculum planners should identify meaningful relationships among subjects rather than treating curricular areas as completely isolated domains.

Textbooks can include interdisciplinary projects, data-based investigations and real-life mathematical situations. Such activities can help students connect abstract concepts with authentic contexts.

Assessment systems should also provide opportunities for students to demonstrate reasoning, interpretation, modelling and application. Although subject-specific assessment remains important, selected interdisciplinary tasks can provide evidence of students’ ability to transfer knowledge.

Teacher professional development should include opportunities for collaborative planning. Mathematics teachers and teachers of other subjects can jointly examine curriculum content and identify natural areas of overlap.

The policy direction in India is supportive of this approach. NEP 2020 calls for holistic and multidisciplinary education, flexible curricular structures and opportunities for cross-disciplinary and interdisciplinary thinking. The National Curriculum Framework for School Education 2023 further reflects the ongoing development of the contemporary school curriculum framework in India.

For teacher education institutions, interdisciplinary mathematics can become an important part of lesson planning, practicum and reflective teaching. Prospective teachers should learn not only how to teach mathematical procedures but also how to identify situations in which mathematical thinking can illuminate questions from other disciplines.

21. CONCLUSION

Mathematics is much more than a collection of numbers, formulas and computational procedures. It is a powerful way of representing quantity, identifying patterns, describing relationships, analysing change and reasoning from evidence. These characteristics naturally connect mathematics with almost every area of school knowledge.

The relationship between mathematics and science can be seen in measurement, equations and data analysis; its relationship with social science appears through statistics and quantitative interpretation; geography uses scale, coordinates and measurement; economics depends on percentages, graphs and financial calculations; computer science draws on logic, algorithms and mathematical structures; art and music reveal patterns, symmetry and proportion; physical education provides opportunities for measurement and statistics; while environmental education and agriculture provide authentic contexts for quantitative reasoning.

However, meaningful interdisciplinary mathematics does not mean using mathematics merely as a service tool for other subjects. Mathematics must retain its conceptual depth and disciplinary identity. The goal is to create learning situations in which mathematical ideas genuinely contribute to understanding another discipline while the contextual discipline gives mathematical learning greater meaning.

Interdisciplinary mathematics can make learning more relevant and can strengthen problem-solving, critical thinking, communication and transfer of knowledge. It can help learners move beyond the perception that mathematics consists only of textbook exercises and examination procedures. When students use mathematics to understand rainfall, maps, economic information, scientific observations, environmental problems,

artistic patterns or agricultural situations, they begin to recognise its wider significance.

For teachers, the central challenge is therefore not to add mathematics artificially to every school activity but to identify authentic situations in which mathematical reasoning can make an important contribution. Such an approach requires thoughtful curriculum planning, teacher collaboration, suitable learning resources and assessment practices that value reasoning and application.

In conclusion, mathematics can be understood as a connecting discipline that links quantitative reasoning with diverse forms of human knowledge. Strengthening these connections can contribute to meaningful, contextual, competency-based and holistic education. The future of mathematics education should therefore move beyond asking students only to solve mathematical exercises and provide opportunities for them to use mathematical thinking to understand the world. In this broader perspective, mathematics is not merely one subject among many; it is one of the important intellectual tools through which learners can make sense of relationships, patterns, quantities and change across disciplines.

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