Relating Difficulty in School Mathematics to Nature of Mathematics: Perception of High School Students from Kerala

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Abstract

This study relates factors in nature of Mathematics and its teaching learning to student difficulties for diverse mathematics tasks. Descriptive survey was done on a sample of 300 high school students in Kerala with a questionnaire on difficulties in learning. Student perception of difficulty on 26 types of tasks, under five heads that students may face in solving problems in school mathematics were obtained. These were subsequently abridged through factor reduction into nine categories of tasks in school mathematics. Parallel to this, ratings on 13 reasons related to nature of school mathematics that students perceive as making mathematics difficult for them were also obtained. In factor reduction, these reasons merge into two broad sources of difficulty. 1. Nature of school mathematics content, 2. Nature of Mathematics Teaching–learning. Nature of school mathematics with less control for teaching learning correlated more with relatively less difficult tasks. Findings imply that tasks in school mathematics where in students perceive higher difficulty can be remedied through adaptation in teaching learning to a considerable extent. Proper guidance on methods of learning Mathematics and metacognitive and self-regulatory strategies are recommended. Practice may be given in understanding questions, key words and analysing word problems. Mathematical content should be prepared and presented in tune with the daily life of the child. Mathematical vocabulary of students needs to be strengthened by helping with symbols, notations and mathematical terms. Frequent cumulative revision may help in meeting challenges from cumulative nature of the subject.

Key words: Nature of Mathematics, Difficulties in learning, Problem solving, symbols and notations, Mathematical Tasks.

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Introduction

"Mathematics provides a powerful universal language and intellectual toolkit for abstraction, generalization and synthesis... Mathematical training disciplines the mind, develops logical and critical reasoning, and develops analytical and problem-solving skills to a high degree." (Smith, 2004). Even though Mathematics is considered as an important subject by everyone most of the students feel difficulty in learning Mathematics. World over, for schoolchildren as well as adults, mathematics is a dreaded subject. Attempts are made to improve the situation through better curriculum, school facilities and practices, classroom strategies, assessment procedures and the like. National curriculum framework (2005) has suggested making mathematics learning enjoyable with deeper insight of basics and the ability to understand abstractions, structuralisation and generalization through arithmetic, algebra and trigonometry. In our attempt to improve Mathematics education, especially in schools, many areas of concerns were investigated. Much of the researches covered learners' cognitive, affective and psychological factors. The teaching learning methods, modern technologies of teaching, relating mathematics to daily life were also well attempted in the effort to improve mathematics learning.

There are plenty of reasons for difficulty in Mathematics, which may vary from curriculum to curriculum and topic to topic. Kerala Curriculum framework (2007) observes different reasons for difficulty in mathematics. They relates to Imbibing basic tenets and unpalatable theories of Mathematics, difficulties with methods of forming ideas of Mathematics, the repetitive nature of exercises in order to gain proficiency in mathematical calculations, mismatch between mathematics in daily life and school mathematics, Sudden introduction of many of the Mathematical figures and signs and the importance given to the established methods of calculation (KCF, 2007).

Mathematics has number of skills to be learned. Students may feel difficulty in these skills also. Tambychik and Meerah (2010) conducted a study on difficulties in mathematical skills and found lack of information Skills such as making connections, manipulating information, stating mathematical sentence and determining formula to be used. Manipulating information and stating mathematical sentence were found to influence the difficulties in problem solving. All groups seem to be lacked in shape orientation and building a connection between problem and diagram. Primary school students lacked in understanding the terms and secondary students lacked in understanding mathematical

language, which causes obstacles in understanding the objective of the problem and affected the ability to solve the problem. Tambychik and Meerah (2010) reports mathematical task difficulties listed by Garnett (1998) and Nathan et al. (2002) that included incomplete mastery of number facts, weakness in computational skill, inability to connect conceptual aspects of math, inefficiency to transfer knowledge, difficulty to make meaningful connection among information, incompetency to transform information mathematically, incomplete mastery of mathematical terms, incomplete understanding of mathematical language and difficulty in comprehending and visualising mathematical concepts .

Another factor considered causing special concern is the factors peculiar to mathematics. The basic nature of mathematics including its language and the skills involved makes it difficult for students to learn. The nature of mathematics like abstractness, accuracy, brevity, symbols and notations and cumulativeness are dealt as part of mathematics teacher education as potential factors causing difficulty in teaching learning it. However, empirical studies of how student perceive these attributes of mathematics causing difficulties in learning it are not adequately investigated. Different attributes of nature of mathematics may have different impact on these varying tasks. How much the various nature of mathematics contributes to student difficulties in fundamental tasks in school mathematics is not adequately understood. It is in this context this study attempts to find out which elements of nature of Mathematics contributes to what types of task difficulties in Mathematics.

Objectives

1. To categorize and order student perceived difficulties in various tasks in school Mathematics.
2. To categorize and order the reasons for difficulty in learning Mathematics sourcing from nature of Mathematics.
3. To find out which elements of nature of Mathematics contributes to what types of task difficulties in Mathematics.

Method adopted

Descriptive Survey procedure with statistical analyses including Mean, Percentage, Pearson's r and factor analyses are employed.

Research instrument

Questionnaire on student's difficulties in learning Mathematics containing two major parts is administered. The first part of the tool comprise of 13 reasons related to nature of Mathematics that makes the subject difficult to learn. The reasons included are Uselessness in daily life, Rote learning, Prevalence of symbols and notations, Need to learn unfamiliar terms, Understanding questions, Need for external support, Toughness of concepts, Number of concepts, Repeated Practice, Prominence of

Problem solving, Need for strenuous attention, Need for unfaltering Regularity in attending classes and Need for Precision in understanding. Participants have to rate their feeling of difficulty in learning Mathematics for each of these reasons. Second part of the questionnaire was in the form of checklist of 26 tasks, under 5 heads viz. Number concept, Mathematical symbols and notations, Mathematical operations, Mathematical abstractions and Problem solving.

Participants

Participants were 300, high school students randomly selected from government and aided schools of Kerala with equal weightage to gender of the student and locality of the school.

Results and Discussion

Difficulties in various tasks of school Mathematics were categorised and ordered. These reasons were abridged into 9 categories through factor analysis. Perceived difficulty in learning Mathematics arising from 13 reasons falling into two categories namely nature of mathematics content and nature of Mathematics Teaching learning were identified through percentage analyses. Then correlational analyses was done to find out which element of nature of Mathematics contributes to what types of task difficulties in Mathematics. Results are discussed under 3 major headings namely Difficulty in various tasks of school mathematics, Reasons for difficulty in Mathematics sourcing from nature of Mathematics and Factors in nature of Mathematics contributing to Mathematics task difficulty.

Difficulty in various tasks of school mathematics

Difficulty in 26 tasks, that students usually have to learn and apply in school Mathematics, covering 5 major areas namely Number concept, Mathematical symbols and notations, Mathematical operations, Mathematical abstractions and Problem solving were analysed.

I. Number concept

Number concept comprised four types of tasks namely Understanding large Numbers, Understanding Place value, using decimals and using fractions. Factorability of these 4 tasks were examined. Principal component analysis revealed two factors. The Eigen values showed that the first factor number systems explained 32.29% of variance, the second factor comprehending numbers explained 30.21 % variance. The 2-factor solution explained 62.51% total variance. Factor loading of each task on the respective factors are given in Parentheses. Tasks related to the factor number systems

are using fractions (0.79) and using decimals (0.76). Tasks related to the factor comprehending numbers are understanding large numbers (0.75) and understanding Place value (0.72).

Percentage of students Perceiving difficulty in tasks related to *number concept* by factors involved is given in Table 1.

Table 1

Percentage of students perceiving Difficulty in tasks related to Number concept by factors involved

Factor	Task	Percentage
Number systems	Using Decimals	64.33
	Using Fractions	56.33
Comprehending numbers	Understanding large numbers	24.00
	Understanding Place value	24.33

Note. N= 300

In number systems, using decimals (64.33%) and fractions (56.33%) are felt difficult for majority of students. Only a small proportion of students feel difficulty in tasks related to comprehending numbers, namely understanding large numbers (24 %) and place value (24.33%).

II. Mathematical Symbols & notations

Mathematical symbols and notations incorporated four types of tasks namely Understanding algebraic problems, Analysing geometrical figures, Understanding symbols and notations, and Drawing geometrical figures. Factorability of these 4 tasks related to Mathematical symbols and notations were examined. Principal component analysis revealed a single factor. Percentage of students perceiving difficulty in Mathematical symbols and notations is given in Table 2.

Table 2

Percentage of students perceiving Difficulty in Mathematical symbols & notations

Factor	Task	Percentage
Mathematical Symbols & notations	Understanding algebraic problems	56.33
	Analysing geometrical figures	44.67
	Understanding symbols and notations	33.00
	Drawing geometrical figures	22.33

Note. N= 300

In tasks related to Mathematical symbols and notations, understanding algebraic problems (56.33 %) is felt difficult for majority of students. More than 1/3rd of the students feel difficulty in analysing geometrical figures (44.67 %) and in understanding symbols and notations (33 %). Only a small proportion of students feel difficulty in drawing geometrical figures (22.33 %).

III. Mathematical operations

Mathematical operations involved six types of tasks namely concentrating for long time to solve problems, doing calculations with speed, remembering numbers while doing operations, following rules while doing calculations, Basic arithmetic operations and mental arithmetic. Factorability of these 6 tasks related to Mathematical operations were examined. Principal component analysis revealed two factors. The Eigen values showed that the first factor, Arithmetic operations explained 29.16 % variance and the second factor, Problem-solving competence explained 20.53% of variance. The 2-factor solution explained 49.68% total variance. Factor loading of each task on the respective factors are given in Parentheses. Tasks related to Problem solving competence are doing calculations with speed (0.82) and Concentrating for long time to solve problems (0.73) and tasks related to Arithmetic operations are mental arithmetic (0.73), following rules while doing calculations (0.71), Remembering numbers while doing operations (0.59) and Basic arithmetic operations (0.58).

Percentage of students Perceiving difficulty in tasks related to Mathematical operations by factors involved is given in Table 3.

Table 3

Percentage of students perceiving Difficulty in tasks related to Mathematical operations by factors involved

Factor	Task	Percentage
Problem solving competence	Concentrating for long time to solve problems	61.00
	Doing calculations with speed	60.33
Arithmetic operations	Remembering numbers while doing operations	35.33
	Following rules while doing calculations	31.33
	Doing basic arithmetic operations	22.33
	Doing Mental arithmetic	22.33

Note. N= 300

In mathematical operations, tasks related to Problem solving competence is felt difficult for majority of students compared to tasks in arithmetic operations. Majority of students feel difficulty in concentrating for a long time to solve problems (61 %) and doing calculations with speed (60.33 %). More than 1/3rd of the students feel difficulty in remembering numbers while doing operations (35.33) and following rules while doing calculations (31.33%). Relatively small proportion of students feel difficulty in tasks namely doing basic arithmetic operations (22.33 %) and doing mental arithmetic (22.33 %).

IV. Mathematical abstractions

Mathematical abstractions comprised two types of tasks namely Comprehending Process unrelated to daily life and Comprehending concept unrelated to daily life. Factorability of these 2 tasks related to Mathematical abstractions were examined. Principal component analysis revealed a single factor. Percentage of students perceiving difficulty in tasks related to Mathematical abstractions is given in Table 4.

Table 4

Percentage of students perceiving Difficulty in tasks related to Mathematical abstractions

Factor	Task	Percentage
Mathematical abstractions	Comprehending Process unrelated to daily life	41.00
	Comprehending Concepts unrelated to daily life	40.67

Note. N= 300

In tasks related to Mathematical abstractions, both comprehension of processes (41 %) and concepts (40.67 %) unrelated to daily life are felt difficult for more than 1/3rd of the students.

V. Problem solving

Problem solving comprised ten types of tasks viz. Identifying key words, Identifying Mathematics problem in word problems, Identifying irrelevant information in word problems, Understanding word problem without external help, Selecting Mathematical operations, doing mathematical operations in order, Identifying equations, Analysing lengthy word problems, Translating word problem to mathematical sentence and Translating mathematical answer to word form. Factorability of these 10 tasks related to problem solving were examined. Principal component analysis revealed 3 factors. The Eigen values showed that the first factor understanding word problems explained 21.51% of variance, the second factor equations and operations explained 14.88 % variance and the third factor translation

of word problems explained 14.61 % of variance. The 3-factor solution explained 51% total variance. Factor loading of each task on the respective factors are given in Parentheses. Tasks related to the factor Understanding word problems are identifying irrelevant information in word problems (0.72), Understanding word problem without external help (0.64), Identifying key words (0.51) and Identifying maths problem in word problems (0.51). Tasks related to the factor equations and operations are analysing lengthy word problems (0.73), identifying equations (0.71), Selecting Mathematical operations (0.38) and doing mathematical operations in order (0.37). Tasks related to the factor Translation of word problems are translating word problem into mathematical sentence (0.82) and translating mathematical answer to word form (0.77).

Percentage of students Perceiving difficulty in tasks related to problem solving by factors involved is given in table 5.

Table 5

Percentage of students perceiving Difficulty in tasks related to Problem solving by factors involved

Factor	Task	Percentage
Understanding word problems	Identifying irrelevant information in word problems	48.67
	Identifying key words	47.33
	Identifying maths problem in word problems	46.00
	Understanding word problem without external help	41.00
Equations and operations	Identifying equations	51.67
	Analysing lengthy word problems	46.00
	Doing mathematical operations in sequence	36.33
	Selecting Mathematical operations	26.33
Translation of word problems	Translating mathematical answer to word form	43.00
	Translating word problem into mathematical sentence	38.00

Note. N= 300

Tasks related to understanding word problems such as Identifying irrelevant information in word problems (48.67 %), Identifying key words (47.33 %), Identifying maths problem in word problems (46 %) and Understanding word problem without external help (41%) are felt difficult for

more than 1/3rd of students. Selecting mathematical operations is felt difficult for relatively small proportion of students (26.33 %). Identifying equation for a given problem (51.67 %) is felt difficult for majority of students. Around 40% of Students feel difficulty in Translating mathematical answer to word form (43 %) and Translating word problem into mathematical form (38 %).

Structure of Difficulty in various tasks of school mathematics

Nine areas of mathematical tasks that are felt difficult for students, revealed by factor analysis is summarized in Figure 1. Majority of students feel difficulty in tasks involved in Problem solving competence (61%) and number system like decimals and fractions (60%). Tasks related to understanding word problems (46%), Mathematical abstractions (41%), translation of word problems (41%), equations and operations (40%), symbols and notations (39%) are felt difficult for more than 1/3rd of the students. Tasks related to Arithmetic operations (28%) and understanding numbers (24%) are felt difficult for about 1/4th of students.

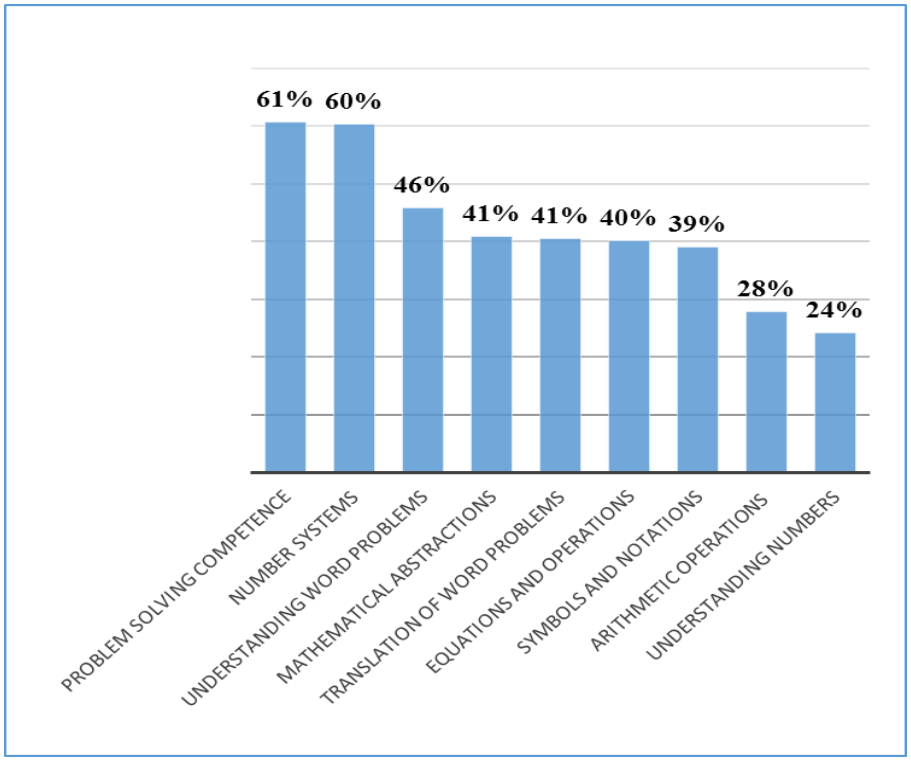

Figure 1. Percentage of students perceiving Difficulty in Mathematical tasks

Reasons for difficulty in Mathematics sourcing from nature of Mathematics

Reasons for difficulty in learning Mathematics sourcing from nature of Mathematics were listed. Students rated their feeling of difficulty due to each of these reasons as high difficulty, Average difficulty and no difficulty. Percentage of students perceiving difficulty in learning mathematics due to the reasons sourcing from Nature of Mathematics is given in Table 6.

Table 6

Percentage of students perceiving difficulty due to reasons sourcing from Nature of Mathematics

Reasons for difficulty	High Difficulty %	Average Difficulty %	No Difficulty %
Need for Regularity in Attending Classes	53	38	9
Need for Strenuous attention	52	34	15
Number of concepts	46	40	14
Problem Solving	46	46	9
Need for Repeated Practice	45	43	12
Toughness of concepts	45	42	13
Difficulty in understanding questions	43	41	16
Need for external support	40	49	11
Need to learn unfamiliar words	37	39	24
Need for rote learning	33	40	27
Prevalence of symbols and notations	31	46	22
Uselessness in daily life	22	39	39
Need for Precision in understanding	81	---	19

Note. N= 300

All the thirteen listed elements of nature of Mathematics cause difficulty in learning Mathematics. Above 60 % of students, rate all these reasons as causing high or average difficulty. For around 90 % of students, prominence of problem solving and need for regularity in attending classes is felt as the major reasons for difficulty in learning Mathematics. Need for external support, Need for Repeated Practice, Toughness of concepts, Number of concepts, Need for Strenuous attention, Difficulty in understanding questions and Need for Precision in understanding are felt as highly or averagely difficult for around 80 % of students. Prevalence of symbols and notations, Need to learn unfamiliar words, Need for rote learning and Uselessness in daily life are considered as elements creating high difficulty for comparatively small proportion of students. However, in these factors only one reason i.e. useless in daily life is considered as creating no difficulty by around 40 % of students. It is evident that Prominence of Problem Solving and Need for Regularity in Attending Classes are the major reasons for difficulty. Need for Strenuous attention, Number of concepts, Need for Repeated Practice, Toughness of concepts, Need for Precision in understanding, Difficulty in understanding questions and Need for external support are moderate reasons for difficulty. Need to learn unfamiliar

terms, Need for rote learning, Prevalence of symbols and notations and Uselessness in daily life are relatively minor reasons for difficulty.

Structure of Reasons for difficulty sourcing from nature of Mathematics

Factorability of 13 reasons for difficulty in learning Mathematics sourcing from nature of mathematics were examined. Principal component analysis revealed two factors. The Eigen values showed that the first factor Nature of Mathematics teaching learning explained 29.16 % variance and the second factor Nature of Mathematics content explained 23.45% of variance,. The 2-factor solution explained 52.61% total variance. Factor loading of each task on the respective factors are given in Parentheses. Elements related to nature of mathematics teaching learning are Need for Regularity in Attending Classes (0.77), Need for Repeated Practice (0.73), Need for rote learning (0.67), Need for external support (0.65) and Difficulty in understanding questions (0.47). Elements related to nature of mathematics content are Prevalence of symbols and notations (0.76), need to learn unfamiliar terms (0.74), Uselessness in Daily Life (0.65), Need for Precision in understanding (0.54), Number of concepts (0.51), Toughness of concepts (0.44), Need for strenuous attention (0.43) and Prominence of Problem Solving (0.39).

Difficulty in learning Mathematics sourcing from both Nature of mathematics teaching learning (Mean =2.28, SD= .69) and Nature of Mathematics content (Mean= 2.27, SD= .68) do not differ.

Factors in Nature of Mathematics contributing to Task difficulty in school Mathematics

Nature of Mathematics has significant positive correlation with all types of task difficulties in Mathematics. Correlation of Nature of mathematics and its factors with task difficulties in mathematics is given in Table 7.

Table 7

Correlation of Task difficulties in mathematics with Nature of mathematics and its factors

Factors of Task Difficulty in school Mathematics	Nature of Mathematics content	Nature of Mathematics Teaching-Learning	Nature of Mathematics (Total)
Equations and operations	0.41**	0.32**	0.39**
Symbols and notations	0.38**	0.28**	0.36**
Arithmetic operations	0.37**	0.23**	0.34**
Problem solving competence	0.26**	0.25**	0.28**
Understanding word problems	0.26**	0.21**	0.26**

Translation word problems	0.24**	0.20**	0.24**
Understanding numbers	0.24**	0.14*	0.21**
Number systems	0.21**	0.13*	0.18**
Mathematical abstractions	0.20**	0.11	0.17**
Total perceived difficulty	0.46**	0.34**	0.44**

Note. N= 300

* p < .05. **p<.01.

In 18 correlations obtained for difficulty in 9 mathematics tasks with Nature of Mathematics teaching learning and Nature of mathematics content, all are significant except one. Nature of mathematics content has higher correlation with relatively easier tasks. Tasks related to equations and operations have significant positive substantial correlation with nature of mathematics content (r =.41, p< 0.01) and low correlation with nature of mathematics teaching learning (r = 0.32, p <0.01). Tasks related to Symbols and notations, Arithmetic operations, problem-solving competence, Understanding word problems and Translation of word problems have significant positive low correlation with Nature of mathematics content (p<.01) and nature of mathematics teaching learning(p<.01). Tasks related to understanding numbers and number systems exhibits significant positive low correlation with nature of mathematics content (p<.01) and negligible correlation with nature of mathematics teaching learning (p<.01). Tasks related to using mathematical abstractions have significant positive low correlation with nature of mathematics content (r = .20, p<0.01) whereas it does not have significant correlation with nature of mathematics teaching learning (r = .11, p > 0.05).

Conclusion

Most of the Students feel difficulty with Problem solving competence and number systems

Most of the Students feel difficulty in 4 mathematical tasks related to 2 different factors. The factors are problem solving competence and number systems. The tasks related to problem solving competence namely concentrating for long time to solve complex problems and doing calculations with speed is creating difficulty for majority of students. Similarly, Using decimals and fractions, which are related to the factor number systems, are also found as difficult tasks for majority students.

While Identifying equations and understanding algebraic problems are difficult for majority of students, only more than 1/3rd students report difficulty with word problems, mathematical abstractions, choosing equations and operations and, symbols and notations

Around 40% of the students feel difficulty in tasks related to factors namely understanding word problems, mathematical abstractions, translation of word problems, equations and operations

and, symbols and notations except identifying equations and understanding algebraic problems. Furthermore less proportion of students feel difficulty in tasks related to the factors arithmetic operations and understanding numbers.

Identifying equations, which is related to the factor equations and operations, and understanding problems involving variables, which is related to the factor symbols & notations, are found difficult for majority of students.

Nature of mathematics, Prominence of Problem Solving and Need for Regularity in Attending Classes in special are major reasons for difficulty in learning Mathematics

All the 13 elements related to Nature of mathematics creates difficulty in learning Mathematics. Prominence of Problem Solving and Need for Regularity in Attending Classes are the major reasons for difficulty. Need for Strenuous attention, Number of concepts, Need for Repeated Practice, Toughness of concepts, Need for Precision in understanding, Understanding questions and Need for external support are the factors related to nature of mathematics that makes moderate difficulty. Need to learn unfamiliar terms, Need for rote learning, Prevalence of symbols and notations and Uselessness in daily life are the factors making difficulty in learning Mathematics for less proportion of students. Both the factors related to nature of Mathematics i.e. nature of mathematics content and nature of mathematics teaching learning contributes to difficulty in learning Mathematics

Factors related to Nature of Mathematics significantly contributes to difficulty in Mathematical tasks

Correlational analysis revealed that all the identified difficulties in Mathematics tasks are correlated with nature of Mathematics. Most difficult task i.e. problem solving competence is correlated with both the factors of nature of Mathematics. Tasks related to the factor equations and operations, which is relatively less difficult task has substantial correlation with Nature of mathematics content .Difficulty in tasks related to Mathematical abstractions is correlated only with nature of mathematics content. All of the identified task difficulties except difficulty in mathematical abstractions are correlated with factors in Nature of Mathematics teaching learning.

Implications

Findings imply that tasks in school mathematics where in students perceive higher difficulty can be remedied through adaptation in teaching learning to a considerable extent. Teachers may use variety of approaches to teach most difficult areas like decimals and fractions. Long-time concentration is needed to solve multi-step problems. Students should be taught to analyse lengthy problems and practice should be given to identify components of the problem. Verifying the answers is to be made

regular part of problem solving which will help to correct mistakes if any. Tasks involved in comprehending mathematical problems are felt difficult for majority of students. Practice may be given in analysing problems and identifying key words.

Language of mathematics should be given importance. To novice learners Mathematical problems, processes and its results are expressed in a language alien for them. Teachers have to find time to teach the special language of mathematics to the students. Language used to communicate mathematics is something special and students should be trained to use it effortlessly. Mathematical vocabulary of students needs to be strengthened by helping with symbols, notations and mathematical terms.

Mathematical content should be prepared and presented in tune with the daily life of the child. Making students aware of the utilitarian value of Mathematics should be a part of everyday mathematics teaching. Give plenty of examples related to daily life of the student to make them aware of the utilitarian value of Mathematics.

Proper guidance on methods of learning Mathematics and metacognitive and self-regulatory strategies are recommended to reduce difficulty in mathematical tasks. Peer interactions and parental involvement can be promoted to reduce the difficulties arising out of help needed to learn mathematics. Unlike other subjects, in Mathematics, it is very difficult to follow the content if we miss one class. Cumulative nature of Mathematics makes it obligatory to learn progressively from simple arithmetic to higher order problem solving. Frequent cumulative revision may help in meeting challenges from cumulative nature of the subject. Teachers have to avoid training mere mechanical calculations in the classroom and rote memorization of rules. This can be achieved by sensitizing students on the logic behind every step followed in mathematical problem solving. Relevant concrete experience should be given to students wherever it is possible. Effective use of mathematical laboratory is a good approach to give concrete experience to students.

Teaching learning strategies are much significant in correcting the major sources of difficulty arising from nature of mathematics. Teachers needs to be conscious of the difficulties of students in mathematical tasks sourcing from nature of mathematics. Teachers should consider the special nature of Mathematics while teaching. student difficulties in Mathematics needs to be dealt also through course designing, use of appropriate language in text books, inclusion of socially and culturally relevant content, relating mathematics to other subjects in school and in through reforms in assessment practices.

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