Learner and Teacher perception on Difficulties in Learning and Teaching Mathematics: Some Implications

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K. Abdul Gafoor & Abidha Kurukkan

Abstract

Mathematics holds a relevant and unique place in the school curriculum as it is important for a better living of the individual. But, it is known that most of the students are considering mathematics as difficult. This study examines the difficulties perceived by high school students and teachers in learning and teaching mathematics. Two hundred 9thstandard students and fourteen mathematics teachers participated in the survey. The questionnaires on perception of students and teachers, comprises closed as well as open ended items. The study incorporated cognitive, affective and environmental reasons that contribute to the difficulty in learning mathematics. The factors that make mathematics difficult for students to learn included difficulty in remembering the content learned in the previous classes, rapid forgetting of the learned material and the difficulty in understanding mathematics concepts. Further analysis revealed that students who feel mathematics highly difficult tends to believe that they lacks in learning strategies. Such students have lack of self efficacy and feel more difficulty in understanding mathematics. Students who feel Mathematics as highly difficult tends to forget it faster. Conversely students who feel mathematics as fairly easy reports their teachers teaching them well and understanding the concepts quickly. It was noted that the students who feel Mathematics as highly difficult tends to leave the task with little effort than those who feel the subject easy. According to teachers, students' lack of effort and prerequisites are the major reasons for mathematics being a difficult subject for students. Reluctance to seek help from others, inattention in the classroom and students' lack of motivation were also perceived to contribute toward difficulty in learning mathematics. Teachers reported also that, lack of relevant prerequisites, difficulty in speedy grasping of the concepts and more number of students in a classroom are causing difficulty in teaching mathematics. The findings indicate the need for teachers to realize the importance of making school mathematics interesting for students to take effort in learning it. The result is discussed in relation to students' beliefs and study strategies.

Key words: Mathematics Learning, Teaching, Self-Efficacy, Learning Strategy, Mathematics Difficulty, Learner Beliefs, Teacher Beliefs.

1. Introduction

Mathematics emerged as a subject of study along with civilisation. In the present scenario mathematics is absolutely necessary subject for living. This importance is evident in school curriculum and in the importance given to mathematics education.

Learning of mathematics results in both cognitive as well as affective outcomes. To learn anything both experience and practice are necessary. There are several types of learning like motor learning, verbal learning, concept learning, discrimination learning and problem solving. Most of the learning in mathematics belongs to the categories of concept learning, principle learning or problem solving. As these types of learning are higher order learning processes cognitive activity and effort from the part of learner is essential. Role of effort in the process of learning is pointed in the initial theories of learning itself. When we consider the cognitive part of mathematics learning, it goes through a higher cognitive processing because Mathematics learning requires higher cognitive processes especially because of interrelated and abstract nature of mathematics content and processes.

Factors affecting Mathematics Learning

Learning in particular mathematics learning is complex type of performance in human cognition. It is affected by many factors like short term memory, long term memory, ability to memorize mathematical facts, visual and spatial perceptual abilities (Chinn, 2004). The degree of influence of these factors may be relative.Previous researches identified many reasons for students' difficulties in learning mathematics. There are cognitive, affective and environmental factors contributing to differences in students' learning of mathematics.

Educational psychologists had studied the relation of mathematics learning with certain cognitive factors. Mathematics is found affected by intelligence, working memory and processing speed (Geary, 2011). Murayama, Pekrun, Lichtenfeld and vom Hofe (2013) found that intelligence is strongly related to achievement in starting stage but motivation and use of cognitive strategies predicted the growth of achievement. In determining a student's achievement, their attitude is rather important than inability to study (Mwamwenda, 1995). Students like and dislike towards

mathematics as well as their belief about efficacy are influencing their learning (Zan and Martino, 2008) as well.

Factors external to the learner also are known to influence learning mathematics. Mbugua, Kibet, Muthaa and Nkonke (2012) reported the findings of Chepchieng (1995) that achievement of secondary school students is strongly related to the availability of quality textbooks. And they found under staffing, inadequate teaching or learning material, lackof motivation and poor attitudes by both teachers and students are some major factors contributing to poor performance in mathematics education. Parental involvement and help from other family members has shown significant improvement in students' achievement (Desarrollo, 2007).

Significance of present study

A subject like mathematics, having a cumulative nature, can't be taught without relevant prior knowledge. It differs from other school subjects for many reasons like its abstract nature, demand of higher cognitive process and engagement and perseverance from learner. It is found that as the students move to higher grades, due to reasons including their lack of previous knowledge they are getting worse in mathematics.

Difficulty in learning mathematics is found as a common and significant problem throughout the school years. As per Annual Status of Education Report (ASER, 2014), 50% of standard fifth students not achieved even the standards of grade two and 44% of eighth standard students not achieved even basic skills in the arithmetic. Also they reported a worrying pan Indian trend that students' arithmetic skill has been dropping since 2010. In 2010, percentage of eighth standard students who could do division of three digits by one digit was 68.3%, but in 2014 it fell down to 44.1%. That is close to half of population still not have basic skills; and even it is falling. From this point the authors felt a necessity to study the causes that make mathematics learning difficult for students. For taking further action to improve students' mathematics learning, it is necessary to analyze the causes. This study is analyzing students' affective beliefs and teachers' perception regarding students' difficulties in mathematics instead of analyzing the content mastery of relevant prior knowledge. Teachers were probed through semi structured interview about possible reasons for students' difficulties in learning mathematics and then teacher cited reasons were used to probe into student perceptions.

Objective

This study is to examine the difficulties perceived by high school students and teachers in learning and teaching mathematics.This study considers difficulties related to cognitive processes, affective beliefs, teacher and instruction and some issues related to management of learning environment.

Methodology

1.1.Participants

The sample comprises of two hundred ninth standard students (101 boys and 99 girls) and fourteen teachers (6 females and 8 males) with experience ranging from one to thirty years, from Malappuram and Kozhikode districts in Kerala.

1.2.Instrument

Students' data is collected with the help of difficulties in learning mathematics questionnaire. The tool includes both closed and open ended items. The teachers' data is collected with the help of difficulties in teaching and learning mathematics: teacher perception questionnaire. This questionnaire has mainly three sections; one is regarding teachers' perception on the reasons that make difficulties for students in learning math, which includes reasons related to cognitive, affective and control of learning environment, second part is about difficulties faced in teaching mathematics, and the last part is about their teaching style and strategy use.

1.3.Procedure

Prior to data collection, good rapports was created with students and were ensured of their anonymity. Each question were explained by the researcher and allowed time to respond. Approximately fifty minutes were allowed to students for completing the questionnaire.

1.4.Data Analysis

Qualitative as well as quantitative methods were used for data analysis. Percentage analysis and χ^2test of independence and mapping of the relations between students' and teachers' perceptions of difficulties in learning mathematics and their interrelationships were used to draw findings.

Results

Teacher perceptions regarding the difficulties of students' in learning mathematics

Among the given thirty two possible reasons, related to cognitive, affective and management of learning environment, teachers perceived lack of sufficient effort and previous knowledge as the prime reasons that make students mathematics learning difficult. Fourteen perceived reasons for mathematics being difficult for students, in their order of mean scale value, are stated in the Table1.

Table 1

Perceived reasons by teachers for mathematics being difficult for students

Reasons for students' difficulties in learning mathematics	Mean value of agreement on 3-point scale
Lack sufficient effort by students	2.71 (0.9)
Lack of previous knowledge	2.64 (0.88)
Reluctance to seek help from teacher or others	2.50 (0.83)
Lack of attention in classroom	2.50 (0.83)
Disinterest of students towards mathematics	2.43 (0.81)
Difficulty in understanding questions	2.43 (0.81)
Lack of time management	2.36 (0.79)
Lack of drill work	2.36 (0.79)
Difficulty in following class	2.36 (0.79)
Inability in connecting different topics	2.36 (0.79)
Grasping concepts slowly	2.36 (0.79)
Difficulty in analysing mathematical principles	2.36 (0.79)
Lack of self efficacy	2.29 (0.76)
Difficulty in changing questions to mathematical forms	2.29 (0.76)

Students possess less control over their learning

Teachers perceive that students are not taking sufficient effort, not seeking help from others and they are unable to manage their time for learning. These external factors are found relevant equally as difficulty making factors related to cognitive variables.

Students' lack of relevant prerequisites, difficulty in speedy grasping of the concepts and more number of students in class are making difficulty for teaching mathematics.

Difficulties felt by students in learning mathematics

Among the given causes, students selected mostly the forgetting of materials learned in previous classes (62.1%) as the reasons for being mathematics difficult to learn irrespective of students' beliefs about the difficulty of subject. But other causes like the rapid forgetting (51%) and not knowing how to learn maths (26.8%), low ability to learn maths (26.8%), toughness of the subject (25.8%) and difficulty in understanding maths (29.8%) are associated to their belief about the difficulty of subject.

Students' perception of difficulty in mathematics associate with efficacy beliefs

Students who believe mathematics is a very difficult subject tends to find toughness of the subject [$\chi^2(2, N=200) = 51.79$, $p<.01$], low ability to learn mathematics [$\chi^2(2, N=200) = 45.52$, $p<.01$], inability in understanding mathematics [$\chi^2(2, N=200) = 44.4$, $p<.01$] and not knowing how to learn maths [$\chi^2(2, N=200) = 16.22$, $p<.01$], as reasons for mathematics learning being difficult.

Students' perception of easiness in mathematics associate with perception on their teacher and instruction

Students who felt mathematics as an easy subject reports that they find mathematics easy as it is easy to understand [$\chi^2(2, N=200) = 25.81$, $p<.01$] and due to the quality instruction provided by teacher [$\chi^2(2, N=200) = 17.19$, $p<.01$]. Among the 145 students (72.5%) who reported quality instruction as making mathematics learning easy, 111 (76.55%) are willing to take effort in learning maths.

Students' perception of difficulty is fairly high and is associated to motivational beliefs and gender

Mathematics is not an easy subject for 76.7% of students. While considering the gender of students, significantly more boys (64.4%) than girls (35.6%) felt mathematics as a very difficult subject. Students expectancy about the difficulty of mathematics is associated to their beliefs like self-efficacy, task value, interest and effort taking behaviour.27.6% of students don't have self

efficacy for learning maths. Self-efficacy for learning mathematics is low for boys (31.3%) than girls (23.7%), (p>.05). When the self-efficacy for learning and succeeding in math is low, students' belief about the difficulty of subject gets significantly high [χ^2(2, N=200) =17.13, p<.01]. Significant more students who find mathematics as easy (44.6%) tends to value mathematics learning in comparison to other school subjects[χ^2(4, N=200) =31.61, p<.01]. Students perception of difficulty in mathematics is significantly associated with their lack of interest in learning mathematics [χ^2(2, N=200) =31.56, p<.01]. Expectancy about the difficulty of mathematics and students' effort taking behaviours are associated too. Significant more number of students who feel mathematics as easy subject tends to seek help from others if they couldn't solve the problem despite effort for a long time (78.3%) [χ^2(6, N=200) =38.61, p<.01], while students who feel mathematics as a difficult subject tend to leave the problem with less effort (43.8%) [χ^2(6, N=200) =38.6, p<.01].

Students' effort and help seeking behaviours in mathematics are influenced by their motivational beliefs

Other than expectancy of the subject, students' effort and help seeking behaviours are found affected by gender, self efficacy, task value and interest. Significant more girls (60.4%) take more effort and seeking help from others, than boys (39.6%) [χ^2(3, N=200) =12.56, p<.01]. Also significant more number of students who value mathematics tends to take more effort and help seeking behaviour than those who do not value mathematics learning [χ^2(6, N=200) =16.94, p<.01]. Students' self-efficacy and effort are related too. As they lack self-efficacy for learning mathematics, significantly more students tend to leave the problem if they felt it as difficult [χ^2(3, N=200) =19.70, p<.01]. Significant more students who are learning mathematics with interest tends to take more effort and help seeking [χ^2(3, N=200) =156.29, p<.01] whereas students with no interest take less effort and leaves the problem [χ^2(3, N=200) =14.26, p<.01].

Discussion

Students' report and teachers' perception indicate that the major cause for mathematics being difficult for students is lack of previous knowledge. Without relevant previous knowledge it is difficult and even impossible to learn mathematics in the higher classes. And, as per content and

structure of existing curriculum, teachers have been reporting that it is hard to allow more time for renewing previous knowledge. However it is meaningless to teach seventy five percentages of students who lack the basics about newer contents. Teaching students without prior knowledge promotes mechanical or rote learning. Gradually students tend to believe that they are not fit to learn mathematics or they would not able to learn mathematics. Here students attributing failure or backwardness in mathematics to an internal, stable and uncontrollable cause, but actually it were an internal controllable reason. So teachers should spend some more time for making relevant prerequisites and to make them aware that problem lies with their learning strategy. Otherwise difficulty becomes progressiveand as they move on to higher class students' achievement in mathematics will go down.

Learning of mathematics is comparable to construction of a complex structure; knowledge of basics determines the students' meaningful understanding of mathematics. So whatever barriers may be there it is important to strengthen essential basics. Also as per cognitive load theory (Sweller, 1994), during problem solving subject need to first identify the categories of problem and the required moves. If the subject lacks in particular schema they would have immense difficulty in solving problem, and the cognitive load will be high; larger the supporting schema, better the learning would be.

Students feel that reason for lack of previous knowledge is the rapid forgetting of learned material. Generally, cause for forgetting is the absence of deep processing of the material or improper coding. Deeper learning strategies promote deeper processing and hence long term memory. But majority of the students are following strategies like just memorizing equations or repeating the class notes. Students are approaching different portions as different, and not connecting the new with existing. Unstructured knowledge is susceptible to forgetting (Carpenter& Lehrer, 1999); to be successful in mathematics students need to create a rich, integrated knowledge structure.

Hay Mcber (2000) reports that students' progress is highly influenced by teacher quality and effectiveness rather than other classroom, school and student factors. Present study found that teacher effectiveness can be a relevant factor in making mathematics easy for those who felt mathematics as an easy subject; but those who feel mathematics as a difficult subject, did not attribute it to teaching. This finding resonates with that of Haimowitz (1989) who observed that

insufficient or inadequate instruction is not the cause of most failures in the school, but active resistance by the learner is a reason. Hence teacher can only make mathematics learning easy to those students who felt mathematics as an easy subject, but not to those who felt mathematics as a difficult subject.

Affective variables are an integral part of cognitive development. Students' expectancy about the difficulty of mathematics should be given serious concern, because expectancy of the difficulty is found associated to many negative beliefs and thoughts, whereas positive expectancy had association with positive believes only. When considering students' motivational beliefs, many students lack self-efficacy for learning mathematics. Self efficacy, person's belief about his own ability to accomplish or succeed in a task, has found to significantly affect cognitive processes, motivational processes, affective processes and selection processes (Bandura, 1994; Schwarzer, 2014). When a student perceives himself as incapable to learn mathematics, s/he tends to leave situation or shunning effort when confronted with difficult problems. The major findings about difficulties in learning mathematics and their inter relations are drawn in the figure 1.

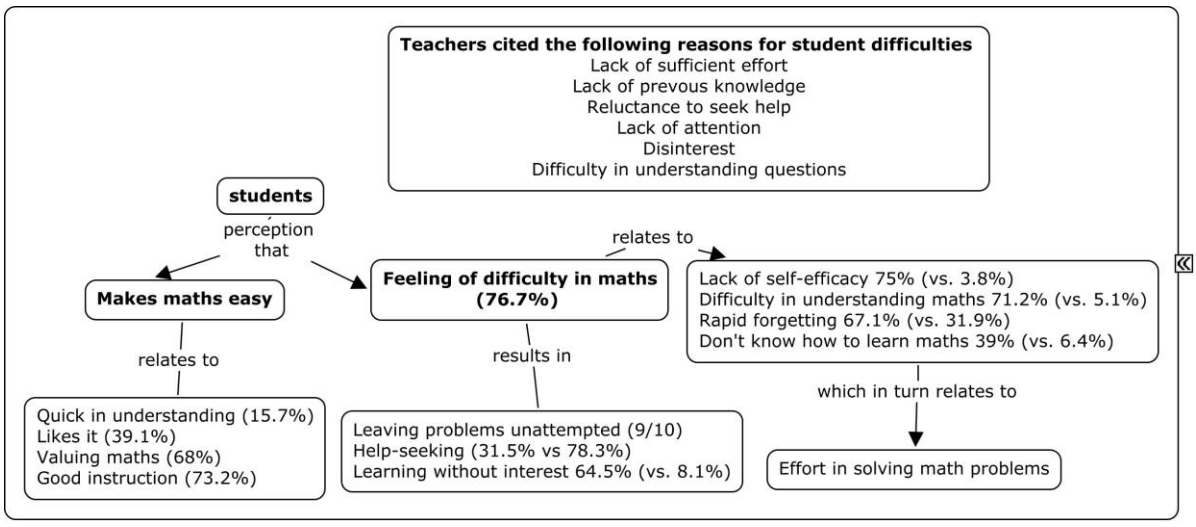

Figure 1

Reasons for students' difficulty in learning mathematics and their interrelation

Majority of students are following surface learning strategies like just repeating the class work and memorizing equations, most of the students are not trying to solve problems in textbook by themselves. And teachers' report indicating that students possess less control over their learning in essence.

The most relevant reason observed by teachers for students' difficulties in learning mathematics is lack of sufficient effort by students, and they were not that much aware about the role of students' self-efficacy for learning mathematics.From this point it is relevant to discuss the reasons for less effort by students. Motivational research finds lack of self-efficacy and interest as major reasons for not taking effort. Thus foremost step for promoting students effort taking behavior is the enhancement of students' self efficacy and interest for learning mathematics.

Implications

- Before starting a new topic, the related previous content should be revised and mastered
- Instruction should be designed in a manner that reduces cognitive load by prior development of relevant schema
- Knowledge should be well structured and connected to previous content to promote meaningful understanding and memory
- Students' should be instructed to follow deeper learning strategies so as to improve understanding and memorization
- Students should be given problems that promote metacognition instead of blind drill work
- Students' self-efficacy, expectancy beliefs regarding mathematics to be finely tuned to increase their effort
- Provide clear the curricular goals to students and help them to set their own goals
- Make students confident that ability can be improved through effort and effort is important than ability

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