Influence of Mathematical Beliefs on Achievement in Mathematics of Secondary School Students

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Abstract

Student’s beliefs about mathematics and mathematics learning can have a substantial impact on their interest in mathematics, their enjoyment of mathematics, and their motivation in mathematical class. The learning outcomes of students are strongly related to their beliefs about the nature of mathematics, beliefs about mathematics education and beliefs about the nature of knowledge and the process of knowing. The study intended to understand the influence of mathematical beliefs on achievement in mathematics of secondary school students. Sample for the study consisted of 600 secondary school students studying in Standard IX selected from Kozhikode and Malappuram districts of Kerala state. The study adopted survey method. Data were collected by using Mathematical Beliefs Inventory. The statistical technique used for analyzing the collected data is Test of significance of difference between means of large independent sample (t-test). The results indicated that the influence of Mathematical Beliefs on Achievement in Mathematics is significant and that there exists significant difference in the mean scores of Achievement in Mathematics for High Mathematical Beliefs group and Low Mathematical Beliefs group.

Introduction

The country needs, today, effective and productive citizens who display scientific and constructive thinking and attitudes in all walks of life. This is possible, to a great extent, with carefully devised educational curricula, especially, on the school Mathematics programme. Mathematics education in school is emphasized as it improves concept development, fosters higher cognitive abilities and skills. Mathematics is a very useful subject for most vocations and higher specialized course of learning and the world of science and technology, mathematics education for all is considered an absolute necessity. Mathematics is a fundamental science subject, which is taught all over the world as an individual’s building foundation from pre schooling age. Mathematics is the only subject which is known either by literate as well as illiterate. Mathematics education is essentially a practical discipline, where the underlying goal is always to promote better learning of mathematics by students. It benefits both individual and society through its contribution to the science, economy, engineering etc. It can empower individuals in everyday life and bring them personal fulfilment through studying its beautiful patterns and working on its magnificent problems.

At the same time, successful problem-solving in mathematics requires students to be able to select and use task-appropriate cognitive strategies for understanding, representing and solving problems. Student’s beliefs about the nature of knowledge and learning influence the strategies they use for several purposes such as
learning, developing the confidence ability, humanizing the critical and creative thinking, improving the problem solving methods and more diversify the self-regulated learning, which in turns affects their academic achievement in mathematics (Foong & Perry, 1998). Mathematical beliefs refer to student’s beliefs towards mathematics, belief on mathematical competency and belief about learning context which impacted mathematical performance. (Schuck & Grootenboer, 2004). Op’t Eynde and De Corte (2003) defines mathematics-related beliefs systems as the implicitly or explicitly held subjective conceptions students hold to be true about mathematics education, about themselves as mathematics learners, and about the mathematics class context. These beliefs determine in close interaction with each other and with student’s prior knowledge their mathematical learning and problem-solving activities in class.

Mathematical beliefs play an important role in enhancing the quality and effectiveness of the teaching and learning of mathematics (Adnan, Zakaria & Maat, 2012). Schoenfeld (1989) states that mathematical beliefs are the ways that students’ conceptions about mathematics shape the ways that they engage in mathematical activities. Kamalimoghaddam, Tarmizi, Ayub and Jaafar (2016) examined the direct and indirect effects of mathematics beliefs on mathematics achievement by mediating mathematics self-efficacy. The results showed that students’ who held strong beliefs on mathematics, had higher self-efficacy in mathematics and these led to high mathematics achievement. The study also indicated that students’ mathematics beliefs had a poor and no significant direct effect on their mathematics achievement. Prendergast, Breen, Bray, Faulkner, Carroll, Quinn and Carr (2018) investigated secondary students (n = 975) beliefs about mathematical problem solving. The analysis of data revealed that students who were further through their secondary education had a stronger belief that not all problems could be solved by applying routine procedures. In contrast, the same students held less positive beliefs than their younger counterparts that they could solve time consuming problems and that conceptual understanding was important. The analysis also indicated that gender had a significant impact on belief in mathematical problem solving. Thus, the present study aims to understand the influence of mathematical beliefs on achievement in mathematics of secondary school students.

**Objectives**

The objective of the study is:

- To study the effect of Mathematical Beliefs on Achievement in Mathematics of secondary school students

**Hypothesis**

Hypothesis of the study is:

- There exists significant effect of Mathematical Beliefs on Achievement in Mathematics of secondary school students for the total sample.

**Methodology**

The study adopted survey method.
Participants

The population of the study comprised of secondary school students of Kerala state. The participants for the study consisted of 600 secondary school students studying in Standard IX selected from Kozhikode and Malappuram districts of Kerala state.

Instruments Used

Mathematical Beliefs Inventory (Niranjana & Ganisha, 2019) was used to measure the mathematical beliefs of secondary school students. The inventory was constructed on the basis of dimensions of mathematical beliefs such as the nature of mathematics, mathematics teaching and learning mathematics in daily life and competence in mathematics. The test re-test reliability coefficient obtained is 0.67, and reliability coefficient obtained split half method is 0.74 which ensured the reliability of Mathematical Beliefs Inventory. The face validity and criterion related validity of the tool was established. The validity coefficient obtained is 0.69 for criterion related validity. The index suggested that the tool is valid.

Data Sheet on Achievement in Mathematics: A data sheet on Achievement was used by the investigators to record the score obtained by the students in the Mathematics test conducted by the school for the first term examination.

Statistical Techniques Used

The statistical techniques used for analyzing the collected data are Test of significance of difference between means of large independent sample (t-test).

Analysis and Discussion

To know whether there exist any significant difference in the mean scores of Achievement in Mathematics among High Mathematical Beliefs group and Low Mathematical Beliefs group, the test of significance difference between means of large independent sample was carried out. The data and results of the test of significance difference between mean scores of Achievement in Mathematics for High Mathematical Beliefs group and Low Mathematical Beliefs group is given in Table 1.
Table 1

Data and Results of the Test of Significance Difference between Mean Scores of Achievement in Mathematics for High Mathematical Beliefs Group and Low Mathematical Beliefs Group

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Critical Ratio</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Mathematical Beliefs Group</td>
<td>311</td>
<td>32.14</td>
<td>14.05</td>
<td>3.41</td>
<td>0.01</td>
</tr>
<tr>
<td>High Mathematical Beliefs Group</td>
<td>289</td>
<td>36.08</td>
<td>14.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table 1, it is evident that the obtained $t$ value is 3.14, is greater than the tabled value at 0.01 level of significance (2.58). Since the $t$-value obtained is greater than the tabled value, it can be concluded there exists significant difference in the mean scores of Mathematical Beliefs of secondary school students. A close observation of mean scores of two groups of Mathematical Beliefs reveals that the mean score of Achievement in Mathematics of High Epistemological Beliefs group ($M=36.08, SD=14.22$) compared to that of Low Mathematical Beliefs group ($M=32.14, SD=14.05$) is significantly greater. This indicates that those secondary school students who are having high Mathematical Beliefs, scores high on Achievement in Mathematics than those students who are having low Mathematical Beliefs among secondary school students.

**Conclusion**

The influence of mathematical beliefs on achievement in mathematics is significant which indicates that there exists significant difference in the mean scores of achievement in mathematics for high mathematical beliefs group and low mathematical beliefs group. Thus it is evident that an increase in achievement in mathematics of secondary students is possible by increasing level of mathematical beliefs held by the students. Mathematics is among the most misunderstood subjects. It is difficult due to its abstract nature, but surely it can overcome through taking systematic effort. Teacher can strengthen student’s mathematical beliefs and convince students that no one excels without effort, and that struggle is part of all kind of achievement. Teacher’s differential treatment can corrode student’s beliefs and help students to learn more effectively by understanding how they learn and how to manage their learning. It is the task of teachers to make the students aware of the value of mathematics task, its nature and learning. Greater emphasis should be given to student’s beliefs regarding mathematics and its learning equally with mathematics content. Curriculum developers should understand the low mathematical beliefs affect students’ learning. Curriculum developers can take up the challenge of helping students to associate their productive mathematical beliefs with the activity of the course.
and the discipline. Teacher’s proper planning and execution of class by considering student’s mathematical beliefs can resolve this problem. Mathematics teacher can improve student’s mathematical beliefs by giving different tasks, activities, experiment or problem by considering student’s beliefs about mathematics.

References


