Research Paper Education

Relationship Between Mathematical Thinking and Achievement in Mathematics Among Secondary School Students

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ABSTRACT

Through the study, the investigator tried to find the relationship between Mathematical Thinking and Achievement in Mathematics among Secondary School Students for total sample and relevant sub samples based on Gender of Students. The investigator also tried to find the relationship between the fundamental processes of Mathematical Thinking and Achievement of Students at Secondary level. There are research works that throws light on the fact that Mathematical Thinking is essential for the development of Achievement in Mathematics of Students. Also, there are studies, which propose that the Achievement in the Mathematical facts and concepts are essential for developing a new pattern of thinking in the way of Mathematics. Hence the investigator tried to analyze the relationship between Mathematical Thinking and Achievement in Mathematics among Secondary School Students. The investigator adopted survey method for the study on a sample of 112 Secondary School Students taken at random. Achievement Test in Mathematics and Test of Mathematical Thinking are used in the study. The study revealed that there exists significant positive relationship between Mathematical Thinking and Achievement in Mathematics among Secondary School Students for total sample. In the case of fundamental processes of Mathematical Thinking, there exists significant positive relationship between Convincing and Achievement in Mathematics among Secondary School Students for total sample and the sub sample based on Gender of Students.

KEYWORDS Relationship, Mathematical Thinking, Achievement in Mathematics, Secondary School Students

Introduction

We are in the age of knowledge explosion. Rapid changes are taken place in all spheres of life especially in the thinking styles of students. The twenty – first century is a thinking century. Students who come to lean Mathematics as a dynamic discipline through which much of the world can be interpreted are able to make sense of a wide range of experiences. They are able to organize and analyze events in systematic ways. Sometimes this might be numerically, but it could equally be spatially or through logic. By viewing the world through a Mathematical lens, considerable progress can be made in everyday circumstances, such as remembering phone numbers, because a pattern can be seen and people are thus able to solve problems more efficiently and effectively.

The ability to think mathematically and to use mathematical thinking to solve problems is an important goal of schooling. According to Burton (2013), the style of thinking labeled Mathematical is pertinent whatever the content to which it is being applied. It is Mathematical not because the operations on which it relies are mathematical operations. Its field of application is general. Mathematical thinking is used when tackling appropriate problems in any context area. It will support science, technology, economic life and development in an economy. According to Stacey (2007), being able to use Mathematical thinking in solving problems is one of the most fundamental goals of teaching Mathematics, but it is also one of its most elusive goals. It is an ultimate goal of teaching that students will able to conduct Mathematical investigations by themselves, and that they will be able to identify where the Mathematics they have learned is applicable in real world situations (Stacey, 2007). If students are to become Mathematical thinkers, then Mathematical thinking must be there in the curriculum. In addition, however students who have an understanding of the components of Mathematical Thinking will be able to use these abilities independently to make sense of Mathematics that they are learning. Mathematical thinking is important in large measure because it equips students with the ability to use mathematics, and as such is an important outcome of schooling. The mathematical thinking dynamic provide the vehicle and energizing element to promote the processes of representation, synthesis and articulation – a language for scientific thought at the receptive, expressive and elaboration levels (Kinard, 2001). The development of mathematical thinking plays an important role on the solution of problems faced in daily life (Pinar and Ahmet, 2014).

Need and Significance of the Study

According to Schoenfeld (1992), Mathematics is an inherently social activity, in which a community of trained practitioners (mathematical scientists) engages in the science of patterns - systematic attempts, based on observation, study, and experimentation, to determine the nature or principles of regularities in systems defined axiomatically or theoretically ("pure mathematics") or models of systems abstracted from real world objects ("applied mathematics"). According to National Research Council (1989), Mathematics is a living subject which seeks to understand patterns that permeate both the world around us and the mind within us. Although the language of mathematics is based on rules that must be learned, it is important for motivation that students move beyond rules to be able to express things in the language of mathematics. According to Stacey (2007), if students are to become good mathematical thinkers, then mathematical thinking needs to be a prominent part of their education. In addition, however, students who have an understanding of the components of mathematical thinking will be able to use these abilities independently to make sense of mathematics that they are learning. Thus in many studies, the researchers point out the fact that Mathematical Thinking is essential for the development of students in their life. Also mathematical thinking is essential in developing problem solving ability of students in their life.

Also there are studies which concentrates on the influence of Achievement on developing mathematical thinking (Joanna and Ro, 2011; Andrew and Alistair, 2010). Andrew and Alistair (2010) mentioned that it is so important in school Mathematics and in mathematical thinking that the students deserves to be able to derive the Pythagorean theorem with an appropriate degree of rigour. Katherine and others (2007) mentioned that the gifted education and Mathematics literature suggest support for curriculum that is both enriched and accelerated with a focus on developing conceptual understanding and mathematical thinking. The studies highlighted the fact that one of the way for developing mathematical thinking is that the opportunities are provided in schools

for engaging in realistic activities to ensure that mathematical concepts and ideas can be taught and expressed in contexts closer to student's own experiences (Tom and Tracy, 2007). On the basis of these studies, it can be concluded that there exists some relationship between Mathematical Thinking and Achievement in Mathematics. Hence the investigator tried to analyze the relationship between Mathematical Thinking and Achievement in Mathematics among Secondary School Students for total sample and relevant sub samples. The investigator also tried to find the relationship between the fundamental processes of Mathematical Thinking and Achievement in Mathematics among Secondary School Students.

Methodology in Brief

The investigator adopted survey method for the study on a sample of 112 students at secondary level. The samples selected from different schools from Ernakulam and Alappuzha Districts selected at random. The tools used for the study are

- Test of Mathematical Thinking (Jaleel, 2015)
- Achievement Test in Mathematics (Jaleel, 2015)

The investigator used Pearson's Product Moment Coefficient of Correlation and test of significance of Coefficient of Correlation for the analysis of collected data.

Analysis and Discussion

The data collected were discussed under the following headings

Relationship between Mathematical Thinking and Achievement of students at secondary level for total sample and relevant sub sample based on the gender of students

The relationship between Mathematical Thinking and Achievement of students at secondary level was calculated using the Pearson's Product Moment Coefficient of Correlation. The result of coefficient of correlation is given in table 1

Table 1. *Relationship between Mathematical Thinking and Achievement*

Sample	N	r	SV	t
Total	112	0.22*	4.84	2.36*
Boys	45	0.22	4.84	1.48
Girls	67	0.22	4.84	1.81

From table1, it is clear that the obtained relationship ($r = 0.22$, $p < .05$) exist between Mathematical Thinking and Achievement is significant at .05 level of significance. It implied that there exists significant positive relationship between Mathematical Thinking and Achievement of students at secondary level. Hence it can be concluded that whenever there is a change in the scores of Mathematical Thinking, there exists a corresponding change in the scores of Achievement in Mathematics. From table 1, the obtained values of shared variance (SV = 4.84) revealed that 4.83% of Achievement in Mathematics of student at secondary level is contributed by their Mathematical Thinking for total sample. The relationship between Mathematical Thinking and Achievement of Boys and Girls at Secondary level is not significant at .05 level of significance.

Relationship between the fundamental processes of Mathematical Thinking and Achievement in Mathematics of students at secondary level for total sample and relevant sub sample based on the gender of students

The relationship between the fundamental processes of Mathematical Thinking and Achievement of students at secondary level was calculated using the Pearson's Product Moment Coefficient of Correlation. The result of coefficient of correlation is given in table 2

Table 2. *Relationship between the fundamental processes of Mathematical Thinking and Achievement*

Components	Sample	N	r	SV	t
Specializing	Total	112	0.16	2.56	1.70
	Boys	45	0.15	2.25	0.99
	Girls	67	0.17	2.89	1.39
Generalizing	Total	112	0.08	0.64	0.84
	Boys	45	0.05	0.25	0.33
	Girls	67	0.09	0.81	0.73
Conjecturing	Total	112	0.06	0.36	0.63
	Boys	45	0.14	1.96	0.93
	Girls	67	0.22	4.84	1.81
Convincing	Total	112	0.32**	10.24	3.54**
	Boys	45	0.39**	15.21	2.78**
	Girls	67	0.28*	7.84	2.35*

From table 2, it is clear that there exists no significant relationship between the fundamental processes of Mathematical Thinking such as Specializing, Generalizing and Conjecturing and Achievement in Mathematics among Secondary School Students for total sample and relevant sub sample based on gender of students. Also Table 2 shows that the obtained coefficients of correlation ($r = 0.32$, $p < .01$ for total sample; $r = 0.39$, $p < .01$ for boys; $r = 0.28$, $p < .05$ for girls) exist between the fundamental process – Convincing and Achievement is significant. It implied that there exists significant positive relationship between the fundamental process of Mathematical Thinking – Convincing and Achievement of students at secondary level. Hence it can be concluded that whenever there is a change in the scores of the fundamental process of Mathematical Thinking – Convincing, there exists a corresponding change in the scores of Achievement in Mathematics. From table 2, the obtained values of shared variance (SV = 10.24 for total; SV = 15.21 for boys; SV = 2.35 for girls) revealed that 10.24% of Achievement in Mathematics of student at secondary level is contributed by the fundamental process of Mathematical Thinking – Convincing for total sample. For boys, Convincing contributed to 15.21% to the Achievement in Mathematics. The percentage of contribution of Convincing to the enhancement of Achievement in Mathematics is 2.35%.

Findings and Conclusion

The study can be concluded that there exists significant positive relationship between Mathematical Thinking and Achievement of students at secondary level for total sample. There exists no significant relationship between Mathematical Thinking and Achievement in Mathematics among Secondary School Students based on the sub sample – gender of students. It was also concluded that there exists no significant relationship between Achievement in Mathematics and the fundamental processes of Mathematical Thinking such as Specializing, Generalizing and Conjecturing among Secondary School Students for total sample and relevant sub samples. But there exists significant positive relationship between the fundamental process of Mathematical Thinking – Convincing and Achievement of students at secondary level for total sample and relevant sub sample based on gender of students.

Based on the above findings of the study, it can be concluded that it is necessary for the learners to enhance their Mathematical Thinking so that they can learn the subject more interestingly and lively. When teachers are going to classrooms, they should keep in their mind about the level of Mathematical thinking of each their students in his / her classroom. It will help them to design the learning activities according to the individual differences. The curriculum planners should design the chapters in Mathematics text books by taking into account of the individual differences in Mathematical Thinking. The curriculum should be learner friendly and should meet the needs of learners successfully.

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