

## RELATIONSHIP BETWEEN MATHEMATICAL THINKING OF TEACHERS AND ACADEMIC ACHIEVEMENT OF STUDENTS OF SECONDARY SCHOOL

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### ABSTRACT

*The main aim of the research was to investigate the relationship between mathematical thinking of teachers and academic achievement of students at secondary school level in Sahiwal division. The major objective of this study was to find out relationship between mathematical thinking of teacher and student's academic achievement and explore the effect of different level of mathematical thinking of teacher on students' academic achievements. The study was descriptive correlational study based on observational survey design. The population of the study was 518 math teachers and 50659 students who were enrolled in secondary schools in session 2018-2019. Data was collected by observational check list from 19 secondary math teachers and also from 132 male students and 80 female students by self-developed questionnaire from Sahiwal Division. The data was analyzed by SPSS 20.0 and found that there is strong relationship between developmental mathematical thinking of teachers and students academic achievement and significant positive weak relationship exist between deductive, integrative, and abstract mathematical thinking of teachers and students' academic achievement while no relationship exist between inductive and analogical mathematical thinking of teachers and students' academic achievement and strong relationship was found between developmental mathematical thinking of teachers and students' academic achievement.*

**Keywords:** Mathematical thinking, Mathematics achievement, Secondary school.

### INTRODUCTION

Quality education is responsible for developing efficient thinking in a way of thinking logically or analytically by carving out mathematical learning in a particular way. Mathematical thinking gets developed through formulas as highly patterned statements which enable students to learn inductive and the deductive logic that is the true end of mathematics and the education as well. As such it can be said that the highly skilled and significant learning turns into the learning of mathematical attitude that stands unique at learning and applying formulae to find out the solutions to the sums (Yildirim, 2014).

Every step in Mathematical thinking requires individualistic intuitive approach and subjectivity coupled deductive pattern to solve the confronted problems properly (Yildirim, 2014). As a result it shapes up personal thinking and creative mindset.

Learners develop their perceptual knowledge. Learners' Mathematical acumen sharpens because of developing relationship between surroundings and concreteness in conception building accordingly (Tall, 2005). Students in due course of time start applying their inductive and deductive knowledge learnt through Mathematics in personal skills to the daily problem solving processes. Teachers play a pivotal role in instituting the leading process. Teacher is an element that leads and has an impact on the learning process. The attitude, belief and mentality of a teachers are very important factors to enhance the coaching procedure, which is a mental procedure.

In the coaching of mathematics, interests of a person in mathematics are directly connected to how mathematics should be taught. In the teaching of mathematics, performance of the teacher is a vital element. In the developing of effected learning of mathematics efficiently and achievement of

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the students the psychological factors; such as anxiety has a vital factor in the formation of the learning of mathematics efficiently and achievement of the students as well. (Bursal and Pazkonas, 2015).

One of the most significant development in students learning is the progress and achievement in learning to prosper. A nation cannot be built stronger without educational prosperity, (2008). More is the students learning lesser leads to the poverty of a country. Promising students are the great asset of a country who straighten the country's economy on the right and fast tracks. Learning mathematics and excelling in it may result in students achievement overall in other subjects. Hence students overall prosperity is based upon learning and excelling in the subject of Mathematics.

Concentration in thinking is a natural phenomenon and it is paved properly by the process known as mathematical thinking. In other words learning Mathematics is the source to pioneering thinking positively. Human performance and capacity to think and work well have been under thorough consideration and many theories are outlined to understand them for the further studies. Man's inquisitiveness is his prime characteristic at individualistic level that originates many other qualities in him. Prompt thinking at appropriate timing to act and react according to the situational needs is a complex phenomenon to explain however theoretical understanding under certain theories presented so far has made it easy to understand. These can be well explained under personal enthusiasm and individualistic style of contemplation. Academic excellence is attained when enthusiasm and idiosyncratic way of consideration are harmonized to the problem solving process. True end of education is to drive such level of problem solving through study of certain subject made integral part of curriculum and the subject of Mathematics is one of them. The role of Mathematics teacher is pertinent in this regard that helps in shaping intra-cum-interpersonal relationship to decisiveness, solving the problems and the communicative competence of learners through teaching of Mathematics.

In Pakistani school system Mathematics is given the status of a core subject and it is delivered till the completion of secondary and higher school certificate level. The syllabus of Mathematics contain number theory with relevant operations, algebraic expressions, measuring, geometrical sums and their solutions by applying formulae, and statistical data processing. Mathematical Curriculum's document, 2006 portrays the significance of it with the charismatic application in shaping the proper body of knowledge. Additionally it has clearly laid down the intents empowering learners to ponder rationally and methodically while in the Lecture Theater. (MoE 2006, National Curriculum for Mathematics grades I – X, p. 2-3).

Essential factors in understanding mathematics are considered as the classroom activities and in all these classroom activities the role of instructor stands pivotal. Therefore in shaping the basic concepts easy to understand the prime responsibility is that of the teacher. Math teacher is regarded as the master mind while students' mind is at micro level to conceptually understand the preliminary process for mathematical thinking and the wisdom as well (Chavajay R, 2006). Classroom activities retains still for a long span of time and may be called at the time when to solve the sums. However teacher's performance adds to fulfil the process of retention and memory building. So teacher should mend his/her manner in a way to make it more attractive and functional. Teachers' efforts and way of presenting the lesson at an earlier level may be made affecting and attractive for students. This is the way by which classroom learning would become retainable and fruitful for the students (Thompson, 2014). Instructors' personal dogma and professional principle, and the way to present the lesson can have greater imprints upon learners' mindset (Wilkins, 2008).

### **Statement of the Problem**

A comparative study to explore the relationship between mathematical thoughtfulness of teachers and academic achievement of students of secondary school level in Sahiwal Division.

### **Research Objectives**

Keeping the topic in the view, the following objectives were formulated.

1. To explore the effect of varied level of mathematical thinking of teacher on students' academic achievement

### **Research Questions**

The following research questions were formulated for the present research:

1. What way the relationship between mathematical thinking of teachers and academic achievement of students at secondary school level exist?

- 1.1 What way the relationship between analogical mathematical thinking of teachers and academic achievement of students at secondary school level exist?
- 1.2 What way the relationship between developmental mathematical thinking of teachers and academic achievement of students at secondary school level exist?

## RESEARCH METHODOLOGY

It was descriptive correlational study based on survey design.

### Population

At the time when research was conducted in Sahiwal division, there were 468 government secondary schools, 518 Mathematics teachers, and 50659 students who were enrolled in these secondary schools in the academic year 2018-2019. So, for the present study, population comprised all government secondary schools, all mathematics teachers who were teaching in these secondary schools and students who were enrolled in these secondary schools during 2018-2019 academic year.

### Sample and Sampling Technique

Data was collected from 212 students and 212 math teachers from Sahiwal division. Out of which 132 students were boys and 80 students were girls.

### Pilot Study

After the initial development of the research instruments, the observational rating scale was discussed with supervisor and research experts. On the basis of their precious opinion and direction, it was modified. After that it was present to the research committee. Some other changes took place in these research instruments according to their instructions. Mathematical achievement test was also discussed with the teachers of mathematics who were teaching at secondary schools in Sahiwal. After that, it was validated by research committee. The objective of the pilot study was to search out the shortness/sufficiency of the tools and to assure content authenticity, trustworthy. Content authenticity says if the things in tools shade the research aims or sums. The trustworthy of the instrument as a usual described as a correlation coefficient, which measures the power of organization among varieties and different among 0.00 and 1.00 out of which "0" show that there is no trustworthy while "1.00" represents the possible to which a tool is free of mistake variety, which is reasoned by factors same as ambiguous sums, language and mood of replier or even the method the researcher commanded the items in the tool. Finally, after modification on the basis of supervisor and research committee, these tools were administered to the sample for final data collection.

### Data Collection and Analysis

The data was collected in two phases; in first phase data was collected from math teachers by using group discussion interview protocol and in second phase, the data was collected from secondary students by questionnaire and also the researcher visited the schools by himself. The data was analyzed by SPSS version (20.0).

## RESULTS

The following tables show the results of the study

Relationship between Mathematical thinking of teachers and students' academic achievement

**Table No. 1** Correlational analysis to analyze the relationship between mathematical thinking of teachers and students' academic achievement, (N=212)

Variable	R	Sig
Mathematical thinking	.702(**)	.000
Students' academic achievement		

\*\* Correlation is significant at the 0.05 level of significant

Table 1 discloses that the computed r-value is .702 and sig value is (.000) which shows there is a strong significant relation between mathematical thinking of teachers and students' academic achievement.

**Table No. 2 Independent sample t-test for the analysis to determine the difference in the level of mathematical thinking between secondary school teachers regarding their gender**

Gender	N	Mean	Std. D	t	df	Sig
Female	80	2.45	.61	-.881	210	.388
Male	132	2.37	.66	-.866	175.93	

Table 2 reveals that the computed t-value (-.866) is less than table value (1.972) and computed sig value is (.388) which is greater than  $p=0.05$ . It shows means difference in the level of mathematical thinking between male and female secondary school teachers do not differ significantly

Gender based Level of Mathematical Thinking of Secondary School Teachers

**Table No. 3 Chi-Square Analysis to determine the difference in the level of mathematical thinking of teachers regarding their gender**

Gender	Count in % age	Level.of.MT			Total
		Low	Medium	High	
Male	Count	13	58	59	130
	% within Gender	10.0%	44.6%	45.4%	100.0%
	% within Level of MT.	72.2%	63.7%	57.3%	61.3%
	% of Total	6.1%	27.4%	27.8%	61.3%
Female	Count	5	33	44	82
	% within Gender	6.1%	40.2%	53.7%	100.0%
	% within Level of MT	27.8%	36.3%	42.7%	38.7%
	% of Total	2.4%	15.6%	20.8%	38.7%
Total	Count	18	91	103	212
	% within Gender	8.5%	42.9%	48.6%	100.0%
	% within Level of MT	100.0%	100.0%	100.0%	100.0%
	% of Total	8.5%	42.9%	48.6%	100.0%

$\chi^2=1.834$ ,  $df=2$ ,  $Sig=.400$ . Table 3 discloses that the computed chi-square value is 1.834 which is less than the table value= 5.991 and computed sig value is .400 which is greater than the  $p=0.05$  value. It shows no significant difference between male and female teachers' level of mathematical thinking exist. But within level of thinking, male and female teachers vary. 10% (13) of the male and 6% (5) of the female possessed low level, and 44.6% (58) male and 40.2% (33) female possessed medium level, and 45.4% (59) of the male and 53.7% (44) of the female teachers were possessing high level of mathematical thinking.

**Table No. 4 Dimensions of mathematical thinking based effect on students' academic achievement, (N=212)**

Dimension of mathematical thinking	Count	Academic achievement					Total	
		B.Avg	Avg	Good	V. good	Excellent		
Analogical Thinking	Low	Fre.	0	<b>9</b>	6	5	5	25
		% age	.0%	<b>36.0%</b>	24.0%	20.0%	20.0%	100.0%
	Medium	Fre.	2	23	<b>37</b>	23	27	112
		% age	1.8%	20.5%	<b>33.0%</b>	20.5%	24.1%	100.0%
	High	Fre.	0	<b>23</b>	16	14	22	75
		% age	.0%	<b>30.7%</b>	21.3%	18.7%	29.3%	100.0%
Integrative Thinking	Low	Fre.	2	<b>3</b>	2	1	1	9
		% age	22.2%	<b>33.3%</b>	22.2%	11.1%	11.1%	100.0%
	Medium	Fre.	0	20	<b>24</b>	11	22	77
		% age	.0%	26.0%	<b>31.2%</b>	14.3%	28.6%	100.0%
	High	Fre.	0	32	30	<b>35</b>	29	126
		% age	.0%	25.4%	23.8%	<b>27.8%</b>	23.0%	100.0%
Developmental Thinking	Low	Fre.	2	2	<b>8</b>	0	4	16
		% age	12.5%	12.5%	<b>50.1%</b>	.0%	25.0%	100.0%
	Medium	Fre.	0	3	27	<b>39</b>	20	89

High	% age	.0%	3.4%	30.3%	<b>43.8%</b>	22.5%	100.0%
	Fre.	0	5	25	25	<b>55</b>	107
	% age	.0%	4.7%	23.4%	23.4%	<b>48.6%</b>	100.0%

Table 4 reveals effect of mathematical dimension on students' academic achievement. The teachers who had low level of analogical mathematical thinking, majority of their students performed "average", the teachers who were enjoying medium level, majority of their students performed "good", and the teachers who had high level of analogical mathematical thinking, majority of their students performed "average". It is concluded that analogical mathematical thinking had no effect on students' academic achievement.

The teachers who had low level of integrative mathematical thinking, majority of their students performed "average", the teachers who were enjoying medium level, majority of their students performed "good", and the teachers who had high level of analogical mathematical thinking, majority of their students performed "very good". It is concluded that integrative mathematical thinking had positive effect on students' academic achievement.

The teachers who had low level of developmental mathematical thinking, majority of their students performed "good", the teachers who were enjoying medium level, majority of their students performed "very good", and the teachers who had high level of developmental mathematical thinking, majority of their students performed "excellent". It is concluded that developmental mathematical thinking had strong effect on students' academic achievement.

Dimensions based analysis of mathematical thinking to determine the most effective dimension that effect students' academic achievement

**Table No. 5 Correlational analysis to analyze the relationship between Inductive mathematical thinking of teachers and students' academic achievement, (N=212)**

Variable	R	Sig
Inductive mathematical thinking Students' academic achievement	.084	.221
Deductive mathematical thinking Students' academic achievement	.149(*)	.030
Analogical mathematical thinking Students' academic achievement	.047	.497
Integrative mathematical thinking Students' academic achievement	.135(*)	.049
Developmental mathematical thinking Students' academic achievement	.570(*)	.000
Abstract mathematical thinking Students' academic achievement	.133	.053

\*Correlation is significant at the 0.05 level (2-tailed). Table 5 discloses that the computed r-value is .084 and sig value is .221 which is greater than  $p=0.05$ . Therefore, no significant relationship exist between indicative mathematical thinking of teachers and students' academic achievement.

The computed r-value is .149 and sig value is .030 which is less than  $p=0.05$ . Therefore, significant positive but weak relationship exist between deductive mathematical thinking of teachers and students' academic achievement. The computed r-value is .047 and sig value is .497 which is greater than  $p=0.05$ . Therefore, no significant relationship exist between analogical mathematical thinking of teachers and students' academic achievement. The computed r-value is .135 and sig value is .049 which is less than  $p=0.05$ . Therefore, significant positive but weak relationship exist between integrative mathematical thinking of teachers and students' academic achievement.

The computed r-value is .570 and sig value is .000 which is less than  $p=0.05$ . Therefore, significant strong relationship exist between developmental mathematical thinking of teachers and students' academic achievement. The computed r-value is .133 and sig value is .053 which is less than  $p=0.05$ . Therefore, significant positive but weak relationship exist between abstract mathematical thinking of teachers and students' academic achievement.

## CONCLUSION AND DISCUSSION

It is concluded by table 1 that there is strong significant relationship between mathematical thinking of teachers and students' academic achievement. Table 2 shows that male and female secondary school teachers were enjoying same level of mathematical thinking.

It is concluded from table 3 that analogical mathematical thinking had no effect on students' academic achievement because as the level of analogical thinking is being increased students' academic achievement is not being increased accordingly. Integrative mathematical thinking had positive effect on students' academic achievement because as the level of integrative thinking is being increased students' academic achievement is also being increased accordingly while developmental mathematical thinking had strong effect on students' academic achievement because even the teachers who had low level of developmental thinking majority of their students performed "good" and who they had medium level, majority of their students performed "very good" while the teacher who possessed high level of developmental mathematical thinking majority of their students performed "excellent"

It is concluded from table 4 that significant strong relationship exist between developmental mathematical thinking of teachers and students academic achievement and significant positive weak relationship exist between deductive, integrative, and abstract mathematical thinking of teachers and students' academic achievement while no relationship exist between inductive and analogical mathematical thinking of teachers and students' academic achievement. Therefore, the most effective mathematical thinking dimension is developmental thinking.

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