

EXPLORING THE EFFECT OF DEMOGRAPHIC FACTORS ON STUDENTS' MATHEMATICAL THINKING AND THEIR ACADEMIC ACHIEVEMENT AT SECONDARY SCHOOL LEVEL

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ABSTRACT:

Exploring the effect of demographic variables on students' mathematical thinking and their academic achievement at secondary school level was the purpose of current study. The present research was conducted in Sahawal Division. It was descriptive research and survey design in nature. In this study for the collection of data, the researcher used both Math's test based on model of mathematical thinking from Punjab text book board curricula and questionnaire to measure students' mathematical thinking. Information was gathered from 589 students (297 boys and 292 girls) of 10th class by applying simple random sampling technique. After the collection of data, it was arranged, coded and entered into computer for analysis. To examine the gathered data, SPSS ver.20.0 software was used. Inferential and descriptive statistics was used to analyze the data. It was found that the students whose fathers were illiterate had high level of mathematical thinking. It was also came to know after analysis that mothers' qualification at least who had matric, high level of mathematical thinking was found in their kids. Parental profession was also had positive effect on students' mathematical thinking. In this research, the fathers who were govt. job holder and the mother who were doing private job, high level of mathematical thinking was found in their kids. Parental income play a vital role in mathematical thinking of kids. So, the parent who were earning upto 15,000/month, high level of mathematical thinking was found in their kids. Gender and locality wise no difference was found in the level of mathematical thinking of students. There is strong correlation was found between mathematical thinking and students' academic achievement.

Key Words: *Mathematical thinking, Demographic factors e.g. gender, location, parental qualification, occupation and income, secondary school students*

Introduction

In our school system, students' mathematical thinking at least is not as it is being characteristically presented by students while doing mathematics problem solving in the classrooms. Actually the main focuses of the math as subject which is being taught in school is the learning procedure which helps the students to solve highly pigeonholed complications. All mathematical experts able the students to think a certain method to solve definite problems which occur in their daily life, or inside the math book or which can arise from science by teaching them math in the class. Ultimate aim of the teaching math in school is able the students who can think outside the box. In the contrast, the foremost purpose of mathematical thinking is to think broadly that is the precious capability of individual is in this current era which would help the students to seek critical techniques of thinking. No doubt math as a subject is consider a very difficult and sensible subject at school, hence for mathematician, researcher, and parents, it has always been very complicated to discuss the topic as mathematical thinking of students regarding mathematics.

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Reimer & Warick (2015) stated that most probably technique of teaching of mathematics become the cause of low mathematical thinking among students. The techniques of teaching math at school level is always based of teacher centered or out-come based. In school, math teacher just come in class and solve whole question on blackboard or white board by ignoring the actual process of problem solving and students just note down it on their note book that it. In this way teacher bypass the process of creativity, understanding, reasoning and critical thinking. (Reimers & Warick, 2015). Furthermore, the quality of thinking mathematically not only helps student to success school exam but also helps them to success in their every walk of future life. There are lots of definition of mathematical thinking. According to Mason (2014) “the dynamics process which enable the students or teacher to generate complicated ideas which satisfied their understanding or direct, and increase their understanding” (p. 123)

Another places, Schoenfeld (2015) tried to define mathematical thinking. He stated that “the process of mathematization, and tendency of applying mathematical operates, and the increment of proficiency of these mathematical skill and using these mathematical skill for the purpose of understanding mathematical structure is cultivated by the development of mathematical thinking in students”. (p.197) Kazemi & Franke (2016) quantified that regarding students for transporting pedagogy, mathematics and understanding together, mathematical thinking work as a power mechanism. In short, the activities which engage in abstract and simplification of mathematical ideas by mental process is called Mathematical thinking. Therefore, these definitions were derived from the research of Krutestski which he conducted on (2016) in the titled of stages of mathematical awareness and on visible realistic activities which become consequently abstraction and simplification as theorized by Schwarz et al in (2014). In Pakistani upto secondary school’ curriculum, mathematics is a core fundamental subject. In school curriculum of Pakistan up to Secondary Education. The component of Pakistani mathematics curriculum are measurement, number sign or operates, data handling, geometry, algebra. The aim of teaching mathematics’ curriculum 2006 upto secondary level is to develop the ability of the students which enable them to use their achieved knowledge to solve daily life and further areas of daily life problems.

Hence, the ultimate objective of teaching math to the students is to develop the ability self-thing to solve mathematical problem. To find the ability of mathematical thinking of students numerous researches had conducted and their results reveals that mathematical curriculum, teacher’s personality, teaching pedagogy, classroom environment and other factors effect students’ mathematical thinking. Amir Zaman (2011) in his research found that gender factors had effect on students’ mathematical thinking. According to his finding male perform better than the female in all aspect of mathematical thinking. Another research Swart (2012) found that female slightly performed better in the context of mathematical thinking. Ma’Moon (2015) in research found that location also effect mathematical thinking. According to him students of thinking level of the urban students was significantly higher than the rural areas schools. There were also performance of male and female students of rural and urban area significantly different. In this perspective, the researcher selected the topic as to explore the effect of demographic factors such as gender, locality, parental

education and occupation, and income on mathematical thinking of students at secondary school level generally in Punjab, especially in Sahawal division.

Statement of the Problem

The study was entitled to explore the effect of demographic factors on students' mathematical thinking and their academic achievement at secondary school level

Objectives of the study

The researcher formulated objectives are under below:

1. To know about the differences among level of mathematical thinking of students regarding their group of:
 - Gender
 - Locality
 - Parental education;
 - Parental occupation, and
 - Parental Income
2. To explore the effect of level of mathematical thinking on students' academic achievement
3. To describe the correlation between mathematical thinking and students' academic achievement.

Research questions

- What is the effect of demographic factors on mathematical thinking of students at secondary school level?
- What way mathematical thinking effect students' academic achievement
- Is there any relationship exist between mathematical thinking of students' and their academic achievement?

Research Methodology

Research design

It was descriptive cross-sectional research and survey design in nature.

Population

The population for the present study consisted 56 govt. secondary schools (boys and girls) which were situated in Sahawal division at the time when researcher conducted research.

Sample and sampling technique

By applying two stage simple random sampling techniques, 56 secondary schools from three selected tehsils of the Sahawal division, were randomly selected. By employing systematic random sampling technique, 589 students were randomly selected from selected schools.

Research Instruments

To find mathematical thinking of students, the researcher used self-developed questionnaire and a test based on cognitive domain from mathematics text book was developed to measure students' academic achievement. The researcher followed the Bloom Taxonomy while developing test. 5 knowledge, comprehension, application based items, 2 analysis level based items, 1 synthesis and 1 evaluation level item based on cognitive domain from mathematics Book of Punjab text book were developed by the researcher. The whole test carry 50 marks.

Pilot testing of the instruments

When questionnaire and mathematics test initially developed, after that, it was discussed with the experts and mathematics teachers. To discover the efficiencies/deficiencies of the questionnaire and to confirm reliability it was pre-tested by 40 students who were not included in the sample. After modification, there was .91 Cronbach' alpha reliability of the final questionnaire.

Procedure of Data Collection

First of all, the researcher himself contacted to CEO education office to seek permission for conducting research in the selected secondary. After seeking permission for CEOs of the selected districts, the researcher personally visited headmaster office for seeking permission of conducting research over here. After permission, researcher visited mathematics class and deliver questionnaire to the students when they filled it the researcher collected questionnaire from the students. Soon after that he/she conducted mathematics achievement test. When students completed it the researcher collected it and set off from this school for the next. The researcher applied same practice in all selected schools and collected data from 589 students of the 10th class from the selected secondary school of the Sahawal division. The practice of data collection took four months.

Data Analysis and Results

When data was gathered from the respondents, it was entered into computer after arranging and coding. Inferential statistics was used to find out the relationship between demographic factors and mathematical thinking of students and descriptive statistics was used to obtain students' demographic information. So, statistically treatment was done with the help of SPSS by applying t-test, ANOV, chi-square. The results are shown in the following table.

It is indicated the following table (Table No.1) that majority of the participants in the present research, gender wise were male, and locality wise were from urban areas. Parental qualification wise, the father of the majority students were illiterate, mothers of the majority of them were primary school certificate holder. Parental profession wise father of the majority students were government job holder while mother were house wife. Monthly income wise, parents of the majority of the students were earning upto 15,000/month.

Table No. 1. *Demographic factors wise description of participants in the Sample*

Demographic Factors	Frequency	%age
Gender		
Male	297	50.4
Female	292	49.6
Locality		
Rural	289	49.1
Urban	300	50.9
Father's education		
Illiterate	241	40.9
Primary	102	17.3
Secondary	136	23.1
Higher Secondary	87	14.8
Higher Education	23	03.9
Mother's Education		
Illiterate	69	11.7

Demographic Factors		Frequency	%age
	Primary	211	35.8
	Secondary	173	29.4
	Higher Secondary	87	14.8
	Higher Education	49	8.3
Father's Profession	Farmer	153	26.0
	Govt. job	149	25.3
	Private job	219	37.2
	Self-business	47	8.0
	Others	21	3.6
Mother's Education	Housewife	271	46.0
	Govt. job	119	20.2
	Private job	69	11.7
	Self-business	49	8.3
	Others	81	13.8
Monthly Income (PKR)	Below 15,000	97	1.6
	15,001-20,000	139	23.6
	20,001-25,000	199	33.8
	25,001-30,000	68	11.5
	30,001-35,000	59	10.0
	Above 35,000	27	4.6

It is display in the following table (Table No.2) that gender wise and locality wise no significant difference was found among students in the level of their mathematical thinking. Majority of the gender and locality wise students were enjoying medium level of mathematical thinking. Parental education wise, the students whose fathers were illiterate, and mothers were matric, theirs mathematical thinking level was high. Parental profession wise, the students whose fathers were government job holder, those whose mothers were private job holder, theirs mathematical thinking level was high. Parental Income wise, the students whose parents were earning upto PKR, 15,000 per months, theirs mathematical thinking level was high. It is concluded that parental qualification, profession, and income had effect on the level of mathematical thinking of students while gender and locality had no effect on the level of mathematical thinking of students.

Table No. 2. *Effect of demographic factors on students' level mathematical thinking*

Demographic Factors	Count	Level of Mathematical Thinking			Total
		Low	Medium	High	
1. Gender					
Male	Count	7	131	127	265
	% within gender of Students	2.6%	49.4%	47.9%	100.0%

Demographic Factors	Count	Level of Mathematical Thinking			Total
		Low	Medium	High	
Female	Count	11	99	73	183
	% within Gender of Students	6.0%	54.1%	39.9%	100.0%
2. Locality					
Urban	Count	10	121	97	228
	% within Locality	4.4%	53.1%	42.5%	100.0%
Rural	Count	8	109	103	220
	% within Locality	3.6%	49.5%	46.8%	100.0%
3. Parental Edu.					
Father Edu.	Count	4	37	41	82
No Education	% within Father Education	4.9%	45.1%	50.0%	100.0%
Mother Edu.	Count	7	45	48	100
Matric	% within Mother Education	7.0%	45.0%	48.0%	100.0%
4. Parental Profession					
Father Govt. job	Count	11	75	85	171
	% within Father profession	6.4%	43.9%	49.7%	100.0%
Mother private job	Count	0	30	31	61
	% within Mother profession	0.0%	49.2%	50.8%	100.0%
5. Parental Income					
≥ 15, 000	Count	8	42	43	93
	% within parental income	8.6%	45.2%	46.2%	100.0%

It is display in the following table (Table No.3) that the students who were enjoying low level of mathematical thinking, majority (44.4%) of them achieved average score in mathematical achievement test and the students who were enjoying medium level of mathematical thinking, majority (53.0%) of them achieved good score in mathematical achievement test while the students who were enjoying high level of mathematical thinking, majority (57.0%) of them achieved excellent score in mathematical achievement test. It is concluded that level of students' mathematical thinking had direct effect of their academic achievement. As the level of mathematical thinking of students is being increased, academic achievement of the students is also being increased.

Table No.3. *Effect of the level of students' mathematical thinking on their academic achievement*

Level of Mathematical thinking	Count	Academic Achievement					Total
		B. Avg	Avrg	Good	V. Good	Excellen t	
Low	Count	6	8	4	0	0	18
	% within Level of Thinking	33.3%	44.4%	22.2%	0.0%	0.0%	100.0%
	% within Performance	23.1%	9.8%	2.6%	0.0%	0.0%	4.0%
	% of Total	1.3%	1.8%	.9%	0.0%	0.0%	4.0%
Medium	Count	20	74	122	14	0	230

Level of Mathematical thinking	Count	Academic Achievement					Total
		B. Avrg	Avrg	Good	V. Good	Excellent	
High	% within Level of Thinking	8.7%	32.2%	53.0%	6.1%	0.0%	100.0%
	% within Performance	76.9%	90.2%	78.2%	20.0%	0.0%	51.3%
	% of Total	4.5%	16.5%	27.2%	3.1%	0.0%	51.3%
	Count	0	0	30	56	114	200
	% within Level of Thinking	0.0%	0.0%	15.0%	28.0%	57.0%	100.0%
	% within Performance	0.0%	0.0%	19.2%	80.0%	100.0%	44.6%
	% of Total	0.0%	0.0%	6.7%	12.5%	25.4%	44.6%

Pearson Chi-Square=328.415, df=4, sig=.000

It is indicated in the following table (Table No.4) that computed r-value (.775) for the correlation between mathematical thinking of students and their academic achievement is significant at .05 level of significance. It is concluded that there is strong correlation between mathematical thinking of students and their academic

Table No.4. *Correlation analysis to analyze the relationship between mathematical thinking of students and their academic achievement. (N=589)*

Variables	r	sig
Mathematical Thinking & academic achievement	.775	.000

* *Correlation is significant at the 0.05 level (2-tailed)*

Conclusion and Discussion

Present research was designed to explore the effect of demographic factors on students' mathematical thinking and their academic achievement at secondary school level in Sahawal division. After analysis it was found that demographic factors had effect of mathematical thinking of students. Gender and locality had no significant effect on mathematical thinking of students. Berberoglu G. (2012) found in study that gender had effect on mathematical thinking of students of students. In his study he found that male students had high level of mathematical thinking while female students had medium level of mathematical thinking. Nouhan K. (2014) stated that in his research he found female students had high level of mathematical thinking and male students had medium level of mathematical thinking. Moreover, he found that locality had also significant effect on mathematical thinking of students. In his research he found that the students who belonged to urban areas were enjoying high level of mathematical thinking as compare those who were from rural areas. The results of Sasaran S. (2015) conducted research shows that male students achieved excellent score in mathematics test as compare to female students. In addition, region wise significant difference was also found in her research. Majority of the students of rural region achieved upto "good" score, and majority of the students of urban region achieved excellent score in mathematical achievement test. It was found in the present research that parental education of profession had significant effect on mathematical thinking of students at secondary school level. The results of the present research reveals that majority of the

students whose fathers were illiterate and mothers were enjoying matric qualification, their mathematical thinking level was high as compare to parents whose were enjoying others qualification. Dinominotry W. (2015) posited that parental education had significant effect on students' mathematical thinking. To second the present research findings, he stated that as the level of parental education in being high up, thinking level of their kids increased accordingly. In the same way, as the level of thinking of the students is being high, they perform in the exam accordingly. On the other hand, the students who possessed low level of thinking, majority of them performed "average" in exam and the students who were enjoying medium level of thinking, majority of them performed "good" in exam, while the students who had high level of thinking, majority of them performed "excellent" in exam. Mungania (2016) in her doctoral dissertation, finding highlighted that parental profession also had significant effect of students' mathematical thinking and their academic achievement also. The parents who were working at high profile level, their kids possessed high level of thinking and the students who possessed high level of thinking majority of them performed excellent in exam. In present research also found that the students whose fathers were government job holder, those whose mothers were private job holder, their mathematical thinking level was high. Parental income also play a vital role in the students thinking. The present research finding revealed that the students whose parents were earning upto PKR, 15,000 per months, their mathematical thinking level was high. The same result was found in Binod N. (2016) research that parental income had significant effect on students' mathematical thinking, the parent who earned high amount their kids possessed high level of mathematical thinking. It was also found in the present research that there is strong correlation between students' mathematical thinking and their achievement in mathematics subject. The finding discloses that the students who were enjoying low level of mathematical thinking, majority of them achieved average score in mathematical achievement test and the students who were enjoying medium level of mathematical thinking, majority of them achieved good score in mathematical achievement test while the students who were enjoying high level of mathematical thinking, majority of them achieved excellent score in mathematical achievement test. It is concluded that level of students' mathematical thinking had direct effect of their academic achievement. As the level of mathematical thinking of students is being increased, academic achievement of the students is also being increased. In the light of above finding, it is recommended that it is indispensable for students to accelerate their mathematical thinking to perform well in mathematics subject. To improve mathematical thinking in students, education department should arrange training programs based on mathematics teaching techniques to improve students' mathematical thinking. Teachers' personality, qualification, experience, their instructional techniques, teaching, learning material, classroom environment, might be the other factors which can be found in further researches.

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