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Factors Associated with Academic Achievements of Students in Mathematics: A Quantitative Study in Peshawar, Pakistan

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Abstract

This study is conducted to find out the factors which are associated with students' academic achievements in the subject of mathematics in different higher education institutions which are based in Peshawar, Khyber Pakhtunkhwa, Pakistan. The data is collected through a structured questionnaire from Bachelor of Studies (BS) 5th semester program of all the academic departments of well-known government educational institutions of Peshawar. All academic departments, except the departments of mathematics were selected, especially where the subject of mathematics is taught as compulsory or general course to the undergraduate students. The collected data is analysed on SPSS-20. For the analysis purpose mean, standard deviation, T-test, chi-square, and odd ratios are used. The results show that earlier performance such as primary level, attitude toward mathematics, difficulty of mathematics, study hours and self-confidence in mathematics learning are associated with students' academic achievement in mathematics.

Keywords: Students, Performance, Students Achievements, Academic Achievements

1. Introduction

In the last few decades, the proportion of literate and educated people have been significantly increased throughout the developing world but the quality and content of curriculums, the teaching methodologies and the required education sector reforms in line with the demands of modern age are yet to be realized by most of the developing countries which not only hinders their economic development but also threaten their unity and national harmony (Ullah, Mustafa, & Badshah, 2017). Mathematics is a critical skill for all, who have good or poor grade. In today changing world, its importance is increasing in terms of technological change (Burghs, 2011; Norris, 2012). The importance of Mathematics cannot be overemphasized in this era of science and technology. It is the language of science which provides a base for developing technology. If anyone does not know the language of science, how can he understand science or develop technology. That is why developed countries are focusing too much/more than on Mathematics. Peshawar as the heart of the province and historical city of Khyber Pakhtunkhwa, Pakistan, produce thousands of graduate every year. Mathematics achievement is affected by number of factors, found in different study of literature review. However, no such study is conducted in this area for assessing the same factors. Therefore, this study has focussed on factors associated with students' achievements in mathematics at higher level educational institutions.

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2. Literature Review

A sample of 197 university level students was studied in Australia to check the effects of past performance of a student on his latter achievements. The analysis revealed that the earlier academic performance was the most significant predictor of students' performance at the university level (McKenzie & Schweitzer, 2001). Attitude has significant effect on achievement as revealed by a comparative study of 14003 school level students in U.S and Australia (Lamb & Fullerton, 2001). In a study of a sample of 300 primary schools children in Kenya, found that most of the students had positive attitude towards mathematics but male students had more positive attitude toward mathematics as compared to the female students (Kiptum et al., 2013). A comparative study was conducted in U.S and Australia at school level in which about 14003 students participated. The results supported the premise that homework has significant effect on the performance of students. The findings also indicated that the effect of homework on achievements of students were more significant in US than Australia (Lamb & Fullerton, 2001).

A study of 7902 school level students showed that one extra hour of homework improves mathematics achievement by 0.243 standard deviations (McMullen, 2007). Literally, it refers to the belief in oneself and one's abilities to cope with situation. Confidence is a sense of self-esteem and general self-efficacy (Neill, 2005). Self-confidence and self-efficacy enhance the ability of a person to successfully pursue the desire objectives. Indeed, a student with a high level of self -confidence is more likely to perform better than the one with a low level of self-confidence. According to Ma & Bradley (n. d.), an investigation performed 3116 school level students in America showed a strong positive relationship between self-confidence and performance in mathematics. Further study of 543 American 11^{th} grade learners had showed that self-confidence had significant direct effects on the performance in the subject of Mathematics (Campbell & Beaudry, 1998).

A study conducted on in Western North Carolina county comprising of 1035 high school student revealed that academic achievement and participation in co-curricular activities were related significantly (George, 2012). Jayanthi et al., (2014) have investigated 144 students in a tertiary institution in Singapore and concluded that students' involvement in co-curricular activities contribute to improved performance in academics. Marsh & Herbert, (1992) have documented that there is small but statistically significant and positive relation between co-curricular activities and academic achievement. An investigation conducted consist of 849 students in colleges of education, polytechnics, and universities in Nigeria, revealed that excessive involvement in sports and other co-curricular activities negatively affect the academic performance of students (Olayiwola et al., 2011).

3. Research Methodology

Different colleges were selected from Peshawar territory. Then from departments, total sample of 940 student from BS (5^{th} semester) was selected, where mathematics was taught as a minor subject. Data was collected via a structured questionnaire. Therefore, whole class of BS (5^{th}) semester were considered as representative sample of the department. For proper tabulation and classification of percentages, the relevant statistical techniques have been used for the analysis of data through SPSS version-20. The techniques that have been used for analysis of data are Student`s t-distribution, Chi-square test, Odds ratios, Confidence Interval estimate and logistic regression.

4. Results and Discussion

Two sample t-tests for independents samples was used to compare the average GPA in relation to the student factors and chi-square and odds ratio to was used compare its percentage in less than 3GPA group in table-1. The results indicate that there is significant difference in average GPA of F.A/F.Sc marks (T-value=4.157, P-value=0.000), whereas it is further shown that in <3GPA group 27.5% students have <800 marks group against 9.5% students have ≥800 marks group (Chi-Square=28.528, P-value=0.000 and O.R=3.670, 95% C.I is 2.233, 6.032). There is significant difference in average Mathematics GPA of students C.GPA group (t-value=8.876, P-value=0.000), where it is further found that 42.7% <3C.GPA group as compared to ≥3C.GPA group in <3GPA group (Chi-Square=68.297, P-value=0.000 and O.R=6.479, 95% C.I is 4.028, 10.422).

There is significant difference in average GPA of student good in Mathematics at primary level (t-value=5.196, P-value=0.000), further results indicate that in <3GPA group 15.9% student good in Mathematics at primary level against 29.2% student do not good in Mathematics at primary level (Chi-Square=9.639, P-value=0.002 and O.R=0.463, 95% C.I is 0.283, 0.759). There is significant difference in average GPA of attitude toward Mathematics (t-value=6.951, P-value=0.000), while it is further available that 14.1% students have positive attitude toward Mathematics compared to 33.3% students have negative attitude toward Mathematics in <3GPA group (Chi-Square=22.744, P-value=0.000 and O.R=0.334, 95% C.I is 0.210, 0.571). There is significant difference in average GPA of Mathematics is difficult for student (t-value=8.687, P-value=0.000), it is more available that in <3GPA group 32.1% students considering Mathematics is difficult as compare to 9.4% students do not considering Mathematics is difficult (Chi-Square=41.144, P-value=0.000 and O.R=4.404, 95% C.I is 2.737, 7.085).

There is significant difference in average GPA on the basis of student`s study hours of Mathematics (t-value=2.435, P-value=0.015), further result tells that 22.3% <2 hours against ≥2 hours in <3GPA group (Chi-Square=4.335, P-value=0.037 & O.R=1.625, 95% C.I is 1.026, 2.572). There is significant difference in average GPA on the basis of student`s self-confidence in Mathematics learning (t-value=7.417, P-value=0.000), where it is further found that 12.9% students have self-confidence in Mathematics learning as compare to 33.3% students have no self-confidence in Mathematics learning (Chi-Square=27.961, P-value=0.000 & O.R=0.303, 95% C.I is 0.192, 0.479). While, there is no significant difference in average GPA of Student`s home tuition for Mathematics in F.A/F.Sc marks (t-value=1.024, P-value=0.307), where it is further indicate that in <3GPA group 21.2% Students had home tuition for Mathematics in F.A/F.Sc marks against 18.0% Students had not home tuition for Mathematics in F.A/F.Sc marks (Chi-Square=0.524, P-value=0.469 & O.R=1.210, 95% C.I is 0.722, 2.028).

There is no significant difference in average GPA on the basis of friends/family member/others help student in problem solving (t-value=1.132, P-value=0.258), where it is further found that 17.3% students whose friends/family member/others help in problem solving against 21.3% students whose friends/family member/others do not help in problem solving in <3GPA group (Chi-Square=1.122, P-value=0.289 & O.R=0.784, 95% C.I is 0.499, 1.231). There is no significant difference in average GPA on the basis of student`s participation in co-curricular activities (t-value=0.553, P-value=0.581), whereas it is further shown that in <3GPA group 19.1% students participate in co-curriculum activities as compare to 17.4% students do not

participate in co-curriculum activities (Chi-Square=0.295, P-value=0.587 and O.R=1.139, 95% C.I is 0.713, 1.819).

Students group having<800 marks in FA/FSc has less average GPA in Mathematics than students having ≥800 group and the difference, is significantly high. Percentage of <800 marks group is higher than ≥800 marks group in <3GPA group. Students having ≥800 marks are likely to get more than 3GPA in Mathematics. The odds of <800 marks group is 3.670 time more likely than ≥800 marks group in <3GPA group. Chi-square indicates that there is association between Mathematics GPA and F.A/F.Sc marks. Student has <3C.GPA group has less Mathematics average GPA than ≥3C.GPA, there difference is highly significant. Percentage of <3C.GPA group in <3GPA is higher than ≥3C.GPA group. The odds of <3C.GPA group is 6.479 time more likely than ≥3C.GPA group in <3GPA group. Chi-square shows that there is association between Mathematics GPA and C.GPA. Students having ≥3C.GPA are likely to get more than 3GPA in Mathematics.

Student who were good in Mathematics at primary level have higher average GPA than students who were good in Mathematics at primary with highly significant difference. Percentage of student who were good in Mathematics at primary level in <3GPA group is less than student who were poor in Mathematics at primary level. Which, means student who was good in Maths at primary level will get high GPA in Maths? The odds of "student was good in Maths at primary level" group is 0.463 time less likely than "student was not good in Maths at primary level" group in <3GPA group. Chi-square indicates that there is association between Mathematics GPA and students' performance in Mathematics at primary level.

Student who have positive attitude toward Mathematics has significantly high average Mathematics GPA than student who have negative attitude toward Mathematics. Percentage of student having positive attitude toward Mathematics in <3GPA group is less than students having negative attitude toward Maths. The odds of student having positive attitude toward Mathematics 0.334 time less likely than students having negative attitude towards Maths. Chi-Square reveals that there is highly significant association between Mathematics GPA and Student attitude toward Maths. Students, who have positive attitude toward Maths, are more likely to get high GPAs in Maths. When students have positive attitude, they take greater interest and work hard to learn maths.

The ratio of students who are considering the Mathematics as a difficult subject has significantly less average Mathematics GPA than the students who are not considering Mathematics as difficult subject. The pPercentage of students who considering Mathematics as difficult in <3GPA group is high than who is not considering Mathematics difficult for them. The odds of students who considering Mathematics as difficult 4.404 times more likely than who is not considering Mathematics as difficult for him. Chi-square tells that there is association in Mathematics GPA.

The number of students who studied the subject of Mathematics <2 hours has significantly less average Mathematics GPA than students who studied Mathematics ≥2 hours group. Percentage of students who studied the subject of Mathematics <2 hours is higher than students who studied Mathematics ≥2 hours in <3GPA group. The odds of <2 hours group is 1.625 times more likely than ≥2 hours group. The Chi-square shows that there is a significant association between the Mathematics GPA and the number of study hours. The students, who study equal or more than two hours on daily basis, are more likely to get a high GPA.

Table-1: Mathematics GPA in Relation to Student Factors

Factor		N	%	T-value P-value	<3GPA		≥3GPA		Chi-Square P-value	O.R	95% C.I
					N	%	N	%			
F.A/F.Sc. Marks	<800	247	48.5	4.157**	68	27.5	179	62.5	28.528**	3.670*	2.233,
	≥800	263	51.5	0.000	25	9.5	238	91.5	0.000		6.032
Overall GPA (C.G.P.A)	<3GPA	131	25.7	8.876**	56	42.7	75	57.3	68.297**	6.479*	4.028,
	≥3GPA	382	74.3	0.000	40	10.5	342	89.5	0.000		10.422
Good in Maths at primary level	Yes	416	79.7	5.196**	66	15.9	350	84.1	9.639**	0.463*	0.283,
	No	106	20.3	0.000	31	29.2	75	70.8	0.002		0.759
Attitude toward Mathematics	+ve	391	75.2	6.951**	56	14.1	335	85.9	22.744**	0.334*	0.210,
	-ve	129	24.8	0.000	43	33.3	86	66.7	0.000		0.571
Mathematics is difficult for me	Yes	209	40.3	8.687**	67	32.1	142	67.9	41.144**	4.404*	2.737,
	No	309	59.7	0.000	29	9.4	280	90.6	0.000		7.085
Home tuition for Maths in F.A/F.Sc.	Yes	113	21.8	1.024	24	21.2	89	79.8	0.524	1.210	0.722,
	No	405	78.8	0.307	73	18.0	332	82.0	0.469		2.028
Study hours of Maths	<2	203	41.3	2.435*	45	22.3	157	77.7	4.335*	1.625*	1.026,
	≥2	288	58.5	0.015	44	15.3	244	84.7	0.037		2.572
Self-confidence in Maths learning	Yes	371	71.7	7.417**	48	12.9	323	87.1	27.961**	0.303*	0.192,
	No	147	28.3	0.000	49	33.3	98	66.7	0.000		0.479
Friends/family member/others help me	Yes	336	64.8	1.132	58	17.3	278	82.7	1.122	0.784	0.499,
	No	123	35.2	0.258	39	21.3	144	68.7	0.289		1.231
Take part in co-curriculum activities	Yes	330	64.3	0.553	63	19.1	263	80.9	0.295	1.139	0.713,
	No	184	35.7	0.581	32	17.4	152	82.6	0.587		1.819

*(p<0.05) and **(p<0.01)

The ratio of the students having a self-confidence in the subject of Mathematics learning have comparatively a high average GPA than students lacking self-confidence in Mathematics learning. The percentage of student having self-confidence in Mathematics learning group has been less than student has no self-confidence in the Mathematics learning group in <3GPA group. The odds of students have self-confidence in the Mathematics learning is 0.303 times more than students having no self-confidence in the Mathematics learning. Chi-Square indicates a highly significant association between the Mathematics GPA and self-confidence in the Mathematics learning. Those students who have self-confidence in Mathematics learning, will achieve a high GPA.

4.1. Logistic Regression Model of Student Factor

The equation of the line from the output is given in the table-2:

$$ln\left[\frac{\hat{p}(x)}{1-\hat{p}(x)}\right] = 1.058 + 1.242x_1 - 0.501x_2$$

For the model selection-2 Log likelihood=493.327, Cox and Snell R-Square=0.005 and Nagelkerke R-Square=0.008. The coefficient for the attitude of students toward mathematics is -0.501. When the attitude toward mathematics is positive, the odds of Mathematics GPA increases by a factor of 0.606 when other variables are controlled. Similarly, logistic coefficient for students perceiving Mathematics difficult is 1.242. When Mathematics learning is considered as a difficult subject by students, the odds of Mathematics GPA raise by 3.463 times, which is highly significant.

The ratio of student having a positive attitude towards learning the subject of Mathematics is 0.606 time of student having negative attitude toward Mathematics in <3GPA group. In other words, the ratio of students with a negative attitude towards Mathematics group are 1.650 times of students having a positive attitude towards mathematics in <3GPA. The students with negative attitude toward Mathematics are almost double in <3GPA group than the students with positive attitude. When students have positive attitude toward Mathematics, they take it seriously and study more for it and hence get better GPA. The ratio of students who perceive mathematics a difficult subject is 3.463 to the students who do not consider mathematics difficult. In other words, the number of students perceiving Mathematics as a difficult subject is three time more than the students who think otherwise. When students consider a subject difficult, they neither take interest in it nor study for it, which negatively affect their performance in examination.

Table-2: Parameter Estimate, Backward Selection Method

Statement	B	S.E.	Wald	Df	Sig.	Exp. (B)
Student Attitude Toward Maths (positive)	-0.501	0.297	2.851	1	0.091	0.606
Mathematics is difficult for Student (yes)	1.242	0.296	17.637	1	0.000	3.463
Constant	1.058	0.233	20.594	1	0.000	2.882

5. Conclusion

Based on the above analysis and discussion, it is concluded that the previous obtained marks of the students; students who are good in primary level education, the home tuition, study hours system and self-confidence in learning mathematics definitely contribute to students' mathematics achievement. The questions such as if students' attitude toward mathematics is positive or mathematics is not difficult subject for them, it has been found that they achieve high GPA. This study also confirms the results of earlier studies like earlier academic background, attitude towards mathematics and self-confidence of the students. However, it has been assessed from the findings that the result for co-curricular activity is against the findings of the earlier studies.

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