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Exploring the Impact of Demographic Variables Gender, Parental Education and Locality on Science Achievement at 8th and 9th Grades

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Abstract

Quality of science education is under the consideration of educationists and researchers. Achievement in science subjects, which is one of the indicators of quality of science education, determines not only the students' performance but it also helps the teachers to evaluate their teaching strategies. This study is an effort to explore the factors related to science achievement in Pakistani perspective. In this survey, science achievement scores of the students of 8th grade decide their entrance in science subjects at 9thgrade. Sample of 1149 students of 8th and 9th grade students of high and elementary government schools were taken randomly for data collection. Major results were that parental qualification and maternal job status effect significantly students' science achievement. Female students were significantly higher than male students, and 8thgrade students were significantly higher than 9th grade students in their science achievement scores. It is recommended that teachers of secondary schools and rural schools during parent teacher meeting may motivate the parents to supervise their children during studies at home and they themselves study books at home.

Keywords: Science achievement, parental qualification and parental profession

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Introduction

In this modern age, scientific advances in all walks of life, e.g. business, industry, and communication need all the commoners to have basic knowledge of science. Science education plays a key role in the economic and technological development of a country. That is why educationists are always concerned about the quality of science education. Concern about science education is increasing in the coming times as the students' choose science subjects to enter into a profession (Association of American Universities, 2006). The achievement scores of a student determine how effectively he /she has mastered the contents of that particular subject. Gaps in achievement of science will determine the profession with good pay and prestige (Hong, 2013) while it is predicted that most of the students will chose scientific profession in the coming decades (Lacey & Wright, 2009). The achievement scores are directly and/or indirectly related to many factors including gender, grade, locality etc.

The gender and achievement in science is the continuous focus of educationists. A number of evidences support the gender differences in science achievement. Some researches' findings were in contradiction to these. In general, researches support the male students' higher achievement in science subjects as compared to their counterparts (Quinn, David, & Coor, 2015; Kahle, 2004). Further, DeBacker and Nelson (2000) and Eisenhart, Finkel, and Marion (1996) explained that one of the reasons of the girls' low performance is traditional role in professions assigned to them. Similarly, female students do not get opportunities related to experiments of science subjects within the classrooms and other activities like visit to different places outside the classrooms. According to Greenfield (1996) low performance of female students is due to gender oriented biasness of the teachers. This difference of performance also results from variation in cognitive abilities as indicated by Baron-Cohen (2003). National Assessment of Educational Progress (NAEP) of USA has conducted researches to study the gender based differences in science achievement for 20 years and concluded that male students perform better than female students in different science subjects. A number of evidences are there in literature that this gap in achievement of male and female students in science subjects is never significant till 4th grade; and interestingly this gap starts widening during high school years (Quinn, David, North, & Coor, 2015; Griffith, 2010; Hill, Corbett, & Rose, 2010) for example in the subject of physics, male students perform better than female students (Bell, 2001; Burkam, Lee, & Smerdon, 1997; Lee & Burkam, 1996; Preece, Skinner, & Riall, 1999).

Glory, Sopuru, and Ihenko (2017) found equal achievement of both male and female students in science subjects. Campbell (1993) stated that male and female students are now taking equal interest to get enrolled in different basic science subjects including algebra, chemistry, geometry, biology and even trigonometry but female students are still far behind the male students in the science courses of calculus, physics and the earth and space sciences. The reason may be explained through the findings of Halpern, Benbow, Geary, Gur, Hyde, and Gernsbacher (2007) who studied sex differences under the funding of Templeton Foundation to Camilla Benbow and concluded that males have higher volume of connecting white-matter tissue which is more linked with quantitative subjects and cognitive abilities as compared to females with higher quantity of gray matter which is more concerned with language, culture and arts subjects.

On the other hand, many research studies have reported equal or higher science achievement by female students as compared to male students (Catsambis, 1995; Greenfield, 1996; Zohar & Sela, 2003). In Turkey, 8th grade female students performed higher in physics subject than male students (Acar, 2015; Bursal, 2013). Female students performed better than the male students in the domain of conceptual knowledge and utility value of science (Acar, 2015); in higher order thinking questions, female students performed higher than males (Preece et al., 1999). According to Sencar and Eryilmaz (2004) the difference in male and female students' misconceptions regarding the concept of electric circuit decreases when students' interests and prior experiences related to the topic are controlled.

According to Gaspard (2016) socio-economic status of family and fathers' positive thinking about importance of science have positive relationship with achievement in science. Studies have also reported that parental education, income and occupation also affect students' achievement (Lytton & Pyryt, 1998; Ma & Klinger, 2004; Manning, 1998; Sammons, West, & Hind, 1997; Rana, 2000).

In the words of Campbell and Wu (1994), parental involvement is one of the factors that contributed towards science achievement. Similarly increase in home resources ultimately leads towards students' better science achievement (Roscigno & Ainsworth-Darnell, 1999; Xin, Xu, & Tatsuoka, 2004). Moreover Parents' communication with school, their involvement in homework and their monitoring cause increase in the science achievement scores at eighth grade students' achievement in math, science, reading, and social studies. Keith and Lichtman (1994) studied Mexican- American eighth graders students' science achievement and parental involvement, and reported that parental involvement has strong influence on academic achievement. Some forms of parental involvement had stronger influence on grades and test scores. The purpose of the study was to explore the difference in students' science achievement on the basis of their gender, locality, grades, school type, parental education and parental qualification.

Objectives of the Study

Following were the objectives of the research study;

1. Explore students' science achievement scores based on gender, locality and school type.
2. Compare students' science achievement scores based on parental education, profession.

Method of the study

In this study, data were collected through survey method by self-visit. In the province of Punjab, Pakistan; three districts i.e. Okara, Sargodha and Rawalpindi were conveniently selected and from these cities, 37 high and elementary (middle) schools were taken on the basis of head teachers' willingness. In this way a sample of 1149 students of 8th and 9th grade of high and elementary government schools was taken randomly for data collection. Among these 596 randomly selected students were male and 553 students were female; 794 students were of grade 8 and 355 students were of grade 9; 741 students were from high schools and 408 were from elementary schools; and 421 students were from rural and 728 were from urban vicinity. All the students participated willingly and it was openly announced that if someone is not willing, he can leave the data collection session.

Science achievement scores

Achievement scores in the General Science subject for students of 8th grade were taken from the centralized exams' results and converted into percent (%) scores. Similarly form the centralized exams' results, achievement scores of 9th grade students in the subjects of Physics, Chemistry and Biology were added and then converted into percent (%) to equate with the scores of 8th grade students. These were the students who willingly participated in research.

Data Analysis

Data were analyzed by applying t-test and one way ANOVA.

Results

Table 1
Comparison of Mean scores on the Basis of Gender, Grade, Locality and Private Tuition

			N	Mean	t	Sig.
Gender	All students	Male	596	40.80	-3.345	0.001
		Female	553	44.27		
	Grade 9	Male	192	36.62	-3.493	0.001
		Female	163	43.30		
	Grade 8	Male	404	42.78	-1.546	0.123
		Female	390	44.67		
Locality	All students	Rural	382	37.74	-6.523	0.000
		Urban	767	44.83		
	Grade 9	Rural	109	40.27	0.396	0.692
		Urban	246	39.44		
	Grade 8	Rural	312	37.79	-8.096	0.000
		Urban	482	47.55		
	School type	High	741	40.93	-4.012	0.000
		Elementary	408	45.27		
	Grade wise scores	Grade 8	794	43.71	3.584	0.000
		Grade 9	355	39.69		

Table 1 shows that overall mean score (*M*=44.27) female students and male students (*M*=40.80) differ significantly in their achievement scores of science subject as indicated by t-value -3.345 and *p*=0.001<0.05. Similarly among the students of 9th grade, the difference in mean scores of female (M = 43.30) and male (M= 36.62) students was significant as indicated by t-value -3.493 and p-value = 0.001<0.05. But there was no significant difference between mean achievement scores of male (*M*=42.78) and female (*M*=44.67) students of 8th grade in the subject of science as indicated by t-value = -1.546 and p-value = 0.123 > 0.05.

Overall locality wise, the urban students (*M*=44.83) and rural students (*M*=37.74) differ significantly in their mean achievement scores in science subject as indicated by t value (-6.523) and *p-value*=0.000<0.05. Similarly among the grade 8th students, there was also significant difference between mean achievement scores of urban (*M*=47.55) and rural (*M*=37.79) as reflected by t-value (-8.096) and p-value= 0.000<0.05. But among 9th grade students there was no significant difference between the mean achievement scores of urban (M=39.44) and rural (M=40.27) as indicated by t-value 0.396 and p-value= 0.692>0.05.

Analyzing the results with respect to institution type; it was found that the grade 8th students of high school (*M*=40.93) and grade 8th students of elementary school (*M*=45.27) differ significantly in their achievement scores in science subject as indicated by t-value = -4.012 and *p-value*=0.000<0.05.

Analyzing overall results of grade 8th and grade 9th students; it was found that the mean achievement score of grade 8th students (*M*=43.71) and grade 9th students (*M*=39.69) differ significantly in science subject as indicated by t-value = 3.584 and p-value = 0.009 < 0.05.

Table 2
One way ANOVA on Science Achievement Scores on Different Demographic Variables

One Way ANOVA		Sum of Squares	*df*	Mean Square	F	Sig.
Paternal Education	Between groups	8422.259	7	1203.18		
	Within Groups	348617.2	1136	306.88	3.921	0.000
	Total	357039.5	1143			
Maternal Education	Between groups	8221.869	6	1370.311		
	Within Groups	349080.4	1139	306.48	4.471	0.000
	Total	357302.3	1145			
Paternal Profession	Between groups	4391.341	5	878.268		
	Within Groups	350998.8	1133	309.796	2.835	0.015
	Total	355390.1	1138			
Maternal profession	Between groups	5368.445	4	1342.114		
	Within Groups	352149.2	1141	308.632	4.349	0.002
Total		357517.6	1145			

Table 2 depicts that the students having different paternal education level differ significantly in achievement scores in the subject of science as indicated by F=3.921, *p=0.000*<0.001; similarly the students differ significantly in achievement scores with respect to maternal education as apparent from F=4.471, *p=0.000*<0.001; students achievement score in the subject of science differ significantly with respect to parental profession as indicated by F=2.835 and *p=0.015*<0.01; similarly students achievement score in the subject of science differ significantly with respect to maternal profession as indicated by F=4.349, *p=0.002*<0.01. For in depth analysis least significant test (LSD) was applied.

Table 3
Post-hoc test

	Education	Education	Mean Difference	Sig. P-value
Paternal education	Illiterate	Primary	-6.102	0.003
		FA/F Sc	-5.089	0.011
		BA/B Sc	-5.079	0.027
		MA/ M Sc	-12.764	0.000
	Primary	Elementary	4.353	0.037
		Matric	3.869	0.049
	MA/M Sc	Elementary	11.016	0.001
		Matric	10.531	0.001
		FA/F Sc	7.673	0.024
Maternal Education	Illiterate	Primary	-4.604	0.002
		Matric	-5.758	0.000
		BA/B Sc	-9.08	0.015
	Primary	Elementary	4.366	0.015
	Elementary	Matric	-5.52	0.002
		BA/B Sc	-8.882	0.001
Paternal occupation	Agriculture	Government Job	-4.566	0.008
		Personal business	-4.685	0.006
		Private job	-6.2	0.003
	Private Job	Labour	4.542	0.02
Maternal occupation	Government Job	Household	10.743	0.001
		Labour	18.651	0.001
		Private job	16.822	0.001

Table 3 shows that the students having different paternal education differ significantly in their achievement in science subject(s). The mean difference -6.102 and p-value 0.003<0.000 shows that students of fathers with primary education achieved significantly better than the students whose fathers were illiterate. Moreover, the mean differences -5.089, -5.079 and -12.764 show that the students whose fathers' qualification was F.A/F.Sc, B.A/B.Sc & M.A/M.Sc respectively, performed significantly better than the students having illiterate fathers. The mean difference 4.353 with p-value=0.037<0.05 and 3.869 with 0.049 < 0.05 shows that the students whose paternal education was elementary or secondary performed better than the students whose paternal education was primary. Similarly the mean differences 11.016 with p-value=0.001<0.05, 10.531 with p-value=0.001 and 7.673 with p-value= 0.024<0.05 shows that the students whose fathers education was M. A/M. Sc performed better than the students whose fathers' education level was elementary, matric or F.A/F.Sc respectively. It shows a trend that the higher the students' paternal education, the higher would be the science achievement of students.

The students having different paternal occupation differ significantly in their achievement of science subject(s). Respondents whose fathers were involved in private job, personal business and government jobs had better science achievement than respondents whose fathers were involved in agriculture sector.

The students having different maternal occupation differ significantly in achievement of science subject(s). Respondents whose mothers are in government job have better science achievement scores than respondents whose mothers are housewives, laborers and doing private job (Table 3).

Discussion and Conclusions

The focus of the study was to explore the factors related to science achievement of students at 8th and 9th grades. The findings based on students' science achievement scores indicate that the female students have significantly higher science achievement than male students, the grade 8 students got higher science achievement scores than grade 9 students, the urban students have significantly higher science achievement score as compared to rural students, the grade 8 students of elementary schools performed better in their science achievement scores than grade 8 students of high schools. The students having different paternal and maternal education differ significantly in their achievement of science subject(s). The higher the level of parental education, the higher would be the science achievement of students. The gradual increase/ decrease in mean differences show that parents' education seems to affect their offspring's' science achievement. The students whose parents were involved in different occupation differ significantly in their achievement of science subject(s).

In this study, the female students have higher science achievement scores than that of male students. This finding contradicts with Glory, Sopuruchi, and Ihenko (2017); Quinn, David , Coor (2015); Griffith, (2010); Hill, Corbett, and Rose, (2010); Greenfield, (1996); Jovanovic and King, (1998) and Kahle, (2004) that reported in favour of male students. But this finding is supported by Catsambis (1995); Greenfield, (1996); McEwen, Knipe, & Gallagher, (1997); Zohar & Sela, (2003), Rana (2000). Similarly overall performance of science students, the female students at different grades have performed better than male students as showed by the results of PEC (Punjab Examination Commission) and BISE (Boards of Intermediate and Secondary Education) of Punjab, Pakistan.

The 8thgrade students have higher science achievement scores than 9th grade science students. This finding was unusual to some extent as 9th grade students who select science subjects are usually hard working, intelligent and select science subjects according to their liking. So, they should have higher achievement scores than grade 8 students. The possible reasons are: a) at 9thgrade, students started to study science subjects separately (Biology, Chemistry and Physics) and this might have affected their overall performance; b) the conduction of 8th grade students exam by PEC (Punjab Examination Commission) might have some problems regarding transparency and fair play, so it might have increased the chances of inflated reflection of students' abilities.

The urban students have significantly higher science achievement scores as compared to rural students and a possible reason may be the availability of science teachers in urban schools ultimately causing the high achievement scores in science subject(s).

The 8th grade students enrolled in elementary schools performed better science achievement scores when compared with same grade students of secondary schools. The possible reason is that the 8thgrade is the terminating grade in elementary schools and their results directly affect the teachers' appraisal by higher authorities, so teachers may focus on their students at this grade causing high achievement scores among students of elementary schools of 8thgrade.

The students having different levels of paternal and maternal education differ significantly in their achievement of science subject(s). These findings of the study are supported by Lytton and Pyryt, (1998); Ma and Klinger, (2004); Manning (1998); Sammons, West, and Hind (1997); and Rana (2002). It is worthwhile to note that increase in parental education ultimately affects the students' science achievement. It may be due to parents' more involvement and awareness in their offspring's studies.

The higher educational level alternatively affects the profession and earning of an individual. So, the higher the level of socioeconomic status of family, the higher the achievement in science subject(s) of students (Coleman et al., (1966); National Centre for Education Statistics, 1992).

Recommendations and Educational Implications

1. There is need of in-depth study of higher female students' achievement in science subject in Pakistani scenario. The results of that study can be used to explore different techniques to enhance the male students' science achievement scores.
2. Underdeveloped and developing countries have the problem of low parental education and their low occupational profile that ultimately seem to affect students' science achievement scores. So, the role of teachers and schools becomes more prominent in this situation by looking for those strategies that can help to overcome this problem like continuously arranging meetings with parents etc.
3. Teachers of secondary schools and rural schools during parent-teacher meetings may motivate the parents to supervise their children during studies at home and inculcate in themselves the habit of reading books at home. Education Department may appoint teachers with higher qualification because usually in rural areas teachers of low qualification are working and the secondary school teachers should also focus on their grade 8 students.

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