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Assessing Scientific Literacy Levels among Secondary School Science Students of District Lahore

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Abstract

The purpose of this quantitative study was to assess the scientific literacy levels among the government secondary school science students of district Lahore. Proportionate stratified random sampling and purposive sampling were used for selection of 16 government secondary schools comprised of seven boys' and nine girls' schools of district Lahore. The selected schools were taken by five percent of proportion of total population. By using Bybee Scale, the test was designed contained two to ten contextual situations and questions of four scientific literacy levels. Analysis of the study was based on percentage, mean, t-test, and ANOVA. The results revealed that secondary school science students attained the nominal and functional level of scientific literacy which was at the lowest levels. Findings also showed that girls performed better than boys in all levels of scientific literacy. There was no difference in the scores of students related to their mothers' education and mothers' skill level. There was a difference in the scores of students related to their fathers' education, fathers' skill level and students' dedicated time for learning of science (hours per day, at school as well as at home). The curriculum developers should plan a course of scientific literacy or merge scientific literacy concepts and activities in science textbooks for secondary schools to increase scientific literacy. The time period for science subjects should be increased in government schools. All teachers from any subject should use such teaching methods especially for boys to make them critical thinkers.

Keywords: Scientific literacy, nominal level, functional level, procedural level, multidimensional level

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Introduction

Science is a systematic initiative that shapes and systematizes knowledge in the form of testable descriptions and forecasts about the universe. Several countries try to make scientific literacy the chief purpose of education. Although there are many other definitions for scientific literacy, they all usually include the aptitude for using scientific knowledge along with thoughtful objectives for personal and societal. *Scientific literacy* is the knowledge and considering scientific views and procedures essential for own decision making, contribution in public and ethnic matters, and economic output. Thus science literacy is much more about being capable of to apply ideas you perceive, and less about knowing evidences the top of your head. There is science in all parts of our lives and henceforth being scientifically literate is certainly important (Ajayl, 2018). The term of scientific literacy has been getting through the literature for over 40 years (Gallagher & Harsch, 1997), but not all the time with the similar meanings (Bybee, 1997). The OECD undertakes the determination of future adult scientific literacy through international longitudinal studies by written tests and questionnaires, achieving these goals show that developing countries are generally poor in performance (Organization for Economic Corporation & Development, 2007).

Scientific literacy is the capability to artistically use science knowledge in daily life to solve problems (United Nations Educational, Scientific and Cultural Organization, 1998). The scientific literacy is the key concept describing sciences and constantly cited in science methodology and teaching literature likewise required to attain for all learners of this time (Zaytoon & Ayesha, 2010). Scientific literacy is a prerequisite to be able to adjust to the tasks of a promptly altering world. This attention brings scientific literacy into line with the development and growth of life time skills. It distinguishes the requirement of intellectual skills in a social setting, and further, this vision distinguishes that scientific literacy is for all of us. It has little to do with science teaching exclusively directing towards occupation in science, or offering merely an scholastic science context for specialty in science. An additional intermediate view for scientific literacy perceives the general purpose as being concerned with social desires, to acquire how to deal with societal disputes and to make sensibly make verdicts (Rychen & Salganik, 2003).

Bybee (1997) has recommended the four scientific literacy functional levels at school level:

Nominal Level: In which students can recognize scientific terms although shows incorrect topics, information, issues, understanding and knowledge. Learners do not have a meaningful understanding of the concepts. They can state scientific principles in a naive way.

Functional Level: In which students can use scientific dictionary, but this is typically only out of perspective. Learners' use scientific vocabulary, describe scientific terms suitably and learn technical words.

Conceptual/Procedural Level: In which students show understand and relations between concepts and of the process of meaning. They understand establishing principles and procedures of science.

Multidimensional Level**:** In which the students not only understanding, but also establish a technology and science perception that comprises of the role of science, nature of science, and technology in life. They can understand science in a societal setting.

A study was conducted in Estonia (2011) by using scientific literacy scale. Test was developed and administered on 10^{th} and 11^{th} grade students. The result indicated that 54% students were in functional level and very few were at the multidimensional level.

According to Al-Momani (2016), a study was conducted on undergraduate students on Bybee's scientific literacy levels. Twenty eight percent of students possessed "Nominal Scientific Literacy". Forty four percent of students were at "Functional Scientific Literacy". Students with "Procedural Scientific Literacy" entailed eighteen percent. Lastly, five percent students possessed "Multi-Dimensional Scientific Literacy".

Durant et al. (1989) worked out on a 23 item questionnaire to measure public considerate the science and the scientific process. The results revealed that as little as five percent of US inhabitants were scientifically literate. The researchers carried out a similar investigation with the people in the United Kingdom by the same instrument, which specified that the scientific literacy level of Britain's was also low.

Popular belief is that women are less capable than men in the area of science courses than do men (Eccles, 1987). In the UK, it is found that the girls usually like science less and succeed less in science than boys (Breakwell et al., 2003). In the U.S, furthermore, the grades of National Assessment of Educational Progress in 2005 have revealed that gender differences in science achievement be as early as 4^{th} grade, and the gap between girls and boys increases with their age.

Parental education and occupation have a large positive influence on scientific literacy (Breen et al., 2009). Those students whose parents have high socio economic status, and higher parental education level scored significantly higher in PISA 2000 scientific literacy test (Turmo, 2004). According to Silinskas et al. in 2013, high educated mothers are having positive state of mind about literacy and are possible to involve in their children's education. Therefore, their child's literacy is exceptional than others.

Earlier studies have shown that how important the role of mothers' employment is in the development of offspring (Cogill, 1986). Children want their mother's time, care, and sustenance to increase scientific literacy. The employment of mothers negatively affects the female students, but this effect is not more than for male students (Rodgers & Thorson, 2003).

International Standard of Classification of Occupations

ISCO (International Standard of Classification of Occupations) is an ILO (International Labor of Organization) classification structure that offers a system of classifying and grouping the numerous occupations i.e. teaching, farming, banking, sales marketing, armed forces, driving, legislation etc. into four skill levels. ISCO is a four leveled hierarchically structured classification that permits all jobs/professions to be classified. The four level hierarchy of skills based on the task difficulty, specialization, education and scope of occupation. The main purpose of ISCO is to find certain categories in the classification and decide where particular occupations are classified.

Skill level can be defined as a function of the difficulty and variety of jobs and responsibilities to be done in an employment (International Labor of Organization, 2012).

International standard classification of occupation (ISCO) defined four skill levels:

Skill level 1

This level involves the people who accomplish easy and usual bodily or manual duties and tasks. They comprise of tasks for example digging, cleaning, lifting and carrying things by hand, categorization, storing or collecting things by hand, functioning non-motorized vehicles and harvesting fruits and vegetables. This level includes office cleaners, cargo handlers, garden workers, and kitchen assistance.

Skill level 2

It involves functioning of jobs for instance electronic and machinery equipment, drive automobiles, repairing and mending of electrical and mechanical tools and handling information. They have numeracy and literacy skills. This classified butchers, bus drivers, secretary, accounts clerks, dress makers, sewing machinists, shop sale assistance, hair dressers, police officers, motor vehicle mechanics, and building electricians.

Skill level 3

This level people do high difficult practical and technical tasks that need wide physique of realistic, professional and procedural knowledge in particular areas. This includes shop mangers, medical laboratory technicians, and medical radiographers, broadcasting and recording technicians.

Skill level 4

This skill requires decision making, problem solving, and creativity depends on a wide body of theoretical and truthful knowledge in particular area. This includes sales and marketing managers, teachers of secondary school, civil engineers, musicians, medical practitioners, computer operators and nurses.

In this study, respondents were asked about the different professions of their parents. Then, these professions were classified into four skill levels as per given by ISCO. For example: the respondents whose parents were teachers, nurse, managers etc. were kept in skill level 4, as ISCO placed them in skill level 4.

Theoretical Framework

Bybee in 1997 recommended scientific literacy (SL) can be measured by four functional levels at school levels. In this study, scientific literacy levels of students were determined by using these four levels. The four levels are:

Nominal SL: Recognize and identify scientific terminologies, but must not be perfect comprehension of the concepts.

Functional SL: Usage of technological and scientific vocabulary, but commonly this is only beyond context as is the case e.g. in a school tests. Student can remember answers and define terminologies appropriately.

Conceptual/Procedural SL: Students are able to define a concept properly, but have a little conception regarding this. Establishes understanding and an association between concepts and can use procedures with meaning. Have procedural knowledge and skills. Student can describe concepts and science ideas in their own words.

Multidimensional SL: Not only has comprehension, but has expanded viewpoints of science and technology that comprise of the nature of science, the role of technology and science in own society and life. Understand the place of one course to others. Recognize the history of subjects. It contains historical, philosophical and social components of technology and science. Students can acquire understanding and admiration of technology and science concerning its association to their daily lives.

The conceptual framework of the study

The conceptual framework of the study is given below:

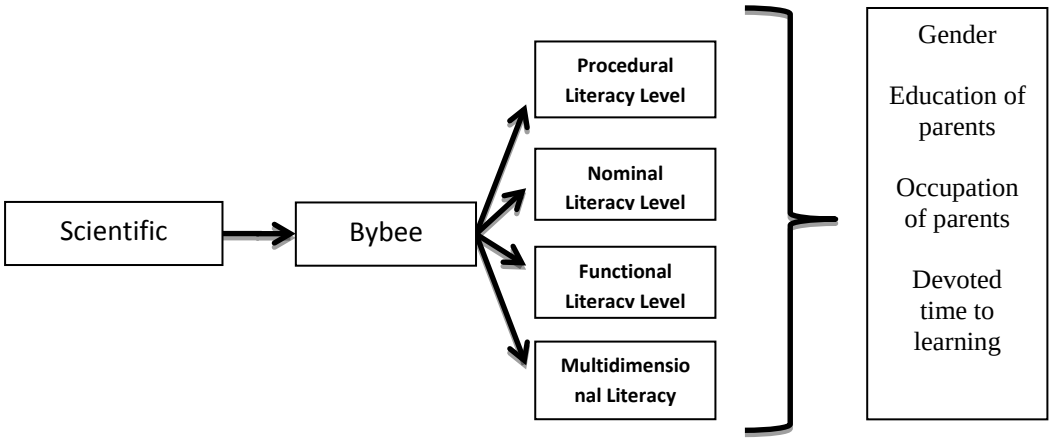


Figure1: *Conceptual framework of the study*

Statement of the Problem

At the level of secondary schools, students are close to the end of basic schooling in many countries and, follow it; their educational practices tend to deviate. Numerous studies of research presented that the scientific literacy do not produce scientific literate people (Al Zoubi & Abdullah, 2008).

According to the national education policy 2017, after the occurrence of TIMSS, mandatory steps will be taken for Pakistan's participation in the Programme for International Student Assessment (PISA) 2021. So this study was conducted for assessing the scientific literacy levels from the upcoming generations and for the approximation of how appropriately young adults are preparing to encounter the challenges of the future? And, are they capable to analyze the cause and convey their scientific opinions efficiently?

Objective of the Study

The major objective of the study was to assess the most and least attained scientific literacy levels among the government secondary school science students of district Lahore related to their gender, parents' education, parents' skill level and students' dedicated time for learning science (hours per day, at school as well as at home).

Research Questions

The research questions of the study were:

1. What is the most and least attained scientific literacy level of the science students of government secondary schools?

Research Hypotheses

The hypotheses of the study were:

HO1: There is no significant mean difference in the scores of scientific literacy levels between boys and girls of secondary school.

HO2: There is no mother's education wise significant mean difference in the scores of scientific literacy levels of secondary school science students.

HO3: There is no father's education wise significant mean difference in the scores of scientific literacy levels of secondary school science students.

HO4: There is no mother's skill level wise significant mean difference in the scores of scientific literacy levels of secondary school science students.

HO5: There is no father's skill level wise significant mean difference in the scores of scientific literacy levels of secondary school science students.

HO6: There is no significant mean difference in the scores of scientific literacy levels to the dedicated time for science learning of secondary school science students.

Method of the Study

Quantitative and survey study was conducted. Cross sectional research design was used to collect data.

Population and Sample

The study population consisted of government secondary school science students (Biology, Physics, and Chemistry at 9^{th} and 10^{th} grade) of district Lahore. According to the report on annual school census 2017-2018, there are 332 government secondary schools in Lahore in which 153 are boys' and 179 are girls' secondary schools.

There are more than 58,000 government secondary school students (collectively arts & science) in 9^{th} grade and more than 47,000 government secondary school students (collectively arts & science) in 10^{th} grade of district Lahore according to the report on annual school census 2017-2018.

Proportionate stratified random sampling and purposive sampling technique was used to select the government girls' and boys' schools of Lahore. Five percent proportion was taken for selecting each boys and girls schools randomly. The seven boys' and nine girls' schools were selected by taking 5% proportion of schools.

By considering the rule of Glenn D. Israel (1992), according to the precision level for the confidence interval 95%, if the population is >100,000 then the estimated sample size would be approximately 400. So there were over 400 secondary school science students of district Lahore in this study.

Only science students (Biology, Physics and Chemistry) of 9^{th} and 10^{th} grade were taken. If the school had more than one section of each science classes, then only one section was selected randomly. From these randomly selected science classes, 50% students were taken randomly as sample. Consequently, more than 400 science students were selected for study.

Research Instrument

Self-made scientific literacy test was used. By using Bybee scale, this self-developed test was designed by making contextual situations and questions of three subjects i.e. Biology, Physics and Chemistry by considering the curriculum alignment of Punjab text books. First pilot testing was done from 100 science students. The items had the range 0.27-0.84 of item difficulty and the range 0.20-above of item discrimination was selected. Then subject wise reliability was determined.

Table 1
Reliability of the Test

Subjects	Reliability
Biology	0.61
Physics	0.64
Chemistry	0.67
Total	0.71

After determining the reliability, test for almost 20-25 min was taken from specified random schools of Lahore. Data was analyzed by SPSS version 23 and Excel. Descriptive and Inferential statistics were used in this study by applying different tests.

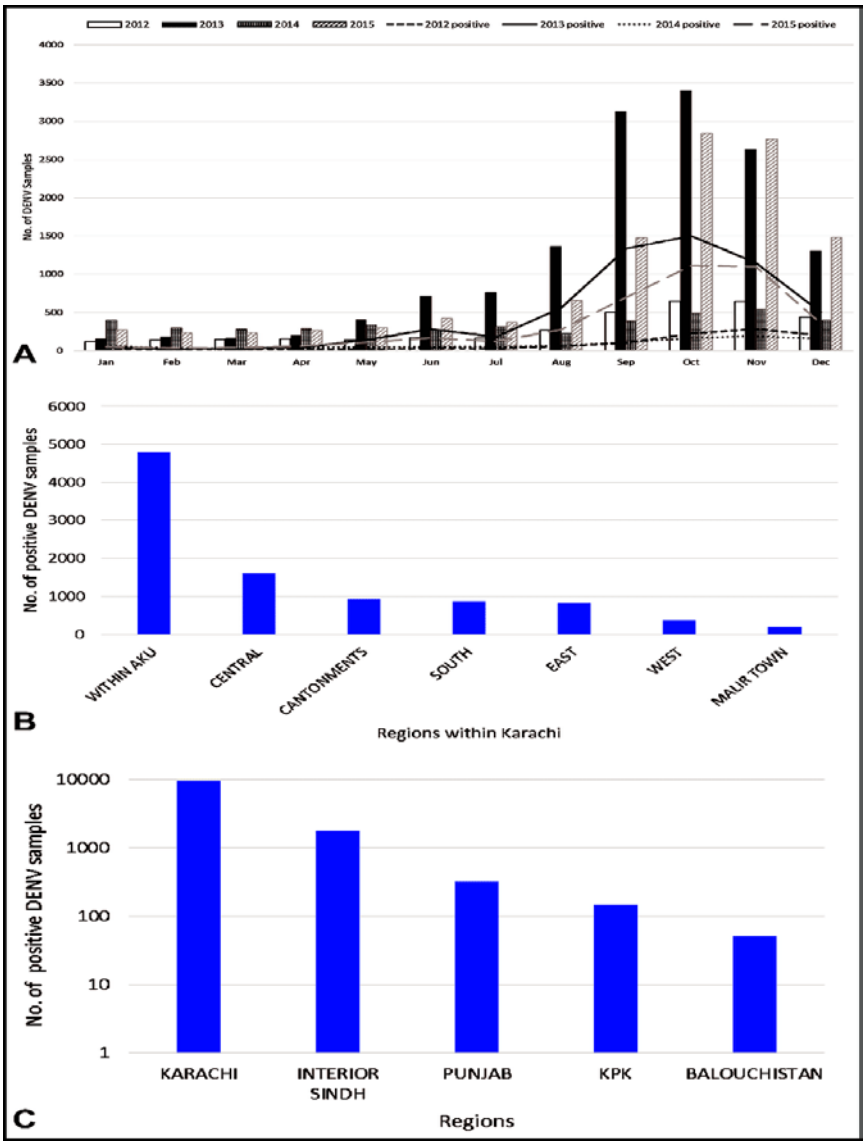
Sample Items of Scientific Literacy Test

Biology (Multidimensional level)

Agha Khan University Hospital reported dengue fever cases from different provinces of Pakistan in the year of 2012-2015. Here is a graph of reported cases:

Researchers investigated that Dengue fever is caused by a mosquito Ades. WHO advises to Pakistani government, the proximity of mosquito vector breeding sites to human inhabitations is a significant risk factor for dengue virus infection. The government of Pakistan is trying to eradicate such disease by collaboration of local

communities and health management. Suppose you are a stakeholder of health management, and then what measures and preventions would you like to implement to eradicate the dengue fever?



Chemistry (Nominal level)

1. Most metallic among following is

a. Na b) K c) Al d) B

2. pH of acid rain is

a. more than 5.6 b) less than 5.6 c) 10 d) 7

(Functional level)

1. The ozone layer and humans would be more vulnerable to various diseases due to the increased quantity of ultra-violet rays from the sun. Name one of these specific diseases that causes by UV rays.

Physics (Conceptual level)

2. You may have seen people while swimming and some other things floating on the water. They do not sink. Look at the pictures of the ship and the paper clip. What is the reason that both the ship and the paper clip can stay on top of the water?

Results of the Study

Research Question 1

What is the most and least attained level of scientific literacy of the science students of government secondary schools of district Lahore?

Table 2
Most and Least Attained Level of Scientific Literacy

Scientific Literacy Levels	*M*	*SD*
Level 1	15.19	4.07
Level 2	8.66	2.70
Level 3	1.88	1.23
Level 4	1.25	1.01

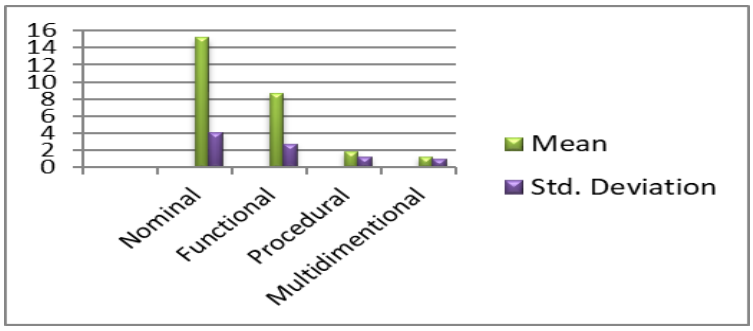


Figure 2. *Most and Least Attained Level of Scientific Literacy*

The mean scores of level 1 and level 2 were high. The mean scores of high levels i.e. level 3 and level 4 were low.

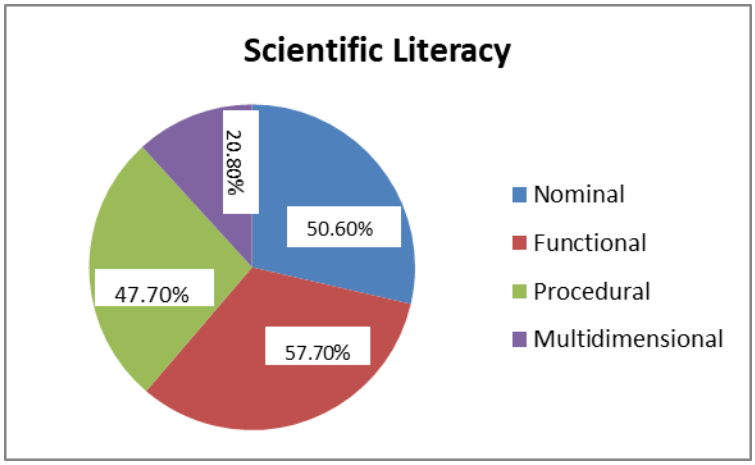


Figure 3. *Percentage of Correct Responses from each Scientific Literacy Levels*

From Nominal level of scientific literacy, students gave 50.6% correct answers. From functional level of scientific literacy, students gave 57.7% correct answers. From procedural scientific literacy level, students gave 47.7% correct answers. From multidimensional scientific literacy level, students gave 20.8% correct answers. It depicts that mostly the students were at nominal and functional scientific literacy levels.

Hypothesis 1

HO1: There is no significant mean difference in the scores of scientific literacy levels between boys and girls of secondary school science.

Table 3
Scientific Literacy Levels between Boys and Girls

Scientific Literacy Level	Gender	No.	*M*	*SD*	*t* value	Sig
Level 1	Boys	200	13.59	3.87		
	Girls	250	16.48	3.76	7.96	0.000
Level 2	Boys	200	7.66	2.67		
	Girls	250	9.46	2.44	7.44	0.000
Level 3	Boys	200	1.62	1.23		
	Girls	250	2.08	1.19	4.04	0.000
Level 4	Boys	200	1.07	1.06		
	Girls	250	1.39	0.95	3.38	0.000
Total	Boys	200	23.9	6.96		
	Girls	250	29.4	6.51	8.58	0.000

Table 3 shows that the independent sample *t*-test was conducted to compare the scores of scientific literacy levels between boys and girls. There was a significant mean difference in scores for boys (*M*= 23.9, *SD*= 6.96) and girls (*M*= 29.4, *SD*= 6.51; *t* (448) = 8.58, 〉 =0.00). This means that the girls are highly scientific literate than boys. Girls have more understanding of the phenomena's of science.

Hypothesis 2

HO2: There is no mother's education wise significant mean difference in scientific literacy levels of secondary school science students.

Table 4
Mean Scores of Scientific Literacy Levels of Students to the Education of Mother

Levels	Illiterate (n=65)		High school (n=173)		Post-Sec. diploma (n=3)		Sec. College (n=80)		raduate college (n=129)		ANOVA	
	M	SD	M	SD	M	SD	M	SD	M	SD	p	η^2
SL1	15.3	4.16	14.7	4.1	10.6	1.1	15.2	3.7	15.7	4.0	0.10	0.27
SL2	8.6	2.57	8.6	2.8	6.3	0.5	8.2	2.4	8.9	2.6	0.16	0.10
SL3	1.6	1.15	1.8	1.3	1.6	0.5	1.7	1.0	2.0	1.2	0.43	0.01
SL4	1.2	0.93	1.3	1.0	0.0	0.0	1.1	0.9	1.2	1.0	0.16	0.01

Table 4 shows that one way ANOVA between groups analysis of variance was conducted to compare the mean scores of scientific literacy levels among the mothers' different qualification levels. It is indicated that there was no statistical significant mean difference among qualification levels of mothers as $p > 0.05$. This means that the students' whose mothers are well educated or not, have no difference in scientific literacy scores.

Hypothesis 3

HO3: There is no father's education wise significant mean difference in scientific literacy levels of secondary school science students of district Lahore.

Table 5
Scientific Literacy Levels of Students to the Education of Father

Levels	Illiterate (n = 27)		High school (n= 137)		Post-Secondary diploma (n= 9)		Secondary College (n= 97)		Graduate college (n= 180)		ANOVA		
	M	SD	M	SD	M	SD	M	SD	M	SD	F	p	η^2
SL1	15.2	3.8	14.6	4.5	13.8	3.5	14.5	4.0	16.0	3.6	3.65	0.01	0.22
SL 2	8.2	2.8	8.3	2.6	6.7	0.6	8.4	2.8	9.2	2.6	3.76	0.01	0.10
SL 3	1.2	0.9	1.7	1.2	2.0	0.7	1.7	1.1	2.1	1.3	4.01	0.00	0.02
SL4	0.8	0.7	1.0	0.9	1.4	1.2	1.1	0.9	1.4	1.0	5.5	0.00	0.02
Total	25.5	6.3	25.7	7.7	24.1	5.2	25.9	7.1	28.8	6.7	5.28	0.00	

Table 5 shows that one way ANOVA between groups analysis of variance was conducted to compare the mean scores of father qualification related to scientific literacy levels. It was indicated that there was statistical significant mean difference at the $p<0.05$ level for the four scientific literacy levels: F (5.28), $p = 0.00$.

Table 6
Post Hoc Test Related to Scientific Literacy Levels of Students to the Education of Father

Dependent Variable	(I) Father Qualification	(J) Father Qualification	Mean Difference (I-J)	Sig.
Scientific literacy	Uneducated	High school	-.21871	1.000
		Post-secondary (diploma etc.)	1.40741	.986
		Secondary college	-.47117	.998
		Graduate college	-3.33148	.156
	High school	Uneducated	.21871	1.000
		Post-secondary (diploma etc.)	1.62612	.964
		Secondary college	-.25246	.999
		Graduate college	-3.11277*	.001
	Post-secondary (diploma etc.)	Uneducated	-1.40741	.986
		High school	-1.62612	.964
		Secondary college	-1.87858	.942
		Graduate college	-4.73889	.292
	Secondary college	Uneducated	.47117	.998
		High school	.25246	.999
		Post-secondary (diploma etc.)	1.87858	.942
		Graduate college	-2.86031*	.013
	Graduate college	Uneducated	3.33148	.156
		High school	3.11277*	.001
		Post-secondary (diploma etc.)	4.73889	.292
		Secondary college	2.86031*	.013

Post hoc Tukey test indicated that the graduate college fathers' qualification (M = 28.85, SD = 6.74) was significantly different from all high school fathers' qualification (M = 25.73, SD = 7.75) and secondary college fathers' qualification (M = 25.98, SD = 7.15). Fathers who are well educated have highly scientific literate children than those students whose fathers are less educated.

Hypothesis 4

HO4: There is no mother's skill level wise significant mean difference in scientific literacy levels of secondary school science students.

Table 7
Scientific Literacy Levels of Students to the Skill Level (SL) of Mother

Levels	SL1		SL2		SL3		SL4		House wives		ANOVA	
	(n=0)		(n=3)		(n=4)		(n=4)		(n=439)			
	M	SD	M	SD	M	SD	M	SD	M	SD	p	η^2
SL1	-	-	14.0	5.19	16.0	1.15	13.0	3.46	15.2	4.09	0.66	0.13
SL 2	-	-	9.0	6.92	5.0	4.61	6.5	1.73	8.7	2.63	0.17	0.39
SL 3	-	-	0.6	0.57	2.0	1.15	1.5	0.57	1.8	1.23	0.34	0.02
SL4	-	-	0.6	0.57	0.0	0.00	1.0	1.15	1.2	1.01	0.05	0.04

Table 7 shows that one way ANOVA between groups analysis of variance was conducted to compare the mean scores of mother skill level related to scientific literacy levels. There is no significant mean difference as $p > 0.05$. The mothers who are house wives or working women, their children's scientific literacy is not different at all.

Hypothesis 5:
HO5: There is no father's skill level wise significant mean difference in scientific literacy levels of secondary school science students of district Lahore.

Table 8
Scientific Literacy Levels of Students to the Skill Level (SL) of Father

Levels	SL1 n=46		SL 2 n=123		SL 3 n=226		SL 4 n=55		ANOVA		
	M	SD	M	SD	M	SD	M	SD	F	p	η^2
SL1	14.13	4.32	14.89	4.46	15.36	3.88	16.09	3.50	2.304	0.076	0.22
SL 2	8.43	2.50	8.47	2.72	8.66	2.75	9.29	2.56	1.289	0.278	0.05
SL 3	1.54	0.98	1.91	1.33	1.87	1.21	2.10	1.22	1.819	0.143	0.01
SL4	0.89	0.82	1.09	0.85	1.30	1.06	1.67	1.10	6.441	0.000	0.03
Total	25.00	7.27	26.38	7.51	27.19	7.11	29.16	6.66	3.207	0.023	

Table 8 shows that one way ANOVA between groups analysis of variance was conducted to compare the mean scores of fathers' skill level related to scientific literacy levels. There was a statistical significant mean difference at the $p<0.05$ level for the four scientific literacy levels.

Table 9

Post Hoc Test Related to Scientific Literacy Levels of Students to the Skill Level (SL) of Father

Dependent Variable	(I) Father Skill Level	(J) Father Skill Level	Mean Difference (I-J)	Sig.
	SkL1	SL2	-1.38211	.682
		SL3	-2.19912	.233
		SL4	-4.16364*	.020
Scientific	SkL2	SL1	1.38211	.682
Literacy		SL3	-0.81700	.741
		SL4	-2.78152	.081
	SkL3	SL1	2.19912	.233
		SL2	.81700	.741
		SL4	-1.96452	.267
	SkL4	SL1	4.16364*	.020
		SL2	2.78152	.081
		SL3	1.96452	.267

From table 9, Post Hoc test indicated that the fathers who had skill level 1 were significantly different from the occupation of fathers' skill level 4. The children of those fathers who were doctors, teachers, managers, engineers, pharmacists, businessman etc. were highly scientific literate than those whose fathers were drivers, cooks, cleaners, gardeners, labors, security guards etc.

Hypothesis 6

HO6: There is no significant mean difference in scientific literacy levels to the dedicated time for science learning (hours per day, at school as well as at home)of secondary school science students of district Lahore.

Table 10

Scientific Literacy Levels of Students' Dedicated Time to Learn Science

Levels	No time (n=1)		Less than three hr. (n=38)		3-5 hr. (n=79)		6-8 hr. (n=64)		>8 hr. (n=268)		ANOVA		
	M	SD	M	SD	M	SD	M	SD	M	SD	F	p	η^2
SL1	13.0	.	12.4	4.4	15.3	4.6	14.9	3.60	15.6	3.8	5.5	0.00	0.26
SL2	8.0	.	7.2	2.8	8.2	3.0	8.2	2.25	9.0	2.5	5.3	0.00	0.11
SL3	1.0	.	1.0	0.9	1.9	1.2	2.1	1.18	1.9	1.2	5.6	0.00	0.02
SL4	2.0	.	0.9	0.9	1.2	1.0	1.2	1.06	1.2	1.0	1.0	0.37	0.00
Tot.	24.0	.	21.6	7.0	26.8	8.2	26.5	5.94	27.9	6.9	6.7	0.00	

Table 10 shows that one way ANOVA between groups analysis of variance was conducted to compare the mean scores of dedicated time to learn science with related to scientific literacy levels. It was indicated that there was a statistical significant mean difference at the $p<0.05$ level for the four scientific literacy levels: F (6.75), $p = 0.00$

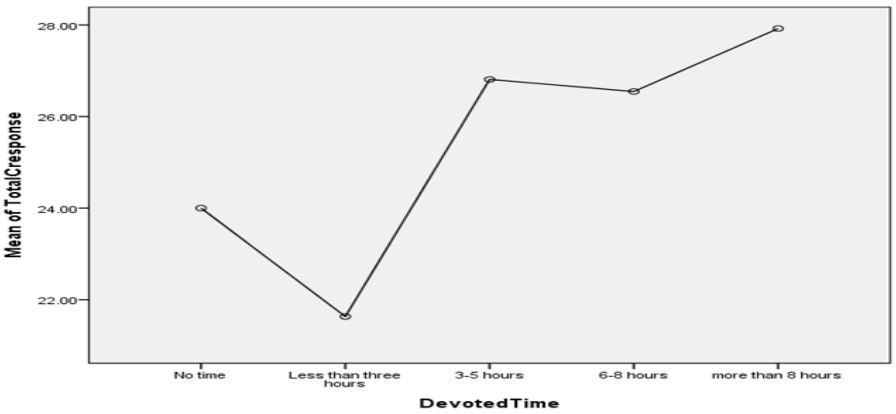


Figure 4. *Mean Plot of Scientific Literacy Levels of Students' Dedicated Time to Learn Science*

From the graph of post hoc test, it was indicated that the students who learned science less than three hours was significantly different from all other dedicated times of learning science i.e. "3-5 hr., "6-8 hr." and more than "8 hr.". The students who gave more time to learn science (at home as well as at school) are highly scientific literate than those students who gave less time to learn science.

Discussion

From above conducted study, the results show that mostly secondary school science students are at level 1 and level 2 of scientific literacy which is 'Nominal Level' and 'Functional Level'. These findings are quite similar to other conducted studies. An American study presented the level of scientific literacy among persons, that only seven percent of the American people were scientifically literates, furthermore, study presented the young individuals as well as older ones were at low level (Miller, 2008). One more study measured chemical literacy development among the students of high school, using "Bybee Scientific Literacy Taxonomy", and came in this decision that students enhanced their nominal and functional scientific literacy which are lower scientific literacy levels of Bybee scale (Shwartz et al., 2006).

In this study, results shows that boys' and girls' secondary schools have significant mean difference in their scores of scientific literacy in all levels. Girls perform better than boys in all levels of scientific literacy. By comparing the gender difference from previous studies of world wide, the results of this study are contradicted. Relative to gender differences, researchers have identified girls do poorer than boys in science, (Caselman et al., 2006). Also, in PISA's reports of 2000, 2003 and 2006, it was determined that there was significant difference in boys and girls scientific literacy levels. Finland was the only country wherein girls were more expected to top performers than boys (OECD, 2009).

Girls are more disciplined about their schoolwork than boys; they study harder and get better grades. Girls consistently outperform boys academically (Damour, L, 2019).

In our opinion, high scores demand study and hard work, and this is where girls may get benefit. In our country, secondary school girls are more self-disciplined, self-regulators, take better notes, are more attentive and focused in class, remember the full content in a better way, and show greater perseverance on boring tasks than boys. All of these characteristics are essential to do well in school. Boys are less hard worker than girls. Along with all of these, in our context, we can easily guess that, girls are performing better in BISE exams from past few years. From above all discussion, it would fair to say that government school girls are more literate than boys as proved from this study.

By comparing from other studies related to mother qualification, it reveals that there is no difference in the scores of students whose mothers are well educated or not, the performance of all students is almost same. PISA 2006 data of Turkey indicated there was a significant mean difference in the scores of those students whose mothers' education were high and those whose mothers' education was not so high. Those students who had graduated mother or in an undergraduate program had a scientific literacy level greater than those students who had a mother who had completed middle school education, primary school education or had not ended primary school (OECD, 2007).

In this study, scientific literacy level increases with the increase in dedicated time for learning science. Same results were found as in other studies. However, the results of the observed studies prove that the scientific literacy increases when dedicated time for learning increases (Kartal et al., 2017).

Conclusion

It is concluded that the scientific literacy of government school students is very low. They cannot describe the ideas in their own words. They cannot relate the different concepts and use science procedures in daily life activities. They just use science vocabulary and define a concept properly, but have a little conception regarding this. They can recognize and identify scientific terminologies, but must not be perfect comprehension of the concepts. The students of government schools cannot expand the scientific and technological viewpoints in life. Girls are more self-regulated, self-disciplined, hard work and persistence. For acquiring high literacy, these characteristics are essential. Parental education and occupation have a large positive influence on scientific literacy. Highly educated fathers are having positive state of mind about literacy and are possible to involve in their children's education. This is the reason to attain high scientific literacy to those government school students whose fathers were well educated and in a good job position. Science is not a cramming subject but it is a practical subject of understanding

and applying the procedures in daily life. And practicality demands more time. If more time is given to learn science then ultimately the science understanding would be increased. So, same in the case of government school science students, those who gave more time to learn science scored high in scientific literacy.

Recommendations

1. The curriculum developers should plan a course of scientific literacy or merge scientific literacy concepts and activities in science textbooks for secondary schools.
2. All teachers from any subject should use such teaching methods especially for boys (as they had low scientific literacy level) that make students critical thinkers that should be able to use critical thinking. Special steps should be taken to discourse this academic gap.
3. The 35-40 minutes of science periods in government schools is not enough. For science subjects, it should be increased.
4. Parents and caregivers should help their children develop on this natural curiosity in science by providing various opportunities to explore and elaborate children's questions about science.

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