Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 12, 1031-1055

Attitude Towards Learning Chemistry: A Case Of Secondary School Students In Pakistan

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Abstract

Attitude is very complex and sticky construct. Pakistani sector educational institutions offer three educational streams; Physics, Chemistry, and Biology. Chemistry is a painstaking subject for secondary school students. Students remain curious during the process of learning. Students move away from Chemistry understanding due to complications. The individuals show their poor attitudes towards learning Chemistry as well. The present research was framed to examine the students' attitude towards learning chemistry at the secondary level by gender, academic stream, locale and school type. The nature of this study was descriptive and quantitative with a positivistic paradigm. 700 individuals were selected from 35 boy secondary schools and 35 girl secondary schools. Individuals were selected on the basis of multi-stage random sampling procedure. An adapted attitude scale was used for data collection comprised of seven factors. The questionnaire was piloted tested; the first draft was distributed to 50 male secondary schools and 50 female of 10th grade. The reliability and validity of the instrument were tested by using the statistical operations. The instrument was revised for the final instrumentation; two items were excluded from the final attitude scale and was consisted of 30 items. The researcher himself distributed and collected the data from the 700 subjects. Data were inserted in SPSS-24 for analyzing the data. Standard Deviation (SD), Mean, and independent sample t-test were applied for analyzing and the data. The results show that female students having better attitude than the male students; in the context of academic stream, biology students having better attitude than the computer students; in locale, urban students possessing more positive attitude than the rural students; furthermore, public school students possessing more positive attitude than the private school students towards learning chemistry at secondary level. Further research studies may conduct on the same construct in the future at primary, elementary, higher secondary, college and university level in different subjects.

Keywords: Attitude, Chemistry, Secondary School, Students' Learning.

Introduction

Education brings attention in individuals and society. To cram about reality makes people skilled, expert, and active. Education fosters rational reasoning and understanding (Anwer et al., 2012). Education conveys information, knowledge, and skills to the learner society. It creates new concepts, skills, ideas, and a positive attitude (Shah et al., 2013).

According to Malik et al. (2010), education transforms evolution to the people, enhances productivity in knowledge and skills. It frames individuals with compulsory proficiency (Groene et al., 2022) and enables them to provide the facilities for the fruitful improvement and strengthening the state (Fernández-García & Fonseca-Mora, 2022). It is disciplined, prescribed communication of expertise (Groene et al., 2022), information, principles, ethical and moral standards (Wonorahardjo et al., 2021), behaviors and attitudinal norms (Asda et al., 2022). The education specially science education uplifts people's attitude and personality support finding the ethical obligation (Musengimana et al., 2021), liability and mission (Najid et al., 2021), reliability, diligence, and sense of responsibility (Arniezca & Ikhsan, 2021). In this way, people were performed their duties, predetermined obligations, customs, and morality (Scheitle & Corcoran, 2021). According to McNutt (2022), Education is essential for all civilizations and societies.

The dexterity, skillfulness, proficiency, creativeness and ability in education showcased individuals to inquire about information and awareness to set new dreams, thoughts and ideas (Cochran-Smith, 2021; Watson & Thompson, 2014). Contradiction and difference in the customs, societies and civilizations based on varying trends of ethics and morality (Kovac, 2021; Llored, 2021). Various researches unbuckled that there is big gap between abilities, thoughts, philosophy of the students and necessities of curriculum at diverse instructive level (Cartiff et al., 2021; Cheung et al., 2021; Higgins, 2021; Kurniawan et al., 2018; Maison et al., 2021; Peláez-Fernández et al., 202; Rutjens et al., 2018). Misconception and misunderstanding in science concepts are closely related to each other in the students (Neidorf et al., 2020; Soeharto et al., 2019; Suprapto, 2020); the researcher reiterates the concepts for better considerate and prolific erudition. The reiteration of concept is much more compassionate of self-motivated learning (Anjarsari, 2018; Crogman et al., 2018). But this is a very acquiescent contribution of individuals, which cannot construct the students' attitude towards chemistry learning (Choudhary, 2020; Ndakwah, 2006).

According to Jha et al. (2018), in the present era chemistry is innovative and interminable inclination. According to Papageorgiou et al. (2016) chemistry is cognitive legacy of the individuals which is innovative addition to culture, evolution and social development. Individuals remained cognizant about their surroundings, environment and milieu (Giordano & Christopher, 2020; National Academies of Sciences & Medicine, 2016); in this way individuals brought the ideas regarding expected miracles surrounded them as the miracles of chemistry (Duffin et al., 2016; Middlecamp & Kean, 2022). The present paradigm's information reshaped his outlook on the concerns, troubles, and dilemmas which encountered in daily existence (Prout & James, 2015). According to Rosenberg and McIntyre (2019), 'Natural philosophy' was a term used in the past to refer to a combination of science and philosophy. Science progressed at a rapid pace beginning in the sixteenth century (Simon, 2015). According to Clark and Sengupta (2015), science generates intellectual and smart minds that are free to work in a certain field. In the early era of science, "scientific knowledge" affected individuals to a certain degree, and its importance cannot be disregarded because attitudes determine and govern the output (Bavel et al., 2020; Genc, 2015; Holt et al., 2019). The impact of science and technology on society had a profound effect on the average individual around the turn of the century (Barmby et al., 2008).

In the current situation, Pakistan is in blooming state of mounting country. In this critical condition, science especially chemistry is much more important in the development and progress of Pakistan due to screening and

shielding of dilemmas, troubles, issues and problem. In this context it is the need of hour to systemize the setup for intellectual and experts in scientific field like chemistry. So individuals must arouse kids' interest towards chemistry so that students' scientific attitudes were developed (Iqbal et al., 2009; Malik et al., 2010).

In the first decade of the 18th century the word of "attitude" was used first time; and this word is widely, regularly and commonly used (Fleck, 2015; Koballa Jr, 1988; Koballa Jr & Crawley, 1985). It is widely acknowledged that teachings in the emotive realm, such as those pertaining to values, virtues, and ethics, are extremely important (Adesoji, 2008; Akınoğlu & Tandoğan, 2007; Ceberio et al., 2016; Tseng et al., 2013). According to Curty et al. (2017), attitude is a term used to describe a person's overall feelings, moods and actions as well as their behavioral patterns, preconceived notions, fears, feelings of insecurity (Olasehinde & Olatoye, 2014), and beliefs in relation to a specific topic (Pell & Jarvis, 2003). As attitude is very complex and sticky so it is impossible to quantify it directly (Brown et al., 2014; Brown et al., 2015), so the attitude is measured indirectly (Reid, 2006; van Aalderen-Smeets & Walma van der Molen, 2013).

Individuals' belief is the main origin of the attitude and such beliefs organize the behaviors; Attitude is basically categorized into three components like cognitive, affective and behavioral attitude (Kurniawati et al., 2012; Pickens, 2005). According to Lawton et al. (2009), cognitive components focused on concentration, sensation, and trust, such as a person's attitude towards something like science, it affects people's cognitive approach, especially students. According to Schwarz and Bohner (2001), affective components are dependent on thoughts and feelings, such as the fact that a legal process has not been initiated to legalize the substance, but the individual believes that use is legal. According to the behavioral components, the individual has a negative attitude toward the substance, writes an application, and tries to prove that drug usage is a good habit (Rhodes & Courneya, 2003). The researchers unbuckled the various factors which influence the attitude in any way like cognitive, affective and behavioral factors (Azubuike, 2011; Davadas & Lay, 2017; Delafrooz et al., 2009; Kaakeh et al., 2019).

When it comes to influencing one's attitude, social factors include how strongly one chooses and responds to the things and people in one's life, as well as how much one can afford to spend. Attitude is inconsistent to some degree, and this inconsistency influences how people perceive the attitude and their actions (Hornsey & Fielding, 2017). A child's outlook on life is heavily influenced by his or her parents. Some of the attitudes that are formed as a result of parental guidance will be re-examined. Some attitudes, however, such as personal preferences, social networks, and career paths, do not alter over time (Oon et al., 2020). According to Prabowo and Nugroho (2019), common sense and mutual sharing based on the cognitive approach to attitude. People must pick how they will communicate with one other in daily life. Students of high school concluded a survey revealing that 48 statements of the survey covering different topics were the same. Maximum statements were sensible, even if relevant items were melted away through feedback form (Vilia et al., 2017). In accordance with cognitive dissonance theory, students' conduct is controlled. People's attitudes are formed and dealt with. The researcher also discussed people's constant and stable thinking (Prabowo & Nugroho, 2019). Cognitive dissonance is generated when two or more views, feelings, beliefs, or opinions are unpredictable and unreliable. They can do it by exchanging opposing ideas (Markic & Childs, 2016).

The primary goal of the current study was to assess students' attitudes about chemistry knowledge and determine whether or not there

was a connection between that knowledge and their attitudes. The last 35-45 years have seen a substantial shift in how science educators view chemistry. Students aren't enrolled in chemistry classes because of a lack of funds or a bad attitude. Choosing a field of study can be a daunting task for students who have little or no interest in the subject matter. As student progress through the grades, a growing number of them exhibit a negative attitude toward chemistry (Aguilera & Perales-Palacios, 2020; Olakanmi, 2017; Vishnumolakala et al., 2017; Wan & Lee, 2017).

An individual's, group's or society's attitude towards chemistry is conveyed by the researcher (Olakanmi, 2017). Another study defined chemistry as spirits, situations and locales, methodology, opinions, approaches, concepts and standards (Irwansyah et al., 2017). There is a considerable agreement of trust that preserves the productive, promising, constructive attitude. It's difficult to grasp the attitude's significance clarified attitudes and science (Chan & Bauer, 2015). The researchers state that they want to foster positive attitudes toward scientists, foster scientific inquiry as a way of thinking, foster scientific attitudes, foster interest in science, foster scientific activities, foster interest in following and working in science, and inspire scientific careers (Klopfer & Madden, 1980; Norris, 2021). According to Schibeci (1984) and Carlson et al. (2019), there are two major sorts of attitudes: science attitude and scientific attitude. according to Astalini et al. (2020), philosophical ideas, beliefs, and thinking patterns are linked to scientific attitude (McPhetres & Zuckerman, 2018). Science attitude is a constructive and cognitive thinking for pupils' development (Pelch & McConnell, 2017; Zeidan & Jayosi, 2015).

In Pakistan, science is a broad phrase which includes Physics, Chemistry, Biology, and Mathematics. From grade 1 to 8, science is taught as an integrated subject. Students in 9th grade pick between physics, chemistry, and biology. (Anderson, 2007; Iqbal et al., 2009). This division extends secondary school credentials from Pakistani educational institutes; secondary school teachers teach chemistry in a variety of ways (Tufail & Mahmood, 2020). Secondary school instructors are nation builders; share their knowledge with 9th and 10th grade pupils studying Chemistry, Physics, Mathematics, and Biology. 9th and 10th grade students in Pakistan are taught Chemistry, Physics, Mathematics, and Biology by SSTs. Chemistry is a difficult subject in Pakistan for 9th and 10th grade students. Students and professors alike have various levels of trust in chemistry (Burns, 1998). Secondary school teachers (SSTs) harness their untapped talent to help students learn chemistry. Our challenge as chemistry teachers is to improve student and teacher confidence, attitudes, and performance according to our own teaching methods. According to Lee (2007), Secondary instructors' chemistry attitudes may vary. In this context, it is necessary to improve science attitudes, particularly in chemistry towards learning. It is time to show the existing situation clearly.

There are so many factors which affect the attitude directly or indirectly; these are the factors which caused the poor attitude of the examinees towards chemistry; it includes the conservative or trivial methods, coordination gap among intellectual approach of students and teachers (Azubuike, 2011), lengthy chemistry syllabus with prearranged time span, inexperience chemistry teachers, deficiency of attentiveness in activities (Ozden, 2008), inaccessibility of chemistry Laboratories (Cheung, 2011), peer understanding, social commutation circle, peers’ attitude in chemistry, enjoyment in chemistry (Penn & Ramnarain, 2019), setting of chemistry laboratory and milieu of chemistry class (Penn & Ramnarain, 2019), depression and performance in chemistry,

pedagogical dexterity and learning ability (Davadas & Lay, 2017).

It is not possible to measure the attitude measured directly. Present study was integrated the attitude of students towards learning chemistry. Various techniques were used to measure and investigated the attitude (Laforgia, 1988); Likert Scaling Technique (Bertram, 2007; Boone & Boone, 2012), TOSRA (Lang et al., 2005; Wong & Fraser, 1996), Thurstone Scaling Technique (Lipovetsky, 2007; Lipovetsky & Conklin, 2004), Guttmann Scaling Method (Conway & Guttmann, 1996), Semantic Differential Technique (Bauer, 2008; Stoklasa et al., 2019), Scientific Orientation Test (S.OR.T) (Adolphe, 2002).

Secondary chemistry curricula have dynamic features that distinguish them in chemistry exams. Pakistani students' chemical skills have always been pitiful. The current circumstance necessitates investigating student chemistry performance. For many years, poor chemistry student performance has been recognized. There is no doubt that secondary school chemistry students face challenges in understanding various chemistry principles. The question is how to overcome the obstacles and help pupils do better in chemistry. It is required to investigate students' attitudes towards chemistry. So the objective of the study was:

1. To examine the students' attitude towards learning chemistry at secondary level by gender, academic stream, locale and school type.

Conceptual Framework

Simpson and Oliver (1990) claim the study involved 4500 subjects of 9th grade. The study sampled students from various educational institutions, but only chemistry students were included. According to the findings, male students have a more positive attitude towards chemistry than female students. Weinburgh (1995) claims that attitude of students toward chemistry is positive. The sample of study were 484 chemistry students at university level. Data analysis shows that female possess better attitude towards learning chemistry than the male students. According to Harvey and Stables (1986), a research study was conducted in USA regarding the students' attitude towards learning chemistry. The researchers concluded the research to determine the differences between the genders. 1,302 male and female high school students from 10th grade were the sample of the study. The results revealed that male students possess much more constructive attitude towards learning chemistry than female students. According to Glasman and Albarracín (2006) conducted the research study on attitude towards chemistry and learning chemistry. 610 subjects including 291 boys and 319 girls were the sample of the study. The results of the study explained that there was no difference in attitude towards chemistry and learning in chemistry of boys and girls. A research study was conducted in Pakistan on students' attitude towards science and finding of the study were that there is insignificant difference between attitude of male and female students (Anwar, 2011). Furthermore, a study was also conducted in Pakistan with the sample of 3526 of 10^{th} grade students and finding of the study was that female students possess significantly higher attitude than the male students towards science (Anwer et al., 2012).

A research was formulated in Pakistani context and finding of the research was that the attitude of the male students was better than the female students (Hassan & Murtaza, 2020). According to Siddique (2020), a research study was conducted at secondary level and results shows that male students having better attitude than the female students towards learning chemistry.

According to the Hassan and Murtaza (2020), a research was formulated on the Pakistani environmental ground and the finding

of the study was that the both the biology and computer students studying chemistry having the same attitude towards learning chemistry.

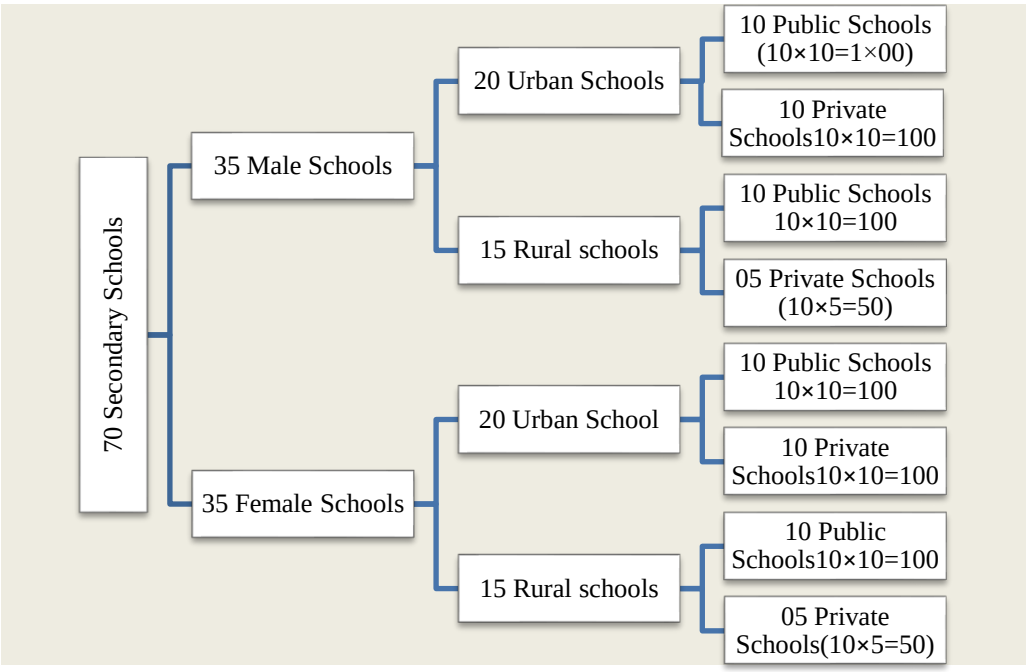
A research study was conducted in Pakistan on students' attitude towards science and finding of the study were that there both rural and urban students have same attitude towards science (Anwar, 2011). Furthermore, a study was also conducted in Pakistan with the sample of 3526 of 10th grade students and finding of the study was that rural students possess significantly higher attitude than the urban students towards science (Anwer et al., 2012). A research study was conducted in Pakistan at university level with the sample of 440 students; the result show that public university students show the better attitude towards science as compare the private university students (Ali et al., 2017). According to Siddique (2020), urban students having better attitude towards learning chemistry than the rural students at secondary school level.

A research study was conducted in Pakistan with the sample of 700 chemistry students in public and private students as demographic variables; and the results of the study shows that the public school students having better attitude towards learning chemistry than the private school chemistry students at secondary level (Siddique, 2020).

Methodology

The nature of this research study was quantitative and descriptive direction the positivistic paradigm. According to Aliyu et al. (2014), the positivistic paradigm is referred as observation and measurement are used by positivists to test a theory or describe an experience, with the goal of predicting and controlling the forces that is in our environment. The population is the total number of elements from which subjects are selected (Ali et al., 2021; Sajjad et al., 2022; Siddique et al., 2021). The population of the study were all the 10th grade chemistry students of district Lahore, Pakistan. The study's target population consisted of 21,439 students from 273 schools in the Lahore District (City) studying in the 10th grade, with 180 public schools having 14,049 students and 93 private schools having 7,347 students. The study included students from both public and private schools.

The sample were the number of subjects chosen from the population (Jabeen et al., 2022; Ali et al., 2021; Siddique et al., 2021). There are various techniques for selecting the sample, depending upon the environmental conditions, type of the research, aims, and study objective. So, to complete the study, the researcher used the multi-stage simple random sampling technique. Only 10th grade students were selected for this research study because the students of this grade have more clear concepts about science like chemistry (Anwar, 2011; Anwer et al., 2012; Siddique, 2020). The list comprising boys and girls secondary schools was obtained from the Chief Executive Officer (District Education Authority) Hall Road, Lahore. The Punjab Education Sector Reform Program provided a list of students enrolled in the 10th grade those were enrolled in the programme. In a study on multistage simple random sampling technique, total 70 schools were selected as a sample, with 35 boy and 35 girl secondary schools. The schools were divided into two groups: 20 urban girl secondary schools (10 public and 10 private) and 15 rural girl secondary schools (10 public and 5 private). In a similar way, 20 urban male secondary schools (10 public and 10 private) and 15 rural boy secondary schools (10 public and 5 private) were chosen as samples for the study. The information was collected from 10th grade students who are enrolled in one of the sampled schools. Ten students were selected from each school to participate in the study. The total sample for the study were 700 students (350 male and 350 female in terms of gender, 400 urban students and 300 rural students in terms of locale). The diagrammatical representation of the sample was as under



Instrumentation and Data Collection

To collect the study's information close-ended adapted questionnaire (Adams et al., 2008) was used on 5-point Likert scale ranges from Strongly Disagree to Strongly Agree. The questionnaire is comprised of seven parts. Part-A is related to demographic factors including the basic information of gender, schools' type, academic stream, and locality, Part-B is related to the knowledge of students in chemistry; comprising of five items, Part-C is related to the assessment of the laboratory activities; comprising of five items, Part-D is related to the emotional factors concerning chemistry learning having five items, Part-E is about cognitive factors concerning chemistry learning have five items, Part-F is related to environmental factor concerning chemistry learning with five items, Part-G is related to general attitude towards chemistry possess five items. A pilot test was applied to the instrument to check its reliability and validity. After checking the reliability and validity two items were excluded, the instrument/ questionnaire comprised 30 items. Questionnaires were administered to the 700 students (academic session 2018-2020) in the sampled secondary school of Lahore, Punjab-Pakistan. With the help of the head teacher of the sampled schools, the researcher personally visited the subjects and inspired them for the independent work regarding the questionnaire. The researcher personally collects the data from the sampled schools. The researcher collects the data from the subject after the consent of the head teachers. Forty (40) minutes were given to the student to fill out the questionnaire. At the end of the class of forty minutes, questionnaires were collected from the students.

Data Analysis

Table 1 Gender Wise Comparison of Students' Attitudes towards Learning Chemistry

Variable	Gender	N	M	SD	t	df	P

Gender	Male	350	118.64	17.92	-7.512	640.544	.000
	Female	350	127.57	13.16			

In the statistical test, the independent sample t-test is used for the comparison of mean score values between two groups whose data is collected at the same time; furthermore, this test is also called student t-test (Kim, 2015; Livingston, 2004). The table 1 depicts significant difference between male and female students' attitude towards learning chemistry at secondary level, t (698) = -7.512, p<.05. The result depicts that female having better attitude (M=127.57, SD=13.16) than male (M=118.64, SD=17.92). It is obvious that null hypothesis is rejected and the alternative hypothesis is accepted. It is concluded that female have better attitude than male students towards learning chemistry.

Table 2 Gender Wise Comparison of Students' Attitudes towards Learning Chemistry Factors

Sub-variables	Gender	N	M	SD	t	Df	p
Knowledge of Students in Chemistry	Male	350	20.64	3.527	-5.797	674.474	.000
	Female	350	22.36	4.261			
Assessment of Laboratory Activities	Male	350	20.58	3.434	-6.525	696.729	.000
	Female	350	22.32	3.584			
Emotional Factors Regarding Chemistry Learning	Male	350	18.16	3.387	-5.904	698.01	.176
	Female	350	19.61	3.110			
Cognitive Factors Regarding Chemistry Learning	Male	350	19.00	3.769	-3.937	677.016	.006
	Female	350	20.03	3.154			
Environmental Factors Regarding Chemistry Learning	Male	350	19.99	3.495	-5.692	621.654	.000
	Female	350	21.28	2.424			
General Attitudes towards Chemistry	Male	350	20.25	3.858	-5.497	688.675	.000
	Female	350	21.95	4.336			

The table 2 depicts the significance difference between gender wise analysis on factors related the students' attitude towards learning chemistry in male and female. This table shows the significant difference between male and female students' attitudes towards learning chemistry against factors regarding: "knowledge of students in chemistry", t(698) = -5.597, p < .05; female students having more constructive attitude towards learning chemistry (M = 22.36, SD = 4.261) as compared to male students (M = 20.64, SD =3.527); similarly, there is significant difference between male and female students attitudes towards learning chemistry in factor concerning: "Assessment of Laboratory Activities", t(698) = -6.525, p < .05,female students possessing better attitude towards learning chemistry (M = 22.32, SD = 3.584) as compared to male students (M =20.58, SD = 3.434); there is no significant difference in male and female students regarding the factor "Emotional Factors concerning Chemistry Learning", t(698) = -5.904, p > .05, male students having same attitudes towards learning chemistry (M = 18.16, SD = 3.387) as female students have (M = 19.61, SD = 3.110); in the factor "cognitive factor regarding chemistry learning", t(698) = -3.937, p < .05; female students having better

attitude towards learning chemistry (M = 20.03, SD = 3.154) as compared to male students (M = 19.00, SD = 3.769); in the "environmental factors concerning chemistry learning", t(698) = -5.692, p < .05;female students having more better attitude towards learning chemistry (M = 21.28, SD = 2.424) as compared to male students (M = 19.98, SD = 3.495); in the factor "general attitude towards chemistry, t(698) = -5.497, p < .05;female students have more constructive attitude towards learning chemistry (M = 21.95, SD = 3.336) than the male students (M = 20.25, SD = 3.858).

Table 3 Academic Stream Wise Comparison of Students' Attitudes towards Learning Chemistry

Variable	Academic Stream	N	M	SD	t	df	P
Academic Stream	Computer	350	118.66	17.93	-7.476	640.768	.000
	Biology	350	127.55	13.17			

The table 03 shows the significant difference between computer and biology students' attitudes towards learning chemistry, t(698) = -7.476, p<.05. It is clear that biology students possessing better attitude (M=127.55, SD=13.17) than computer students (M=118.66, SD=17.93). It is clear that null hypothesis is rejected and the alternative hypothesis is accepted. So it is concluded that biology students having better attitude towards chemistry than the computer students.

Table 4 Academic Stream Wise Comparison of Students' Attitudes towards Learning Chemistry Factors

Sub-variables	Academic Stream	N	M	SD	t	Df	p
Knowledge of Students in Chemistry	Computer	350	20.65	3.530	-5.756	674.593	.000
	Biology	350	22.35	4.262			
Assessment of Laboratory Activities	Computer	350	20.58	3.434	-6.525	696.729	.000
	Biology	350	22.32	3.584			
Emotional Factors Regarding Chemistry Learning	Computer	350	18.16	3.388	-5.928	698.02	.163
	Biology	350	19.61	3.108			
Cognitive Factors Regarding Chemistry Learning	Computer	350	18.98	3.772	-4.026	676.304	.005
	Biology	350	20.04	3.147			
Environmental Factors Regarding Chemistry Learning	Computer	350	20.00	3.502	-5.587	620.536	.000
	Biology	350	21.27	2.421			
General Attitudes towards Chemistry	Computer	350	20.26	3.866	-5.382	688.992	.000
	Biology	350	21.94	4.336			

The table 4 depicts the significance difference by academic stream on the factors related the students' attitude towards learning chemistry in biology and computer students. This table reveals the significant difference between biology and computer students' attitudes towards learning chemistry in the factors like "knowledge of students in chemistry", t(698) = -5.756, p < .05;

biology students having more constructive attitude towards learning chemistry (M = 22.35, SD = 4.262) as compared to computer students (M = 20.65, SD =3.530); similarly, there is significant difference between biology and computer students' attitudes towards learning chemistry in factor like "Assessment of Laboratory Activities", t(698) = -6.531, p < .05,biology students possessing better attitude towards learning chemistry (M = 22.32, SD = 3.584) as compared to male students (M =20.58, SD = 3.434); there is insignificant difference in biology and computer students regarding the factor "Emotional Factors concerning Chemistry Learning", t(698) = -5.928, p > .05, biology students having same attitude towards learning chemistry (M = 19.61, SD = 3.108) as computer students have (M = 18.16, SD = 3.388); in the factor "cognitive factor regarding chemistry learning", t(698) = -4.026, p < .05; biology students having better attitude towards learning chemistry (M = 20.04 , SD = 3.147) as compared to computer students (M = 18.98, SD = 3.772); in the "environmental factors concerning chemistry learning", t(698) = -5.587, p < .05;biology students having more better attitude towards learning chemistry (M = 21.27, SD = 2.421) as compared to computer students (M = 20.00, SD = 3.502); in the factor "general attitude towards chemistry, t(698) = -5.382, p < .05;biology students have more constructive attitude towards learning chemistry (M = 21.94, SD = 4.336) than the computer students (M = 20.26, SD = 3.866).

Table 5 Locality Wise Comparison of Students' Attitudes toward Learning Chemistry

Variable	Locality	N	M	SD	t	df	p
Locality	Urban	400	127.08	13.19	7.383	514.245	.000
	Rural	300	117.81	18.51			

The table 05 shows the significant difference between urban and rural students' attitudes towards learning chemistry, t (698) = -7.383, p<.05. It is clear that the urban students having more constructive attitude (M=127.08, S.D =13.19) than rural students (M=117.81, S.D =18.51). It shows that null hypothesis is rejected and the alternative hypothesis is accepted. So, it is concluded that urban students having better attitude towards chemistry than the rural students at secondary level.

Table 6 Locality Wise Comparison about Factors of Students' Attitudes towards Learning Chemistry

Sub-variables	Locality	N	M	SD	t	df	P
Knowledge of Students in Chemistry	Urban	400	22.26	4.102	6.040	679.103	.000
	Rural	300	20.49	3.631			
Assessment of Laboratory Activities	Urban	400	22.28	3.503	7.245	647.881	.000
	Rural	300	20.35	3.465			
Emotional Factors Regarding Chemistry Learning	Urban	400	19.38	3.119	4.596	698	.054

	Rural	300	18.23	3.489			
Cognitive Factors Regarding Chemistry Learning	Urban	400	19.98	3.139	3.997	563.982	.000
	Rural	300	18.89	3.871			
Environmental Factors Regarding Chemistry Learning	Urban	400	21.27	2.435	6.145	496.125	.000
	Rural	300	19.79	3.596			
General Attitudes towards Chemistry	Urban	400	21.89	4.189	5.972	662.463	.000
	Rural	300	20.04	3.955			

The table 6 depicts the significance difference rural and urban students on factors related the students' attitude towards learning chemistry. This table predicts the significant difference between rural and urban students' attitudes towards learning chemistry regarding the various factors like "knowledge of students in chemistry", t (698) = 6.040, p < .05; urban students having more constructive attitude towards learning chemistry (M = 22.26, SD = 4.102) as compared to rural students (M = 20. 49, SD =3.631); similarly, there is significant between rural and urban students attitudes towards learning chemistry in factor concerning "Assessment of Laboratory Activities", t(698) = 7.245, p < .05, urban students having better attitude towards learning chemistry (M = 22.28, SD = 3.505) as compared to rural students (M =20.35, SD = 3.465); there is no significant difference in rural and urban students regarding the factor "Emotional Factors concerning Chemistry Learning", t(698) = 4.596, p > .05, urban students having same attitude towards learning chemistry (M = 19.38, SD = 3.119) as rural students have (M = 18.23, SD = 3.489); in the factor "cognitive factor regarding chemistry learning", t(698) = 3.997, p < .05; urban students having better attitude towards learning chemistry (M = 19.98, SD = 3.139) as compared to rural students (M = 18.89, SD = 3.871); in the "environmental factors concerning chemistry learning", t(698) = 6.135, p < .05; urban students having more better attitude towards learning chemistry (M = 21.27, SD = 2.435) as compared to rural students (M = 19.79, SD = 3.596); in the factor "general attitude towards chemistry, t(698) = 5.972, p < .05; urban students have more constructive attitude towards learning chemistry (M = 21.89, SD = 4.189) than the male students (M = 20.04, SD = 3.955).

Table 7 School Wise Comparison of Students' Attitude towards Learning Chemistry

Variable	Nature of School	N	M	SD	t	df	p
School Type	Public	400	127.08	13.19	7.383	514.245	.000
	Private	300	117.81	18.51			

The table 7 reveals that there exists a significant difference between secondary school students' attitude towards learning chemistry, t (698) = 7.383, p< .05. It is obvious that public school students (M=127.08, SD=13.19) keeping the more constructive attitude as compare to the

private school student (M=117.81, SD=18.51). So, it is concluded that public school students have better attitude than the private students regarding attitude towards learning chemistry.

Table 8 School Wise Comparison of Factors about Students' Attitude towards Learning Chemistry

Sub-variables	School Type	N	M	SD	t	df	p
Knowledge of Students in Chemistry	Public	400	22.26	4.103	6.040	679.103	.000
	Private	300	20.49	3.632			
Assessment of Laboratory Activities	Public	400	22.28	3.504	7.245	647.881	.000
	Private	300	20.35	3.465			
Emotional Factors Regarding Chemistry Learning	Public	400	19.38	3.119	4.596	698.45	.054
	Private	300	18.23	3.489			
Cognitive Factors Regarding Chemistry Learning	Public	400	19.98	3.139	3.997	563.982	.001
	Private	300	18.89	3.871			
Environmental Factors Regarding Chemistry Learning	Public	400	21.27	2.436	6.145	496.125	.000
	Private	300	19.79	3.596			
General Attitudes towards Chemistry	Public	400	21.89	4.190	5.972	662.463	.000
	Private	300	20.05	3.955			

As reflected in table 8, independent sample t-test was applied to compare the public and private students' attitude towards learning chemistry on various factors as mentioned in table. The interpretation of the table shows the significant difference in some factors and insignificant difference in some one. In the factor "knowledge of students in chemistry", $t(698) = 6.040$, $p<.05$, public students having better attitude (M=22.26, SD=4.103) than the private school students (M=20.49, SD=3.632); there exist a significant difference in the factors of "assessment of laboratory activities", $t(698) = 7.245$, $p<.05$, as public school students having better attitude (M=22.28, SD=3.504) than the private school students (M=20.35, SD=3.465); Contrarily, in factor "emotional factors regarding chemistry learning", $t(698) = 4.596$, $p>.05$, the public students (M=19.38, SD=3.119) having same attitude towards learning chemistry as private school students (M=18.23, SD=3.489) have; in factor "cognitive factors regarding chemistry learning", $t(698) = 3.997$, $p<.05$, the public school students having better attitude (M=19.98, SD=3.139) than the private school students (M=18.89, SD=3.871) in this regard; in the factor "environmental factors regarding chemistry learning", $t(698) = 6.145$, $p<.05$, the public school students possessing the more constructive attitude (M=21.27, SD=2.436) than the private students (M=19.79, SD=3.596) having; in the factor "general attitude towards chemistry" , $t(698) = 5.972$, $p<.05$, the public school students keeping more positive attitude (M=21.89, SD=4.190) than the private school students (M=20.05, SD=3.955) have.

Discussion

Attitude of the students depends upon the so many factors like environmental grounds, strategies, learning capabilities, teaching style, teaching methods etc (Fishbein et al., 1980; Fleck, 2015; Genc, 2015; Giordano & Christopher, 2020; Glasman & Albarracín, 2006; Groene et al., 2022; Harvey & Stables, 1986); both male and female having different attitude towards learning chemistry (Genc, 2015; Giordano & Christopher, 2020; Glasman &

Albarracín, 2006). In the context of gender, the findings of current study show that female having better attitude towards learning chemistry the male students which contradict the findings of the studies (Harvey & Stables, 1986; Hassan & Murtaza, 2020; Siddique, 2020; Simpson & Oliver, 1990) that male have better attitude towards learning chemistry. Furthermore, the findings of the present study aligned with the findings of (Anwer et al., 2012; Weinburgh, 1995) that female having better attitude than the male students towards learning chemistry; in addition, the finding of this do not aligned with the findings of (Anwar, 2011; Glasman & Albarracín, 2006) that there is insignificant difference of male and female students' attitude towards learning chemistry.

In the context of academic stream, the findings of this study revealed that biology students possessing more positive attitude towards learning chemistry than the computer students which contract findings of (Hassan & Murtaza, 2020) that both male and female having same attitude towards learning chemistry at secondary level. In the context of locale, the findings of present study revealed that urban students having more positive attitude than the rural students which do not aligned with the results of (Anwar, 2011) with the findings that both male and female students having same attitude towards learning chemistry; in addition, the findings of the present study also contradict with study of (Anwer et al., 2012) that rural students having better attitude than urban students. Findings of present study aligned with the findings of (Ali et al., 2017; Siddique, 2020) that urban students having more better attitude towards learning chemistry. In the context of the locale, the findings of the study revealed that public school students having better attitude towards learning chemistry which aligned the findings of (Siddique, 2020) that public school students having better and positive attitude than the private students.

Conclusion

Attitude is very complex and sticky construct (Arniezca & Ikhsan, 2021; Astalini et al., 2020; Azubuike, 2011; Barmby et al., 2008; Brown et al., 2014; Brown et al., 2015). It is concluded that mean difference exists between male and female students; and obvious that female students having more positive and constructive attitude than the male students. In the sub-scale of attitude; "knowledge of students in chemistry", "Assessment of laboratory activities", "cognitive factors regarding chemistry learning ", "Environmental regarding chemistry learning" and "General attitude towards chemistry"; mean difference exists as female students having more positive attitude than the male students on these factors but there exists no difference between male and female students, as both have the same attitude on the factor "Emotional factors regarding chemistry learning".

There is also exists mean difference between biology and computer students as biology students having better attitude than the computer students. In the sub-scales of attitude there exist mean difference in "knowledge of students in chemistry", "Assessment of laboratory activities", "cognitive factors regarding chemistry learning", "Environmental regarding chemistry learning" and "General attitude towards chemistry"; as biology students having better attitude than the computer students in chemistry. Contrarily, there exists no difference in biology and computer students as both having the same attitude in the factor like "Emotional factors regarding chemistry learning".

There exists mean difference between rural and urban students as urban students possessed much more positive attitude than rural students. In the sub-scales of attitude there exist mean difference in "knowledge of students in chemistry", "Assessment of laboratory activities", "cognitive factors regarding chemistry learning", "Environmental regarding

chemistry learning" and "General attitude towards chemistry"; as urban students possessing much more better attitude than the rural students in chemistry. Contrarily, there exists no difference in rural and urban students as both having the same attitude in the factor like "Emotional factors regarding chemistry learning".

There exists significant difference between public and private students as public students having better attitude than the private students. In the sub-scales of attitude there exist mean difference in "knowledge of students in chemistry", "Assessment of laboratory activities", "cognitive factors regarding chemistry learning", "Environmental regarding chemistry learning" and "General attitude towards chemistry"; as public students having better attitude than the private students in chemistry. Contrarily, there exists no difference in public and private students as both having the same attitude in the factor like "Emotional factors regarding chemistry learning".

Limitation and Future Concerns

It is not possible to collect the data from all the elements in the population so, researcher s have some limitation for conducting the research smoothly. In the present study researchers have delimit the study in tehsil City from Lahore-Pakistan. To complete this study, the researcher used the multistage simple random sampling technique. An adapted tool was used for data collection. Various sampling techniques may use for data collection; based on the type of the research, population, and sample and environmental ground too. It is obvious that this research study was quantitative in nature, so other research studies may be conducted like qualitative study, experimental study, casual-comparative study, comparative study and mix-method study. As showcased that this study 10th-grade, so further research study may be conducted at different level like primary, elementary, college and university level or at various grade in science subjects. Furthermore, researcher can use the self-structured tool for the research study.

Acknowledgment

It's an immense pleasure and honour to have divine help of ALLAH (سبحان و تعالی) and kind attention of

HAZRAT MUHAMMAD (خاتم النبیینﷺ) in the completion of this research paper. The researchers are grateful to all the stakeholders for helping in completing this manuscript.

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