

How to Cite This Article: Mehmood, N., Arif, M., & Anwer, M. (2023). Relationship of Students' Attitude towards Science with their Learning Approach: A Gender and Socioeconomic Status (SES) based Study. *Journal of Social Sciences Review*, 3(2), 1176–1189. <https://doi.org/10.54183/jssr.v3i2.369>



Relationship of Students' Attitude towards Science with Their Learning Approach: A Gender and Socioeconomic Status (SES) based study

Nasir Mehmood	PhD Scholar, Department of Education, Superior University, Lahore, Punjab, Pakistan.
Muhammad Arif	Assistant Professor in Education, Superior University, Lahore, Punjab, Pakistan.
Muhammad Anwer	Associate Professor, University of Education, Lahore, Punjab, Pakistan.

Vol. 3, No. 2 (Spring 2023)

Pages: 1176 – 1189

ISSN (Print): 2789–441X

ISSN (Online): 2789–4428

Key Words

Attitude, Science, Learning Approach, Gender, SES

Corresponding Author:

Nasir Mehmood

Email: nasirue1@gmail.com

Abstract: For decades, students' attitude toward science has been debated within diverse contexts, and the growth of positive attitude toward science has been a key goal of science. Classroom learning approaches for science students are a strong factor that predicts and determines the attitude of science students. Current research focused on the relationship of students' attitudes towards science with their learning approach, meaningful and rote learning approaches on gender and SES basis by using 1966 science students from selected public secondary schools of Pakistan. The empirical results are estimated by using TOSRA approach by using a reliability value of 0.89 as an attitude scale. To measure the Learning Approach (LAQ), Cavallo (1996) scale was used (reliability value 0.74 for the Learning Approach scale, 0.56 for the Meaningful Learning scale, and $r = 0.58$ for the rote Learning scale). Alongside descriptive statistics, Pearson r was used in this research. Pearson r results revealed a positive and significant correlation between the variables, and a similar relationship was found for genders with no differences. The findings of this study would open new horizons for future researchers by showing the relation between different variables for wider consideration of the perspective.

Introduction

Learning is the essence of life. In the case of human beings, it is sequential in nature and starts from the formation of the zygote till the end of individuals. It is a vivid fact that the evolution of life into modern form has happened gradually, and survival of the fittest human life is dependent on science. Science has improved the attitude and outlook of society from superstitions to reasoning. The revolution of societies through the development of culture and economic advancement is dependent on education, especially science education. It broadens the outlook of humans towards life by their balance development at a personal level,

preparing society and thus raising the status of a nation as a whole. Such nations contribute not only to their country but to the entire global village. These developments and transformations lead to learning. In this way, society and science are considered the two sides of the same coin. Modern urbanization and internationalization have developed into a global village in which the common man also has awareness about the happenings around him. This awareness may be termed as education, which is a change in behavior, and science education is one of the prominent branches of

education which is influencing the insights of human beings.

For a scientific process, open imagination, creativity, logic, inquiry, and new ideas are very important, which are dependent on the way students' science learning approaches construct new knowledge and individual differences. Learning approaches in science teaching have attracted the consideration of experts. Teachers should strive to understand how students learn science. "Ausubel (1963) describes that if the learners don't form new information, he/she memorizes the information, which leads rote learning to occur and otherwise leads to meaningful learning". In the literature, a strong correlation has been reported between science students' attitudes with respect to learning approaches. It was focused in this research explores the correlation between science and learning approaches on gender and SES bases within a developing nation.

According to Osborne (2003, p.1050) definition of attitude is "feelings, beliefs, and values, which are about the impact of science on school science, and society." Cavallo, Rozman, and Potter (2004) have divided student learning approach into two categories, namely rote and meaningful learning approaches. Özkal (2007) indicated learning approaches can be predicted by scientific attitude. In another study positive correlation was found between the variables like science students' attitudes and learning approaches; researchers like Hacıeminoglu (2016) found a more progressive relation between attitudes toward science and meaningful learning approach resulting in higher achievement. Other researchers (Kizilgunes et al. 2009) found that students adopting meaningful learning approaches revealed positive attitudes toward science. It is due to the fact that this learning approach may be helpful for science students to enhance their learning in science resulting more positive attitude toward science subjects. Therefore, in the long run, a positive attitude toward science can only be retained with

the help of meaningful learning, while rote learning leads to a negative attitude toward science. This was also supported by Hacıeminoglu et al. (2013), by recommending that teaching science through traditional methods and rote memorization from textbooks leads to negative attitudes. Traditional learning approach instruction has been related to the negative attitudes of science students, while the constructive learning approach led to positive attitudes toward science (Oh and Yager, 2004). Similarly, classroom learning approaches for science students are a strong factor that can predict and determine the student's attitudes toward science (Aldolphe, Fraser & Aldridge, 2003). For a scientific process, open imagination, creativity, logic, inquiry, and new ideas are very important, which are dependent on the way students' science learning approaches construct new knowledge. Moreover, the major focus of the current curriculum of science in Pakistan at the secondary level is to construct a scientific outlook through meaningful learning as it is based on a constructivist approach (National Curriculum, 2006). Student meaningful learning was also positively correlated with self-efficacy and achievement in science (Cavallo, 2004). Another research indicated a positive and significant correlation between meaningful learning performance orientations (Hacıeminoglu et al., 2009). It was found that a negative correlation was found between learning approach, science attitude, and performance orientation.

Similarly, researchers (Cavallo 2003, 2004; Hacıeminoglu et al., 2009) concluded that rote learning never leads to higher grades and a positive attitude towards science, thus resulting in problems memorizing scientific concepts. Hacıeminoglu (2016) remarkably determined a significant relationship between attitude, motivational goals, and learning approaches. Rote learning is not helpful for retaining a positive attitude towards the long term.

Hacıeminoglu (2016), in a study having attitude and learning approaches as variables,

concluded a positive correlation between attitude and learning approach, while it was found that rote learning and parents' socioeconomic status were negatively correlated with students' attitudes towards science. Researchers like Cavallo (2004), Hacıeminoglu (2009), and Hacıeminoglu (2016) found that students' attitudes toward science, learning approach, and self-efficacies were positively correlated as the students having positive-attitude towards science show good command of learning because they are well aware of their self-efficacies. As a result, rote learning will be discouraged. Hacıeminoglu et al. (2009) also revealed that self-efficacy and rote learning showed a negative correlation across gender and SES. For attaining good grades in the present education system, rote memorization is being promoted, which promotes a negative attitude towards science, thus causing failure to build their self-concept, learning approach, and low self-efficacy. The girls had less positive attitudes and more rote learning approaches in science (Chan, 2003; Cano, 2005).

Hacıeminoglu (2016) also explored the influence of parents' income on the science attitudes of students. Moreover, the income level of the students had different levels of correlation. It was noted that students belonging to high-income level families showed more positive attitudes than medium and lower-level-income families. People from elite families have more chances for science-related visits as compared to the lower class, which results in vice versa. Students from low-income families had more mean scores than medium-level-income families. It may be due to the fact that low-income students strive hard to gain status in society, which is why they exhibit more positive attitudes than medium-level income students. It was also noted that educated parents provide more facilities to their siblings and also activate them, which leads to attaining high grades and attitude towards science at their end.

Statement of the Problem

Rare number of studies had found relationship between students' Attitude towards science and learning approach, on gender and socioeconomic status bases at secondary level not in Pakistani context but also at international level. Even, Rana (2002) had found an effect of socioeconomic status of parents with science attitude, self-concept related with achievement, having a quite different direction as compared to the present study in Pakistani context. As very limited studies having variables like learning approach and other demographic factors have been reported in this regard. But it is the crying need of the hour which is obvious from the above discussion. So, the present study would deal Attitude towards science in relation to students learning approach with respect to gender and socioeconomic status in developing country like Pakistan.

Objectives

This study focused on the following objectives.

- To find out the relationship of students' Attitude toward science with their learning approaches on the basis of their gender and socioeconomic status.

Research Questions

- What is the level of students' Attitude toward science, learning approach, meaningful and rote learning approaches?
- Do male and female students possess the same Attitude toward science, learning approach, meaningful and rote learning approaches?
- What is the relationship students' Attitude toward science with their learning approach, meaningful and rote learning approaches?
- What is the relationship of male and female students' Attitude toward science with their learning approach, meaningful and rote learning approaches?
- What is the relationship of low, medium and high-level SES students' Attitude towards science and their learning

approach, meaningful and rote learning approaches?

- What is nature and magnitude of the relationship?

Method

It was survey research in which correlation was explored between the variables. The population comprised of science students belonging to both genders from tenth grade. It was selected only from government institutions of Punjab Province (Pakistan). Reason for selection of tenth grade is that at this age pupils have clear state of mind and they are able to easily respond on any Likert type scale logically. Punjab Province is comprised of 36 districts and respondents from 4 districts were conveniently selected for the sample purpose. The selection of districts was purely based on their literacy rates. This data was collected from the 16 randomly selected schools. This random selection from each district was equal for genders. Both the gender was equally selected from the selected districts and schools (four districts and 64 schools). At classroom level one section of 10th grade science (depending upon the number of sections in each school) students was randomly selected for respondents of this research.

Research Tools

TOSRA

Students' Attitude has been a very important construct, and Fraser (1981) gives a scale to measure it. TOSRA has been used for attitude measurement of science students since the 1970s. In the present study, the same tool was adapted to explore the attitude of students. Firstly, it was used in grades 7 to 12 to measure the science-related attitude of science students (Adolphe, Fraser, & Aldridge, 2003). TOSRA was validated across different contexts (developed and developing countries like Australia, America, and Pakistan, respectively) with reliability values of 0.83 to 0.96 in different research (Rana, 2002). Formally

in Pakistan, Rana (2002) used it to explore science attitudes in 11–12 grades. Rana (2002) translated it into Urdu. This modified questionnaire had a 0.93 reliability value. It was further modified in the Pakistani context by Anwer (2012) with 52 Likert-type items having a reliability coefficient value of 0.89, and he used it across grades 9–10 during his doctoral study.

Learning Approach Questionnaire (LAQ)

Student learning is the most important outcome of education, which must be determined through a valid and reliable questionnaire; in the current research learning approach questionnaire was used. It consisted of 22 items to measure learning approaches (Cavallo et al., 2003). This learning approach tool was categorized into two subscales first sub-scale was named a meaningful learning approach, and the second sub-scale was the rote learning approach dealing with the Rote learning approach. Both subscales were equally assigned, with 11 items showing meaningful and Rote learning, respectively. Cavallo et al. (2003) found the reliability of both subscales and was reported as 0.81 and 0.76, respectively. In this research, reliability values for the LAQ scale were 0.74 and 0.56 for the meaningful learning approach, and 0.58 was reported for the Rote learning approach.

Socioeconomic Status (SES)

For the measurement of SES, Rana (2002) considered the following indicator, education of parents, income level of the family, house ownership, availability of home servants and transport to attend educational institutions, and other facilities like computers, TV, AC, telephone, and internet. But in the present study, after the consultation with experts, parental education, occupation, and family income (Wells & Lynch, 2012) were used as indicators for the calculation of SES. After the computation of total scores on SPSS, the SES was classified into three categories like higher, medium, and low levels.

Results

Table 1

Mean and SD of TOSRA, *L-A, *M-LA and *R-LA Scales

Variable	All	Male	Female	Low SES	Med SES	High SES
N	1966	997	969	828	561	577
Attitude towards Science						
Mean	189.29	185.20	193.49	188.98	190.47	188.59
SD	20.45	21.60	18.27	22.44	19.25	18.50
*L-A						
Mean	83.31	83.98	82.63	85.15	82.21	81.75
SD	10.02	11.05	8.79	10.66	9.93	8.65
*M-LA						
Mean	42.59	42.96	42.21	43.23	42.09	42.18
SD	5.65	6.38	4.76	6.27	5.34	4.85
R-LA						
Mean	40.75	41.07	40.43	42.01	40.13	39.58
SD	5.27	5.71	4.77	5.36	5.34	4.67

*LA, M-LA, R-LA indicates learning approaches

The mean and SD for all respondents on the Attitude scale was (189.29, 20.45) for male (185.20, 21.60), female (193.49, 18.27), Low SES (188.98, 22.44), for Med SES (190.47, 19.25) and for Hi SES was (188.59, 18.50).

For Learning Approach Scale mean and SD for all respondents was (83.31, 10.02) for male (83.98, 11.05), for female (82.63, 8.79), Low SES (85.15, 10.66), Med SES (82.21, 9.93) and for Hi SES was (81.75, 8.65).

Regarding Meaningful Learning Approach Scale mean and SD for all respondents was (42.59, 5.65) for male (42.96, 6.38), for female (42.21, 4.76), Low SES (43.23, 6.27), for Med SES (42.09, 5.34) and for Hi SES was (42.18, 4.85).

In the case of the Rote Learning Approach Scale mean, and SD for all respondents was (40.75, 5.27) for male (41.07, 5.71), female (40.43, 4.77), Low SES (42.01, 5.36), Med SES (40.13, 5.34) and for Hi SES was (39.58, 4.67).

T-Test

Table 2

Gender basis comparison of students' attitude

Respondents	N	Mean	SD	df	t	p	Effect size
Male	997	185.05	21.607	1964	-9.170	0.000	0.42
Female	969	193.49	18.271				

*p<0.00

As mentioned above t value, (-9.170) with df (1964) was significant. The value of the effect size

was 0.42. Hence it was noted that females showed significantly higher levels of attitude than males.

Table 3

Gender-based Comparison of Respondents' L-A*

Respondents	N	Mean	SD	df	t	p	Effect size
Male	997	83.98	11.049	1964	2.980	0.000	0.136
Female	969	82.63	8.791				

*p<0.00

The table shows a gender-wise comparison of the Learning Approach of respondents with a t value (2.980) and df (1964) was significant. These findings were compared with effect size (0.136).

If it was less than 0.2, it was negligible (Cohen, 1988). Therefore, it was found from the above comparison that no gender differences were found in their learning approach.

Table 4

Gender-wise Comparison of Respondents' R-LA*

Respondents	N	Mean	SD	df	t	p	Effect size
Male	990	41.07	5.713	1956	2.705	0.000	0.12
Female	968	40.43	4.769				

*p<0.00

The table shows a gender-wise comparison of the Learning Approach of respondents with t value (2.705) and df (1956) was significant. These findings were compared with the effect size

(0.12). If it is less than 0.2, then it is negligible (Cohen, 1988). Hence, it was found from the above comparison that both genders showed no difference in the rote learning approach.

Table 5

Gender-wise Comparison of Respondents' M-LA*

Respondents	N	Mean	SD	df	t	p	Effect size
Male	997	42.96	6.376	1962	2.951	0.000	0.134
Female	967	42.21	4.760				

*p<0.00

The table shows a gender-wise comparison of the Learning Approach of respondents with a t-value (2.951) and df (1962) was significant. These findings were compared with the effect size (0.134).

If it is less than 0.2, then it is negligible (Cohen, 1988). Hence, it was found from the above comparison that both genders were not different in their Meaningful learning approach.

One-way ANOVA

Table 6

Learning Approach and Levels of SES

	Sum of Squares	df	Mean Square	Effect Size Eta squared (η^2)	F	p
Between Groups	4897.928	2	2448.964	0.0248	24.986*	0.000
Within Groups	192401.063	1963	98.014			
Total	197298.991	1965				

* p<0.05

The F value (24.986) for all respondents of three levels of SES was significant at $p < 0.05$ with effect size $\eta^2 = 0.0248$. It was obvious that the Learning Approach scores of respondents were

significantly different among the three levels of SES, for further details Least Significant Difference (LSD) was used as a post-hoc test.

Table 7

Post hoc test (LSD)

Level of SES	Level of SES	Mean Difference	p
Low level	Medium level	2.942*	0.000
Medium level	High level	0.463*	0.000

* $p < 0.01$

The mean difference (2.942 & -.463) between respondents of low-level SES and medium-level SES and respondents of high-level SES and

medium-level SES were significant at $p < 0.05$, respectively.

Correlation Analysis

Table 8

Relationship of Students' Attitude toward Science with Learning Approach (r), Meaningful Learning Approach (r1), and Rote Learning Approach (r2)

Respondents	N	r	r1	r2
Overall	1966	0.292**	0.265**	0.267**
Male	997	0.319**	0.294**	0.285**
Female	969	0.304**	0.272**	0.287**
Low SES	828	0.434**	0.366**	0.426**
Medium SES	561	0.220**	0.248**	0.162**
High SES	577	0.096*	0.072	0.103*

**Correlation is significant at the 0.01 level (2-tailed)

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

The Relationship of Students' Attitude toward Science with their Learning Approach (r), Meaningful Learning Approach (r1), and Rote Learning Approach (r2) for all the respondents were analyzed, and correlation coefficients of 0.292**, 0.265** and 0.267** were measured respectively. It shows that a positive and significant relationship at $p < 0.01$ exists between Students' Attitude toward Science and their Learning Approach (r), Meaningful Learning Approach (r1), and Rote Learning Approach (r2).

For male respondents, correlation coefficients of (0.319**, 0.294**, and 0.285**) respectively were measured, which shows that there exists a positive and significant relationship at $p < 0.01$ between Attitude toward Science and their Learning Approach (r), Meaningful Learning Approach (r1) and Rote Learning Approach (r2). Similar kind of relationships (0.304**, 0.272**, 0.287**) at $p < 0.01$ were measured in case of female respondents

In the case of levels of SES, comparatively higher magnitude of correlation coefficient (0.434^{**}, 0.366^{**} and 0.426^{**}) were measured for low levels of SES, but the magnitude of correlation coefficient was weak though positive

and significant (0.220^{**}, 0.248^{**} and 0.162^{**}) in case of medium level of SES. Differently, a very weak though positive relationship (0.096^{*}, 0.072, and 0.103^{*}) was found for higher levels of SES.

Table 9

Relationship of Students' Attitude toward Science with Learning Approach (r), Meaningful Learning Approach (r1), and Rote Learning Approach (r2) across SES and Gender

SES	Male				Female			
	N	r	r1	r2	N	r	r1	r2
Low SES	510	0.430 ^{**}	0.362 ^{**}	0.410 ^{**}	318	0.447 ^{**}	0.384 ^{**}	0.459 ^{**}
Med SES	296	0.267 ^{**}	0.289 ^{**}	0.217 ^{**}	265	0.176 ^{**}	0.221 ^{**}	0.096
Hi SES	192	0.117	0.123	0.092	386	0.159 ^{**}	0.124 [*]	0.160 ^{**}

^{**}Correlation is significant at the 0.01 level (2-tailed)

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

The Relationship of Students' Attitude toward Science with their Learning Approach (r), Meaningful Learning Approach (r1), and Rote Learning Approach (r2) across SES and Gender was analyzed, and the correlation coefficients for male and female respondents were (r = 0.430^{**}, 0.447^{**}), (r1 = 0.362^{**}, 0.384^{**}), (r2 = 0.410^{**}, 0.459^{**}) positive and significant at p<0.01 for low-level SES.

For medium-level SES, the correlation coefficients for male and female respondents were (r = 0.267^{**}, 0.176^{**}), (r1 = 0.289^{**}, 0.221^{**}), (r2 = 0.217^{**}, 0.096) weak positive and significant at p<0.01 but not in case of Rote Learning Approach for female respondents r2 = 0.096 which is less than 0.1 and as described by Cohen (1998) Bartz (1999) and Hopkins (1997) that if the co-efficient value is below r = 0.1, it is negligible even if significant.

In the case of high-level SES, the correlation coefficients for male and female respondents (r = 0.117, 0.159^{*}), (r1 = 0.123, 0.124^{*}), and (r2 = 0.092, 0.160^{*}) were measured, respectively. It is evident that the relationship is very weak, only significant for female respondents at p<0.05 regarding the Learning Approach and Meaningful Learning Approach but negligible for male respondents.

Conclusion and Discussion

It was found that the attitude of science students was positive, which was convenient with Hacıeminoglu (2016), Anwar and Bhutta (2014), Rani (2000 & 2006), Rana (2002), Mukhopadhyay, 2014; Abell & Lederman, 2007). It was explored that females' science attitude was higher with respect to males, which was supported by Hacıeminoglu (2016), Anwer and Iqbal (2012). Dissimilar results were also reported in the literature with respect to gender, with no gender differences (Dhindsa & Chung, 2003; Miller, Lietz & Kotte, 2002). In the case of levels of SES, on the attitude scale, medium-level respondents had higher mean scores than low and high SES was similar to the findings of Rana (2002). The results were dissimilar from Hacıeminoglu (2016), where it was concluded that low attitude was revealed by medium SES level students and higher aptitude for higher SES level science students, and even students with medium level SES showed low attitude scores than low SES level. In the present study, males and females didn't differ with respect to mean scores of learning approach, rote learning approach, and meaningful learning approach scales. Dissimilarity in results was that scores of

the meaningful (strategic) approach were low for girls with respect to boys (Soundariya, Deepika, Kalaiselvan, 2017). Even boys and girls showed similar scores for the meaningful learning scale (Ahmed & Ahmad, 2017).

Analysis of the gender differences in the learning approaches among the science (medical) students showed that females predominantly adopt a strategic approach to learning compared to the male medical students, which was statistically significant. Similar results were observed in other studies (Amini, Tajamul, Lotfi, Karimian, 2012). The influence of gender on learning capabilities is a never-ending debate. Females tend to organize their study to the assessment demands, and males always go for logical reasoning and search for evidence supporting their understanding (Rehman, Khan, Akahai, Hassan, 2013). It has also been observed that meaningful approaches to learning result in high-academic performance and positive attitudes in science students (Hasnor, Ahmad, Nordin, 2013). The mean score of the various approaches of all the students in a class provides a good index of the standard of the educational strategies adopted in the class (Dart & Clark, 1999).

It was evident that Learning Approach scores for students differ for all levels of SES. Low-level SES respondents had higher mean scores than the medium and high SES, and medium-level SES respondents had higher mean scores than high SES respondents. Duncan and Magnusson (2012) and Gottfried, Gottfried, Bauthurst, Guerin, and Parramore (2012), learning approaches of science students were positively related to SES. According to Nunes, Bryant, Strand, Hillier, Barros, and Friedmann, (2017), it is the need of the hour to pay more attention to science-related fields and the creation of knowledge not only in the UK but also in all developing countries as science opens new horizons for students to prosper and achieve prestigious jobs. Social Justice is being discriminated against students on an SES basis not only in the UK but also in

Pakistan, leading unbalance facilities for Science students. Nunes, Bryant, Strand, Hillier, Barros, and Friedmann (2017) found a relation between SES and learning approaches of science students up to the age of 16; higher income level students learn through meaningful learning and show good performance than low SES students and vice versa, even more, similar case was for attitude towards science (Report on SES and Science Learning, 2017, ALSPAC, 2015).

As a whole, a positive and significant relationship exists between students' attitudes toward science and their learning approach, meaningful and rote learning approaches. The results revealed a positive relationship between attitude toward science and meaningful and rote learning approaches (Hacieminoglu, (2016). This result showed that students who have a more positive attitude towards science preferred to undertake meaningful learning rather than rote learning, resulting in the achievement of higher scores. Hacieminoglu et al. (2013) supported the idea that traditional teaching and over-dependence on textbooks could be responsible for the increasing negative student attitudes about science. Kristiani, Susilo, and Aloysius (2015) show that the correlations between attitude and learning approaches in biology learning approaches are significant. Usak, Prokop, Ozden, Ozel, Bilen, and Erdogan (2009) reported a statistically significant correlation between students' attitudes toward learning approaches.

At the gender level, the correlation between attitude and variable of approaches to learning was positive and significant in the present study. In the case of levels of SES, a comparatively higher magnitude of correlation was measured for low levels of SES, but the magnitude of the correlation coefficient was weak though positive and significant in the case of medium levels of SES. Differently very weak though a positive relationship was found for higher levels of SES. Hacieminoglu (2016) noted that parents' SES level affects the science attitude of pupils. The income and education level of parents was

significantly correlated with the science attitude of students (Hacieminoglu, 2016). Usak et al. (2009) reported that significant link between attitudes toward biology with respect to learning achievement, although the correlation was weak. It is also reported that the correlation was not affected by gender (Dwyer & Moore, 2001) but by the student's interest in the biology program.

The relationship of students' attitudes with their learning approach, meaningful and rote learning approaches across SES and gender were moderate, positive, and significant for all categories low level and medium-level SES except negligible for females in the case of rote learning approach. In the case of high-level SES, the correlation coefficients for male and female respondents were very weak and only significant for female respondents regarding Learning Approach and Meaningful Learning Approach but negligible for male respondents. The findings of Zohar and Sela (2003) revealed that showed that correlation was more positive for boys with respect to girls (Zohar & Sela, 2003). According to Kumari and Saraladevi (2014), males were more positive for active and sequential learning, and girls were more positive for reflective learning (rote learning) and showed negative attitudes as compared to the opposite gender. Gender issues may be addressed by innovation in learning approaches which help to enhance the science students' Attitude. Yamtinah, Masykuri, Ashadi, and Shidiq (2017) revealed that female students were more positive for conceptual knowledge (meaningful learning) as compared to male students.

Özkal (2007) explored that science student's Attitude and meaningful learning approach had a strong relationship and concluded that attitude is the predictor of both learning approaches. Cavallo (1994), in a study on New York State biology students, found that boys inclined more toward meaningful learning and girls more towards rote learning; both genders showed positive attitudes and correlations between the variables. Conley et al. (2004) found

that gender, ethnicity, and SES had a moderate correlation with attitude and learning. SES level showed a difference as a low level of SES leads to attitude and more inclined to rote learning.

Balci (2005) explored that 8th-grade students' attitudes and learning approaches had a significant relationship. Soylu (2006) found that females and males differ in attitude and reasoning level for learning science. Cavallo et al. (2004) concluded that rote learning differs on gender level but has no difference in meaningful learning for science courses; more girls were more positive for meaningful learning at the start and less at the end of science courses, and it was reversed for boys. Cano (2005) indicated males had a higher surface approach and positive attitudes toward science than girls. In the research of Dart et al. (2000), a negative correlation was noted between attitude, rote and meaningful learning. Moreover, Saunders (1998) and Cavallo et al. (2003) revealed no correlation between the above-mentioned approaches, gender, and attitudes toward science.

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