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AN ASSESSMENT OF PHYSICS LABORATORY LEARNING ENVIRONMENTS, TEACHER INTERPERSONAL BEHAVIOUR AND THEIR ASSOCIATION WITH STUDENTS' ATTITUDE TOWARDS PHYSICS IN HIGHER SECONDARY SCHOOLS OF JAMMU CITY

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This study presents an assessment of the physics laboratory learning environments, teachers' interpersonal behaviour and students' attitudes towards physics at the higher secondary level. Two widely used questionnaires, i.e. Science Laboratory Inventory (SLEI) and the Questionnaire on Teacher Interaction (QTI) along with an Attitude towards Science Scale was used to assess the perceptions of students about physics laboratory learning environments. The sample consisted of 300 students taken from six higher secondary schools of Jammu city. The results of the study showed that students had positive perceptions about their physics laboratory learning environment. Students were found to be helpful, cooperative and supportive of each other in the laboratory classes. They rated their teachers in terms of exhibiting helpful and friendly behaviour, understanding of their needs and were giving freedom and responsibility in the classroom. Significant associations between student attitudes towards physics and physics laboratory learning environments were observed. Also, significant gender differences were found, and the results showed that female students felt that they were more cooperative, interested and encouraged in their physics laboratory classroom as compared to male students. No significant associations have been found to exist between teacher-student interactions and attitude towards physics.

KEYWORDS: Physics laboratory, Learning Environments, SLEI, QTI, Attitude Towards Physics

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INTRODUCTION

The laboratory experiment is an important part of science teaching. Many studies show that experiments in the laboratory influence students to have better attitudes towards science and learning outcomes. Laboratory experiments can help students to understand abstract concepts in physics. Practical work is also fun and interesting for the students. As a result, we are motivated to explore the various scientific concepts that we learn in the classroom in a science laboratory. According to Swain et.al (2000) at cited in Parkinson (2004, p.186), there are four aims of practical work in a laboratory i.e. to encourage students to (1) practice seeing problems and solve it. (2) find the facts and new principals, (3) develop ability to cooperate, and (4) develop critical attitude. The teacher's role is to help the students to achieve the aims of the practical work along with creating a positive learning environment in the laboratory to achieve the best educational performance.

In the teaching learning process, there are different factors which can affect the students learning. Factors may be related to teachers and their behaviour, students and their socio-cultural background and the environment. As students are very much nearer to the teachers thus it can be said that teacher related factors are very important to affect students learning. In other words, the behaviour of the teacher influences that of his students, whereas at the same time the behaviour of the students' influences that of the teacher. Thus, it is important for the teacher training institutions to prepare the teachers who can enhance students learning and create positive learning like environments (Walberg, 1990).

Pickering (1980) writes that the work of lab courses is to give the experience of doing science. Although the objective is hard to achieve, the obstacles are organizational and not inherent in laboratory teaching itself. By presenting an authentic, undisguised scientific experience, a lab course can create a student into better viewer, a more careful and precise thinker and more deliberate problem solver and that is what education is all about (cited in Hofstein, 2008, p.211). This was written 30 years ago yet is basically still true today. While reform is possible, however it is not necessarily cheap as it requires time for careful planning to take place and in today's society time is money.

The main purpose of this study was to assess the psychosocial learning environments that exist in a physics laboratory when practical work is integrated with theoretical learning in the classroom. The researchers were also interested in assessing the attitudes of students towards physics when studying in a laboratory classroom. Since the teacher is the central figure in any classroom environment and interacts with the students for a longer period of

time, it was also of interest to understand and assess the teacher-student interactions in terms of how students perceive their relationship with the teacher in a physics laboratory for teaching of scientific concepts.

REVIEW OF LITERATURE

Research specifically on classroom learning environments began about 40 years ago with the work of Walberg (1981) and Moos (1979). Since then the study of educational environments and their effects has been a major concern of educational researchers, policy makers and practitioners. Many questions have been asked about the relationship between the classroom environment and educational outcomes. Some of these have included, does a classrooms environment affect student learning and attitudes? What types of questionnaires and instruments should a teacher use to measure the environment of a classroom? What are the factors which influence students learning? The development of various learning environment instruments has enabled researchers to explore these problems. As a result, learning environments have become a firmly established field of study in educational research (Fraser, 1998).

In the context of the present study on physics laboratory learning environments and teacher interpersonal behaviour, a number of research studies have been undertaken to assess the impact of science laboratory and teacher interpersonal behaviour on the learning environments.

a. Research Studies Using Science Laboratory Environment Inventory (SLEI)

Fisher, Harrison, Henderson and Hofstein (1998) conducted a study of senior high school biology, chemistry and physics laboratory environments and drew data from student responses to the Science Laboratory Environment Inventory (SLEI) and a curriculum analysis of the implemented laboratory tasks. The study involved 387 biology, chemistry and physics students in 20 classes in Tasmania, Australia. The curriculum analysis was based on Lunetta and Tamir's Laboratory Structure and Task Analysis Inventory and the Laboratory Task Analysis. The study found that the SLEI did differentiate between the three subject areas and that the Laboratory Structure and Task Analysis Inventory confirmed the open-ended nature of the school physics investigations as evident from students' responses to the SLEI.

Lightburn and Fraser (2007) administered the SLEI to 761 high school biology students and found that students' attitudes to science were more positive where there is strong integration between theory and practical

experiences, a high amount of student cohesiveness and clearly defined rules.

Ahmad, Osman and Halim (2013) conducted a survey to determine teachers' perception of the science laboratory learning environment and the relationship between different aspects of this environment and satisfaction from teaching and learning. Teachers' perceptions of psychosocial aspects were measured by use of the Science Laboratory Environment Inventory (SLEI), whereas perceptions of physical aspects were measured by use of the Physical Science Laboratory Environment Inventory. The level of satisfaction was measured by use of a satisfaction scale (SC). Data were collected from 800 science teachers in secondary schools in Malaysia. Analysis of findings revealed that teachers have positive attitudes on all SLEI scales, with the exception of the open-ended scale. In terms of physical aspects, teachers regard lighting and technology as highly important but furniture and equipment, space, air quality and safety as of moderate importance only. Results also showed that teachers' satisfaction from teaching in the laboratory was positive. Subsequent analysis revealed a significant predictive relationship between teachers' perception of science laboratory learning environments and their teaching and learning satisfaction.

Gupta, Koul and Sharma (2015) investigated that learning science can be made more interesting by providing the students hands on experience through experimentation and project work etc. This is especially true for science laboratories where students get a chance to test their ideas and learn difficult science concepts by performing experiments. Science laboratories have become a very important part of learning science in schools and thus students' perceptions of their science laboratory learning environments would provide valuable insights as to how science laboratories can be further improved and the right kind of environment is created that fosters learning. This study, which was the first of its kind in India, reports the use of the modified form of Science Laboratory Learning Environment Inventory (SLEI) for assessing the students' perceptions of their learning environments in General Science laboratories. Analysis of data of 460 students from higher secondary classes i.e. grades 10th to 12th provided evidence for the reliability and validity of the questionnaire for use in Indian school settings. The same data was also used for studying gender differences and the associations between students' perceptions of their science laboratory learning environments with their attitude towards science.

b. Research Studies Using the Questionnaire on Teacher Interaction

Khine and Fisher (2003) examine this study investigated associations between teacher student interaction and students' attitudes towards chemistry among 497 tenth grade students from three independent schools in Singapore.

Analyses supported the reliability and validity of a 48-item version of the Questionnaire on Teacher Interaction (QTI). Statistically significant gender differences and stream differences (i.e. gifted vs. non-gifted) were observed for numerous QTI scales, but gender x stream interactions also emerged. Associations were found between the interpersonal behaviour of chemistry teachers and students' enjoyment of their chemistry lessons.

Brok, Fisher and Scott (2005) investigated relationships between students' perceptions of their teachers' interpersonal behaviour and their subject related attitude in primary science classes in Brunei. Teacher–student interpersonal behaviour was mapped with the Questionnaire on Teacher Interaction (QTI) and reported in terms of two independent dimensions called Influence (teacher dominance vs submission) and Proximity (teacher cooperation vs opposition). While prior research using the QTI mainly focused on secondary education, the present study was one of the first in Brunei and in primary education and one of few studies to use multilevel analysis. Data from 1305 students from 64 classes were used in this study. Results indicated strong and positive effects of Influence and Proximity on students' enjoyment of their science class and supported findings of earlier work with the QTI.

Gupta and Fisher (2011) conducted a study which reports the use of Questionnaire on Teacher Interaction (QTI) for assessing the students' perceptions of their teachers' interpersonal behaviour in a technology-supported science classroom environment in an Indian school. Analysis of data of 705 students from 15 classes provided evidence for reliability and validity of the questionnaire in Indian settings to be used at the secondary level. The same data was also used for studying gender differences and the associations between students' perceptions of their teachers' interpersonal behaviour with three learner outcomes i.e. their attitude towards science, academic efficacy and academic achievement which have been reported as significant.

Kour (2012) conducted a study to assess the teacher -student interaction in English classroom at the secondary level by using the Questionnaire on Teacher Interaction (QTI) (Wubbels and Levy, 1993). The results showed that students perceive their teachers to be strict which is quite acceptable in the Indian classroom situation as a teacher is in the command of class most of the time. The negative aspects of teacher interaction as assessed using QTI have been rated quite low by the students. No significance associations were reported between the teachers-student interactions. Result on investigation of gender difference suggest that only five scales i.e. understanding. Helping/friendly, uncertain, dissatisfied and admonishing are statistically significant in terms of the teacher-student interaction in favour of female

students. The results also highlight students' positive attitude towards English.

The review of literature on SLEI and QTI suggests that laboratory experiments in teaching and learning science has brought about improvements in students' achievement, helped in creating interest in various aspects of science and enhanced their learning ability. Relative superiority of teaching through laboratory experiments over the conventional classroom teaching has also been established in these research studies along with positive effects of teacher interpersonal behaviour.

Objectives Of The Study

The main objectives of this study were: 1) to assess the physics laboratory learning environments in terms of perceptions of the students in higher secondary schools; 2) to assess the teacher interpersonal behaviour in a physics laboratory in higher secondary schools; 3) to assess students' attitude towards Physics while learning in a laboratory setting; 4) to investigate whether gender differences exist in a physics laboratory learning environment, teacher interpersonal behaviour and attitudes towards physics at the higher secondary level and 5) to investigate associations of students' perceptions of their physics laboratory learning environments and teacher-student interactions with attitude towards physics.

Sample For The Study

In this study the researcher attempts to study higher secondary students' perceptions in physics laboratory learning environments in selected schools of Jammu city. The sample involves students in selected higher secondary schools of Jammu where the various concepts of physics are being taught in a physics laboratory setting. The sample will be chosen carefully so as to be representative of the population and comprise of coeducational classes in order to permit an unbiased test of gender differences. The sample includes 300 students (both boys and girls) at the higher secondary level i.e. from grades 11th and 12th from 6 Central Board of Secondary Education (CBSE) affiliated schools of Jammu city. The students were chosen through random sampling.

Tools Used In The Study

After reviewing a number of instruments, the Science Laboratory Environment Inventory (SLEI, Fraser, Giddings & McRobbie, 1995) and the Questionnaire on Teacher Interaction (QTI, Wubbels & Levy, 1993) were selected. Two forms of the Science Laboratory Environment Inventory (SLEI) were used i.e. the Actual Form and the Preferred Form. The Actual Form measures the classroom

environment in its current form while the Preferred Form measures perceptions of students' ideal or preferred classroom environments. The SLEI has five scales having seven items each (Student Cohesiveness, Open-Endedness, Integration, Rule Clarity and Material Environment) and the five response alternatives are Almost Never, Seldom, Sometime, Often and Very Often which have scores 1,2,3,4 and 5, respectively for positive items and reverse scores for the negative items. Table 1 gives the description of the various scales of the SLEI.

Table 1

Description of Each Scale in the Science Laboratory Environment Inventory (SELI).

Scale Name	Scale Description
Student Cohesiveness	The extent to which student know, help and are supportive of one another.
Open Endedness	The extent to which the laboratory activities emphasize an open-ended divergent approach to experimentation.
Integration	The extent to which the laboratory activities are integrated with non-laboratory and theory classes.
Rule Clarity	The extent to which the behaviour in the laboratory is guided by formal rules.
Material Environment	The extent to which the laboratory equipment and materials are adequate.

The Questionnaire on Teacher interaction (QTI) was developed by Fisher, Fraser, & Wubbels (1993) to study the teachers' interpersonal behaviour. This shorter version has six items in each of the eight scales. The 48-item Australian version of the QTI was used for this study which is given in Table 2. Responses to the QTI items are recorded on a five-point Likert scale scoring from 1 (Never) to 5 (Always) on the questionnaire only.

Table 2

Names and Description of the Scales of the Questionnaire on Teacher Interaction.

Scale	Description
Leadership	Extent to which teacher provides leadership to class and holds student attention.
Helping/Friendly	Extent to which the teacher is friendly and helpful towards students.
Understanding	Extent to which teacher shows understanding and care to students
Student Responsibility/ Freedom	Extent to which the students are given opportunities to assume responsibilities for their own activities
Uncertain	Extent to which teacher exhibits her/his uncertainty.
Dissatisfied	Extent to which teacher shows unhappiness/dissatisfaction with the students.
Admonishing	Extent to which the teacher shows anger/temper and is impatient in class
Strict	Extent to which the teacher is strict with demands of the students

In order to investigate associations among students' attitudes towards physics and their perceptions of science laboratory classroom environments the researchers also used the Attitude Scale as given in Table 3.

Table 3

Description of the Attitude Towards Physics Scale.

Attitude Scale	Scale Description
Attitude Towards Physics	The extent to which students are involved in, enjoy and look advance to lessons in science.

FINDINGS AND RESULTS

Means and Standard Deviations on the SLEI

Items means and standard deviations were computed to determine the nature of physics laboratory learning environment using SLEI. The statistical significance of the difference between means (t- test) was also calculated to study whether the differences in the means of the actual and preferred forms of the SLEI when used in physics laboratory classroom settings were significant. The data obtained are presented in Table 4.

Table 4

Means, Standard Deviations (SD) and Significance of Difference between Means (t) for the SLEI.

Scale Name	No. of Items	Mean		Standard Deviation		*t*
		Actual	**Preferred**	**Actual**	**Preferred**	
Student Cohesiveness	7	3.00	2.90	0.54	0.54	2.50*
Open Endedness	7	3.10	3.04	0.54	0.66	1.27
Integration	7	3.10	3.02	0.54	0.48	2.12*
Rule Clarity	7	3.08	3.07	0.52	0.47	0.03
Material Environment	7	3.04	3.02	0.52	0.59	0.60

**Significant at 0.01, N=300*

From the results in Table 4, it can be seen that the mean scores of the different scales of the SLEI ranged from 3.00 for the Student Cohesiveness scale to 3.10 for the Open Endedness in the Actual Form. Students were found to be helpful, cooperative and supportive of each other in the laboratory classes. Students found that laboratory activities are open-ended and enjoyed doing different experiments and laboratory activities which are related with the theory being taught in their classes. Certain rules that have been defined have been followed by the students in their laboratory classes and the equipment and materials needed by the students for laboratory activities are readily available to them which makes their physics laboratory learning environment conducive for learning. On examining the mean scores in the

preferred form of SLEI, it can be seen that they range from 2.90 for Student Cohesiveness scale to 3.08 for the Rule Clarity scale. The values of the standard deviation in both the Actual and Preferred Forms of the SLEI are less than 1, which suggests that there are no major deviations in students' perceptions of their physics laboratory learning environments.

The results for the paired t-tests indicated that there is a significant difference ($p<0.01$) between the actual and preferred means for two out of the five scales (Table 4). This shows that most of the students are helpful, Cooperative and supportive with each other in the laboratory classes and in integration scale we find that physics laboratory session helps the student to understand the theory that is covered in regular physics classes. This result also shows that physics laboratory work is related with their theory topics. This means physics laboratory activities and theory classes both are integrated, and students perceived their physics laboratory classroom environment to be cohesive. Figure 1 represents the average score on the actual and preferred form of SLEI in a graphical form. There is also a significant difference on the scales of Student Cohesiveness and Integration at 0.05 level of significance.

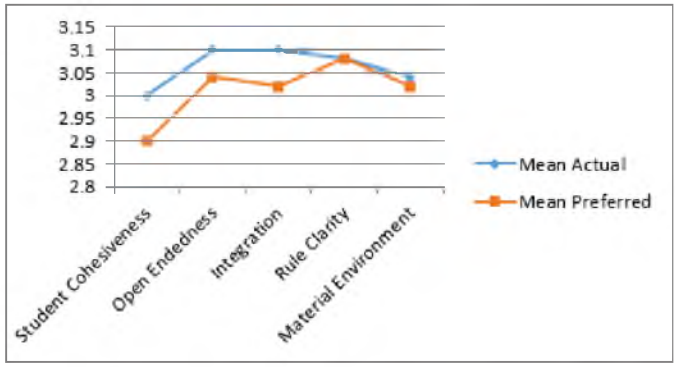

Figure 1. Mean scores of actual and preferred forms of the SLEI.

Means and Standard Deviations on the QTI

The values of means and standard deviations were computed to determine the extent of teacher student interactions in physics laboratory at the higher secondary level as measured by QTI. The values of means and standard deviations are given in Table 5. The mean scores of the different scales of the QTI range from 2.84 for the Leadership scale to 3.17 for strict scale. In the same table we can also see the values of standard deviation, range from 0.55 for Student Responsibility/Freedom scale to 0.88 for the uncertain scale. The

values of the standard deviations are less than 1.00 which suggests that there is no major diversity in teacher-student interactions in a physics laboratory at the higher secondary level. The mean scores of the eight scales of the QTI are shown in Table 5.

Table 5

Values of Means and Standard Deviations for the QTI.

Scale Name	No. of items	Mean	Standard Deviation
Leadership	6	2.84	0.71
Understanding	6	3.01	0.56
Helping Friendly	6	3.06	0.88
Students Responsibility/Freedom	6	3.08	0.59
Uncertain	6	2.88	0.79
Admonishing	6	3.09	0.55
Dissatisfied	6	3.05	0.62
Strict	6	3.17	0.63

N = 300

From the results in Table 5, we can interpret that usually students do not see their teachers as good leaders and students also perceived their teachers are uncertain and that they keep a low profile, are hesitant, timid and not sure what to do. They have rated their teachers in terms of exhibiting helpful and friendly nature, understanding and giving students freedom and responsibility in the classroom. In fact, positive factors have been displayed by teachers in the classroom quite often. An interesting feature of analysis is that students consider their teachers as strict as acceptable in Indian classrooms because a teacher is in charge of a classroom and gives students direction in various academic matters. This shows that the physics laboratory classroom learning environment may help in creating healthy teacher-student interactions, build mutual relations and promote positive behaviour. Figure 2 represents the area of student depiction perception of the teacher-student interpersonal behaviour in physics classroom at higher secondary level which was developed by plotting the mean scores of the eight scales of the QTI (student questionnaire) in an excel worksheet. The sector profile reveals diagrammatically the degree to which students distinguish each behavioural aspect exhibited by the teacher as measured through the QTI i.e.

the Leadership Scale, Helping/Friendly, Understanding Scale, Student Responsibility/Freedom Scale, Uncertain Scale, Dissatisfied, Admonishing Scale and Strict Scale.

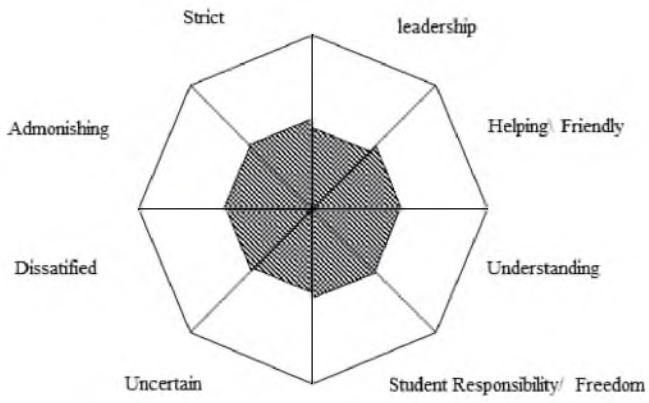

Figure 2. Sector profile diagram of students' perceptions of their Teachers' Interpersonal Behaviour.

Mean and Standard Deviation on Attitude Towards Physics Scale

The value of the mean for the Attitude towards physics is 3.0. The results have been shown in Table 6. The high mean score of the Attitude towards Physics scale shows that students have a relatively positive attitude towards the subject when they are taught in a physics laboratory.

Table 6

Values of Mean and Standard Deviation for Attitudes Towards Physics.

Scale Name	Mean	Standard Deviation (SD)
Attitude Towards Physics	3.0	0.53

N = 300

The Attitude towards Physics scale shows that students sometimes look forward to lessons in physics and also think that lessons in physics are fun. They sometimes also feel that it is one of the most interesting school subjects. They sometimes enjoy lessons in physics which creates interest among the students. Students expressed that they sometimes also dislike lessons taught

in physics and consider physics to be boring.

Gender Differences in Physics Laboratory Learning Environments

The means and standard deviations for each of the male and female groups were compute followed by a test of significance of the difference between means (t-test for independent samples) on the five scales of the SLEI in the Actual form and Preferred form.

The data obtained statistically has been presented in Table 7. Results shows that t- value ranged from 0.39 to 2.34 for the difference between the perception of males and females of their physics laboratory learning environment as assessed using the Actual Form. From the information given in the Table 6, it can be seen that only one of the five scales of the SLEI in the actual form, i.e. Student Cohesiveness with a 't' value of 2.34 is statistically significant ($p<0.05$). In the scale, which is statistically significant, females have a higher mean score than males. This means that female students feel that they are more cooperative, interested and encouraged in their physics laboratory classroom as compared to male students.

Table 7

Gender Differences in Student's Perceptions Towards Physics Laboratory Learning Environments as measured by the SLEI in the Actual Form.

Scale	Gender	Mean	Standard Deviation (S.D)	*t*
Student Cohesiveness	Female	3.08	0.51	2.34*
	Male	2.93	0.56	
Open ended	Female	3.10	0.59	0.02
	Male	3.10	0.50	
Integration	Female	3.09	0.51	0.39
	Male	3.11	0.56	
Rule Clarity	Female	3.14	0.51	1.73
	Male	3.03	0.52	
Material Environment	Female	3.09	0.51	1.41
	Male	3.00	0.54	

** Significant at $p<0.05$*

Females (n) = 137, Males (n) = 163

From the information given in the Table 8, it can be seen that there is no significant difference between male and female students in their perceptions about the physics laboratory learning environment as measured by the SLEI in the Preferred Form. Hence, it is clear from the results that both the boys and girls perceived their preferred physics laboratory learning environment in a similar manner.

Table 8

Gender Differences in Student's Perceptions Towards Physics Laboratory learning Environments as Measured by the SLEI in the Preferred Form.

Scale	Gender	Mean	Standard Deviation (S.D)	*t*
Student Cohesiveness	Female	2.95	0.52	1.68
	Male	2.85	0.55	
Open Endedness	Female	3.00	0.50	0.85
	Male	3.07	0.78	
Integration	Female	3.05	0.49	1.26
	Male	2.98	0.47	
Rule Clarity	Female	3.11	0.46	0.85
	Male	3.06	0.48	
Material Environment	Female	3.07	0.64	1.49
	Male	2.97	0.55	

Females (n) = 137, Males (n) = 163

Gender Differences in Perceptions of Teacher-Student Interactions

The means and standard deviations for the two gender groups were computed followed by a test of significance of difference between means (t-test for independent samples), to investigate if any gender differences exist on the eight scales of the QTI. The data obtained statistically are presented in Table 9.

The data analysis reveals that there are no gender differences on the different scales of the QTI ($p<0.01$, $p<0.05$) in students' perceptions of their teacher-student interactions in a physics classroom environment. Thus, both male and female students perceived their teachers' interpersonal behaviour in a similar manner, thus signifying homogeneity in the group.

Table 9

Gender Differences in Student-Teacher Interactions as measured by the QTI.

Scale Name	No. of items	Mean	S.D	*t*
Leadership	Female	2.81	0.76	0.70
	Male	2.87	0.67	
Understanding	Female	3.07	0.60	1.20
	Male	2.97	0.53	
Helping Friendly	Female	2.99	0.60	1.15
	Male	3.11	1.05	
Students Responsibility/Freedom	Female	3.05	0.62	0.81
	Male	3.11	0.57	
Uncertain	Female	2.91	0.77	0.54
	Male	2.86	0.80	
Admonishing	Female	3.09	0.51	0.14
	Male	3.09	0.58	
Dissatisfied	Female	2.98	0.67	1.9
	Male	3.12	0.56	
Strict	Female	3.20	0.57	0.76
	Male	3.15	0.68	

Female (N) = 137, Male (N) = 163

Gender Difference in Attitude Towards Physics.

Gender differences in Attitude towards physics were also investigated. The means and standard deviations for the two groups were computed followed by a significance of the difference between means (t-test). The data are shown in Table 10.

Table 10

Gender Differences in Student's Attitude Towards Physics as Measured by the Attitude Scale.

Scale	Gender	Mean	S.D	*t*
Attitude Towards Physics	Female	2.97	0.54	0.046
	Male	3.01	0.52	

Female (N) = 137, Male (N) = 163

From the data analysis it is evident that there are no gender differences between male and female students in their attitude towards physics. This means that both boys and girls perceived their Attitude towards physics in a similar manner.

Investigation of Associations with the SLEI and QTI

Investigation of the Association between the SLEI scales and Attitude Towards Physics

Simple and multiple correlation analysis, followed by computation of regression coefficient were used to explore the students' perception of their physics laboratory learning environment and its association with the Attitudes Towards physics, which is the fifth objective of the study. Table 11 shows the significant associations between physics laboratory learning environments and student outcomes. The results from Table 11 indicate that for simple correlations(r) one out of five scales of SLEI is statistically significantly and positively associated with students' attitude towards Science ($p<0.05$) at the individual level of analysis. The values of correlation range from -0.005 for the Rule Clarity to 0.13 for the Student Cohesiveness scale.

Table 11

Associations between the SLEI Scales and Attitude Towards Physics in terms of Simple Correlation (r) Multiple Correlation (R) and Standardized Regression Coefficient (β).

Scale Name	Attitude Towards Physics	
	r	β
Student Cohesiveness	0.13*	0.147*
Open-Endedness	-0.012	-0.035
Integration	0.003	0.014
Rule Clarity	-0.005	-0.007
Material Environment	-0.029	-0.048
	Multiple Correlation $R = 0.15$ $R^2 = 0.02$	

**Correlation is significant at the 0.05 level.*

Associations between the perceptions of physics laboratory learning environment measured using the SLEI and the Attitude of students towards physics were explored using simple (r) and multiple correlations (R) followed by the regression analysis between the SLEI scales and the Attitude Towards Science scale. The data thus obtained have been presented in Table 11. From the data, it can be deduced that out of the five scales of SLEI only one scale has a significant association with the Attitude towards Physics scale.

The multiple correlations (R) among Students' perceptions as measured by the different scales of the SLEI and the Attitude toward Physics Scale (see Table 11) are 0.15 at the individual level of analysis. The R^2 values indicate that 2% percent of variance in the students' attitude towards physics subject can be attributed to the students' perceptions of their physics laboratory learning environments. Standardized regression value was calculated to provide information about the unique contribution of each learning environment scale to Attitude Towards Physics scale. Regression coefficient values (β) indicate that one of the five scales of SLEI is significantly associated with the Attitude towards Physics scale. Thus only one of the five SLEI scales uniquely account for a significant ($p<0.05$) amount of variance in student's attitude towards science; that is student cohesiveness.

Investigation of the Association between Teacher-Student Interactions and Attitude Towards Physics

Association between teacher-student interactions as measured by the QTI and the attitude of students towards physics were explored using simple (r) and multiple correlations (R) follow by the regression analysis between the QTI scales and the Attitude towards Physics scale. The data thus obtained have been presented in Table 12. From the data, it can be deduced that out of the eight scales of QTI only one scale has a significant correlation with the Attitude towards Physics scale. This scale is admonishing which has a positive and significant correlation which implies that the admonishing behaviour of the teacher will have a positive influence on the attitude of the students towards physics. Regression coefficient values (β) indicate that none of the eight QTI scales are significantly associated with the attitude towards physics scale.

The multiple correlation (R) between students' perceptions as measured by the different scales of the QTI and the Attitude towards Physics Scale (as seen in Table 12) is 0.21 at the individual level of analysis. The R^2 value indicates that 4% percent of the variance in the students' attitude towards physics can be attributed to the students' perception of teacher student interactions. Standardized regression values were calculated to provide information about the unique contribution of each QTI scale to the Attitude towards Science scale. It was found that none of the scale of QTI uniquely account for their association with Attitude towards Physics scale.

Table 12
Associations between the QTI and Attitude Towards Physics in terms of Simple Correlation (r), Multiple Correlation (R) and Standardized Regression Coefficient (β).

Scale Name	Attitude Towards Physics	
	r	β
Leadership	0.02	0.04
Understanding	0.10	0.08
Helping Friendly	-0.03	-0.04
Students Responsibility/Freedom	0.08	0.06
Uncertain	0.03	0.02
Admonishing	0.14*	0.11
Dissatisfied	0.08	0.05
Strict	0.08	0.05
	Multiple Correlation R = 0.21 R^2 = 0.04	

**Correlation is significant at the 0.05 level.*

Conclusions

The results of the present study in the context of research in the field of physics laboratory learning environment, teacher interpersonal behaviour and their association with students attitude towards physics in India are considerable mainly because it is one of the Initial studies to use the Science Laboratory Environment Inventory (SLEI), Questionnaire on Teacher Interaction (QTI) and Attitude towards Physics scale in the secondary schools of Jammu City to assess the perceptions of the students about their physics laboratory learning environment, teacher-interpersonal behaviour and Attitude Towards Physics.

The results show that the students perceive their Physics Laboratory Learning environment in a positive manner. The mean score values on the Attitude towards Physics scale are also high. Also, the students' perceptions of their physics laboratory learning environments and teacher- student interaction are associated in a significant manner with attitudes towards physics. Gender differences between male and female students were also investigated which reported that there are significant differences in the perceptions of the physics laboratory environment and that female students feel that they are more cooperative, interested and encouraged in their physics laboratory classroom as compared to male students. No significant gender differences have been reported in teacher-student interactions in a physics laboratory learning environment and attitude towards physics in secondary schools of Jammu. The main purpose of practical work is to provide opportunities for the development of aspects of scientific literacy, understanding the nature of science and especially the understanding of scientific evidence and the development of critical thinking skills (Venville and Dawson, 2004), and knowledge of the environment will help in furthering these objectives. The present study is important for teachers of science who want to improve science education system by focusing on the learning environment. In a nutshell, the results from this study can provide guidelines for teachers to develop more positive and productive physics laboratory learning environments. The same findings can be used in broader perspective to study the learning environments in areas other than science education.

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