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A STUDY OF SCIENTIFIC ATTITUDE, TEACHING EFFECTIVENESS AND PHYSICS ACHIEVEMENT AMONG PHYSICS SENIOR SECONDARY STUDENTS

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ABSTRACT

The global documented aim of secondary science teaching is to develop and augment rationality, objectivity, open-mindedness, curiosity, scientific temperament, etc. The development of such qualities helps in the development of a major quality as scientific attitudes (SAs). And a teacher plays vital roles in not only cognitive but non- cognitive developments among the students as well. The present work was aimed at finding the impact of teaching effectiveness (TE) and SAs over physics achievement (PA) of senior secondary students. The study utilized 309 senior secondary students in Shahjahanpur district of Uttar Pradesh, India. The results show good significant correlations among TE & SA and TE & PA, but a weak correlation between SA & PA. And no gendered responses were reported among students SAs and experienced physics TE. While the multiple stepwise regression analysis does not establish SAs as a predictive variable of PA and only TE was found to have 18.3% of the total variance in students' PA scores.

KEYWORDS: *Scientific Attitude, Teaching Effectiveness, Physics Achievement*

INTRODUCTION

Science education and its aims in India have been well accentuated in different educational documents. These documents such as Report of the Education Commission (1964-1966), National Policy on Education(1968,1986,1992), National Focus Group position paper on aims of science education (2006), lay special emphasis on the need and importance of science education together with various recommendations regarding the curriculum to achieve them. The documents clearly uphold the aims of science teachings in schools and the ways to attain them, the role of a teacher has been emphasized as of utmost importance. As the success of the science reforms in a school is very much dependent on the teachers of the school (Darling-Hammond, 1996). And teachers are the earliest questionable persons for the students learning in classrooms as well as in school (Patrick & Mantzicopoulos, 2016).

There are several pieces of research that reported the impact of effective teacher instructions as more significant in terms of student achievements (Druva & Anderson, 1983; Darling-Hammond, 2000; Aina et al, 2015). And in the particular terms of physics, students might comprehend the subject as difficult (Elby, 1999), and its instructions might be considered as challenging (Machold, 1992), yet physics teachers are regarded as the responsible persons towards student learning's (Lawrenz et al, 2009). Though there are no set criteria for effective teacher characteristics (Harris, 1998). Yet different definitions with different types of teachers' preparation and knowledge to plan and execute the classroom activities adds to their classroom effectiveness (Darling-Hammond, 2000). As Cimer (2007) identified effective teachers as the ones who successfully achieve the learning objectives of the students as set by themselves before the class. While,

Hipkins (2002) argued that teaching science and physics is effective when students' existing ideas, values, and beliefs, which they bring to a lesson, are elicited, addressed and linked to their classroom experiences at the beginning of a teaching program. And educational documents have discussed such roles of science teachers that will strengthen the teaching effectiveness of the teachers. Though the documents have accentuated science teachings and learning differently at all educational levels secondary science education has been foremost discussed for recommendations regarding secondary science educations. As at secondary levels, the level of all sciences contents is much advanced from primary level contents and works as the basis of future higher education (Report of the Education Commission, 1964-66).

The recommendations of the Indian educational documents regarding secondary science educational so directs the teaching of science to develop some effective qualities among students that help accomplish the aims of science education. As the aim is not only to develop student intellect as cognition only but affective domains of student learning has equal importance (Payne, 1977). These documents clearly emphasize development and enhancement of effective qualities as a spirit of inquiry, the courage to question, the removal of superstitions, skepticism, curiosity, scientific temperament, etc. Among the students (National Policy on Education, 1992; National focus group position paper, 2006). And such qualities can be grouped into a broader category quality as scientific attitudes (SA) (Glaud, 1986). Where SA is a very older term and consists of several scientists' behavioral attributes, as Klopfer (1971) have considered them as 'desirable attitudinal outcomes' and directly points towards characteristics that are possessed by the scientists. And attributes can be many or few depending on the researchers as their aim and focus of the research.

The development and advancement of SAs as well as TE are crucially important at secondary science instructions, while literature is comprised of a number of researches that reported SAs as a correlate of learning outcomes in science subjects (Jaleel & Philip, 2017; Ahuja, 2017; Srivastava, 2015; Mukhopadhyay, 2013; Annakkodi, 2008; Bhaskar, 2001). And teaching effectiveness is found to be directly relating to the student learning outcomes (Wang et al, 2018; Newman et al, 2017; Atsuwe et al, 2016, Hussain et al, 2012; Ahmedet at, 2011; Monoharan & Sundaram, 2003). But there exists a research gap in considering all these three variables altogether in a single study. The present work thus aimed to study SA, physics TE, and PA among the senior secondary students. The study was to find whether there exists any correlation between the dependent and independent variables, their interrelations, and gender differences if any.

OBJECTIVES

The objectives of the present study were:

- To explore the relationship between SA, TE, and PA for senior secondary students.
- To study the difference in SA of senior secondary students in terms of gender (Male/Female).
- To study the difference in physics TE as experienced by senior secondary students in terms of gender (Male/Female).
- To study the impact of SAs and physics TE over the PA of the senior secondary students.

HYPOTHESIS

And consequently following hypotheses guided the study:

H_{01}. There exists a significant relationship between SA, TE, and PA among the senior secondary students.

H_{02}. There exists a significant difference in SA of senior secondary students in terms of gender (Male /Female).

H_{03}. There exists a significant difference in student experiences of physics TE in terms of gender (Male/Female).

H_{04}. There exists no significant impact of SAs and physics TE over PA of the senior secondary students.

METHODS & PROCEDURE

The study has whole Central Board of Secondary Education (CBSE) senior secondary school students in Shahjahanpur city as the population and it involved a sample of 309grade 12 senior secondary students from 6 CBSE schools, selected through simple random sampling. The data were collected with the help of two data instruments which involved a self- constructed physics teaching effectiveness scale having a reliability coefficient of 0.95. The physics teaching effectiveness scale measures student experiences in physics classroom and laboratories to determine the overall effectiveness of the physics instructions in the schools. And an adapted version of SA scale by Sukhwant Bajwa & Monika Mahajan (2017) has also been utilized with its reliability being re-established over the population as 0.82. And students' grade 11 physics scores were treated as their PA of the senior secondary students. While the data has been analyzed with the help of different statistical techniques on the basis of our research objectives, which are discussed in the next section.

RESULTS & DISCUSSIONS

To explore the interrelationships among the three variables, i.e. SAs, TE, and PA among the students, the Pearson correlation coefficients were formed among all the three variables as seen in table 1.

Table 1: Exploring Relationship among SA, TE and PA

Correlations	r- Value For Total Sample	p- Value	r- value for total Male Sample	p- Value	r- Value for total Female Sample	p- Value
SA and PA	0.254	0.015	0.360	0.007	0.188	0.023
TE and PA	0.423	0.000	0.458	0.000	0.378	0.050
TE and SA	0.564	0.000	0.497	0.000	0.345	0.000

The Pearson's correlation coefficients among the variables show a good significant correlation between TE & PA and TE & SAs for the total sample students as well as among the male and female samples. The results indicate that an effective teacher has a significant effect on the development of SAs and achievement in physics among the students. Thus, as effective is the teaching, the better will be the SAs and PA of the students, the result is in line with the study of Hussain et al (2011) and Monoharan & Sundaram (2003). Table1 also shows a weak, yet significant correlation between SA and PA among the students. Though the relationship between SA and PA is not found to be strong enough still the relation is significant with $p<0.05$.

Now t-test was applied to find out any gendered responses among the sample for SAs of the students and experienced TE by the students.

Table 2: Difference in SAs in term of Gender

Source		N	Mean	df	t-value	p- value
Gender	Male	182	135.0	307	1.35	0.180
	Female	127	137.6			

The t- value in table 2 for SAs among male and female samples is found to be insignificant with $p> 0.05$, thus showing no significant differences among the gender groups among SA.

This result rejects our second hypothesis and in opposition to the research report of Ahuja (2017), Jaleel & Philip (2017) who reported the presence of gendered responses among the students. And in line with the research of Lucas (2016) who also found no significant differences among male and female sample over SAs.

Table 3: Difference in Experienced Physics TE in Terms of Gender

Source		N	Mean	Df	t- value	p- value
Gender	Male	182	9.71	307	-1.55	0.112
	Female	127	8.48			

The t- value for TE is also insignificant with p-value >0.05, the results thus report no significant differences between the male and the female samples over their experienced TE. It thus confirms that both male and female students do not differ in their physics classroom and laboratory experiences, and they experience their teachers' effectiveness approximately equal. And this result is in contradiction to the research reported by the Korur and Eryılmaz (2012), who found female students perceiving their physics teachings as more effective than their male counterpart students.

Further to study the individual contributions and predictive strength of both the variables i.e. SA and TE to the PA among the senior secondary students' multiple stepwise regression were analyzed. The regression analysis excluded SAs as a predictive variable of PA and found only physics TE as a predictive variable to PA with a total variance of 18.3%. The F- value is found to be 26.139 with $p<0.01$ as significant, while the regression coefficients are given in table 4.

Table 4: Regression Coefficients for the Total Sample (N=309)

Model	Un standardized Coefficients		Standardized Coefficients	t-Value	p-Value
	B	Std. Error	Beta		
Constant	40.735	4.302		9.470	0.000
TE	0.113	0.028	0.323	4.017	0.000

From table 4 it is evident that the regression equation for the prediction of PA scores can be written as: PA = 40.735 + (0.323) TE. Thus, showing that only TE acts as the predictive variable among the chosen variables, i.e. SA and TE, and PA scores can be predicted with the help of this equation. This result is in line with the study of Olasehinde & Olatoye (2014) who did not find any causal relationship between SAs and science achievement among the students.

CONCLUSIONS

The research work involved 309 senior secondary students from Shahjahanpur district of Uttar Pradesh state India. The collected data over the two data collection instruments together with student physics scores as their PA revealed interesting results from the study. On the lower statistical grounds, the data show strong correlations among TE & PA and TE and SA, while the weak correlation between SA and PA. The correlation between student experiences of effective teaching and achievement in physics was found to be 0.423, $p<0.01$; between TE and SA as 0.564, $p<0.01$. The results thus show that effective teaching is related to students PA as well as to the development of SAs among the students, but SA is weakly associated with PA. And these similar results were found in male and female samples as well, except in the case of SA and PA correlations which are stronger for the male sample than the female sample. Although, it was good to see no gendered responses as reported over the population under study. As both the independent t- values for SAs and TE are found to be insignificant between both of the genders.

While at advanced statistical levels the analysis involved regression analysis for finding the individual percentage contribution of SA and TE to the students' school PA as well as to know the predictive strength of these variables over students' PA. The regression analysis revealed that only TE is acting as the predictive variable to students' PA, while SAs were excluded from the stepwise regression analysis. The F value for TE is found to be significant as $F= 26.13$, $p<0.01$, and TE is reported to cause a total variance of 18.3% in the students' PA scores. The contribution of TE alone is significant and sufficient for us to realize the importance of physics TE for any improvement in students' physics learning outcomes.

However, the research does not reports sufficient causal relation between students SAs and physics learning outcomes in terms of PA. But this result does not directly discard possibilities of any correlation between SAs and PA. And it might come up due to some other reasons as well, which can be explored in further studies. As initially SAs was found to be weakly associated with PA of the students, but later it does not show up as a predictive variable of the students' PA.

IMPLICATIONS OF THE STUDY

As our Indian educational policies and programs aim inculcation of scientific attitude while determining the roles of science teachers. And the current research report also confirms the impact of TE on PA of the students together with a strong significant correlation between TE and SA of the students. The teachers are thus required to realize their roles and administer them effectively in the classrooms as well as in laboratories. And we need to facilitate effective physics teachings for the students by providing trained quality teachers, good school environment, better physical facilities in terms of infrastructure and specifically physics laboratories, etc. An effective teacher is a key concept of student achievements in any subject and in the case of a subject as physics the responsibilities of the teachers are much more.

Although there are a number of ways to orient ones teaching effectively generally through student-centered instruction together with maximum student participation and technology. But field specific physics teaching effectiveness should put special emphasis over student motivation and development of positive attitudes towards the subject stressing over the mathematical and laboratory competencies. As the subject is many considered as dry and difficult the student perceptions and interests in the subject should be developed and maintained. And secondary level instructions have lifelong implications over the students as helping them not only in developing a further choice to study, but also to earn a livelihood, to employ science in daily lives and to become an active nation provider. The teachers are required not only to play the role of an instructor, but to work as a guidance provider, and should always be available to the students even outside the class and school premises.

Although the current research does not directly from SAs as a predictive variable of the PA among students literature has a number of studies showing strong correlations of SAs with science and or physics achievement among students. SAs are always the primary crucial aims to be developed among any student who is involved in any science field studies. As recommended by the various educational documents SAs are the very first desired attitudinal or more specific behavioral developments in the students studying science. And teachers are realized as a responsible entity in achieving these aims as well. Thus the recommendations of the educational documents should be made real on practical grounds and schools should focus not only on cognitive developments of the students, but equal importance should be given to the student non- cognitive developments as well.

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