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Achievement in Science as Predictors of Students' Scientific Attitude

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Abstract:

The present study is an attempt to find out whether achievement in science contributes to prediction of scientific attitude in intent as well as action. The sample consisted of 480 ninth graders (240 boys and 240 girls) of Allahabad city, India. Scientific Attitude Questionnaire prepared by K. S. Misra and Science Achievement Test (Form A) prepared by researcher were used. It was found that knowledge, comprehension and application in science do not contribute to the scientific attitude in intent among male students. Male students with more ability to comprehend in science are not likely to have better scientific attitude in their action. So science educators should provide more personal autonomy to male students and increase their motivation in learning science. Among female students comprehension in science has been found to be a predictor of scientific attitude in intent and knowledge in science is found to be the best predictor of scientific attitude in their action. This implies that science teachers should emphasize these two aspects of achievement in science among female students.

Key words: Achievement in science, Scientific attitude, Knowledge, Comprehension, Application.

Introduction

The importance of students' scientific attitudes in learning science has attracted significant attention from researchers for the past 50- 60 years. Since 1960s many of the science educators have done researches hoping to promote scientific attitude among students (Kozlow & Nay, 1976; Billeh & Zakharidas, 1989; Noll, 1935; Heiss, Oburne & Hoffman, 1958; Baumel & Berger, 1966; Jain, 1967; Srivastava, 1987; Yadav, 1988; Misra, 2008). According to Klopfer (1971) scientific attitude refers to the 'desirable attitudinal outcomes' which are the professional attributes of the scientists that are displayed in conducting scientific inquiries. A person who has scientific attitude will be (1) critical- minded (2) open- minded (3) demands or supply empirical evidences to support or contradict statements or explanations (4) he is willing to alter his decisions when new evidences support his viewpoint or when it becomes necessary to accommodate empirical data (5) suspends reaching conclusions and forming judgements when reliable and objective information is lacking (6) approaches the situation or a problem with a minimum prejudice or bias (7) asks questions and tries to know more about some event, organism, equipment or phenomenon (Misra, 2008).

A great number of studies demonstrate that there are associations between students' scientific attitudes and achievement in science. For instance, Alexander (1995) found that achievement in science has direct influence on students' scientific attitude. Singh (1988) proposed that scientific attitude can be divided in three components namely cognitive, affective and psychomotor. Bhattacharya (1997) reported that all the three domains of scientific attitude were found highly positively related to students' science achievement. There exists a positive relationship between scientific attitude and achievement in science (Ksheersagar, 2013; Mukhopadhyay, 2011; Sharma, 2007; Kaushik, 1998; Bhattacharya, 1997;

Paulose, 1992; Rao, 1990; Bileh & Zakhariades, 1975; Moore, 1930). Findings of Srivastava (2002), Shinde (1982) revealed that students with high achievement in science exhibit higher scientific attitude than their counterparts with low achievement. Science achievement is found to be the predictor of scientific attitude (Bhattacharya, 1997; Alexander, 1995). In contrary to these findings, studies also revealed that there is no relationship between students' scientific attitude and their science achievement. Dhatrak & Wanjari (2011), Baumel & Berger (1965) and Hoff (1936) found no relationship between scientific attitude and achievement in science. Students with high, moderate and low level of achievement in science do not differ in their scientific attitude (Sharma, 2007; Baumel & Berger, 1965; Hoff, 1936). Gender differences in the relationship between students' scientific attitude and achievement in science are emphasized by the studies of Shinde (1982) and Sharma (2007). Sharma (2007) and Shinde (1982) found that girls showed a better relationship between scientific attitude and achievement in science than boys.

The present study is an attempt to find out how intent and action components of secondary students' scientific attitude are associated with three different levels of achievement in science among secondary students. Three major research questions were investigated:

(1) Is there any relationship between two components of scientific attitude and three dimensions of achievement in science namely knowledge, comprehension and application among male and female students?
(2) Whether male and female students' scientific attitude can be explained by levels of achievement in science?
(3) Whether male and female students differ in achievement in science and intent and action components of scientific attitude?

Objectives of the study:

1. To study the relationship between scientific attitude in intent and achievement in science.
2. To study the relationship between scientific attitude in action and achievement in science.
3. To find out whether achievement in science contribute to the prediction of scientific attitude in intent.
4. To find out whether achievement in science contribute to the prediction of scientific attitude in action.
5. To compare male and female students on-
    1. Knowledge, comprehension, application and overall achievement in science
    2. Scientific attitude in intent and action.

Hypotheses of the study:

The following hypotheses will be tested:

1. There is no significant relationship between scientific attitude in intent and achievement in science.
2. There is no significant relationship between scientific attitude in action and achievement in science.
3. Achievement in science does not significantly contribute to scientific attitude in intent.
4. Achievement in science does not significantly contribute scientific attitude in action.

Methodology of the study:

Sample

The sample consisted of 480 ninth graders (240 boys and 240 girls). Multistage random sampling was used. Ten schools were randomly selected from different areas of Allahabad city in India. From each school, two classes of ninth grade students and from each class 24 students were randomly selected.

Tools

'Scientific attitude questionnaire' developed by K. S. Misra was used for measuring scientific attitude of grade 9 students. The questionnaire contains 112 items, 84 items to elicit students' scientific attitude in intent and 28 items for measuring students' scientific attitude in their action.The test- retest reliability for the SAQ is 0.78 (Misra, 2009), split- half reliability values of 0.72 (Gautam, 2001). Reliability of SAQ scores as further calculated by researcher (split- half = 0.81, N= 200). Inter- dimension correlations among all the dimensions of scientific attitude were stated to provide evidence for the validity of the tool (Misra, 2009).

'Science Achievement Test (Form A)' developed by the investigator was used to measure science achievement of IX grade students. The reliability for SAT has been calculated by split- half method and it was found to be 0.67 (N= 200) and parallel form reliability was found to be 0.59 (N= 50). Content and criterion related validity has been established.

Statistics Used:

Product- moment coefficients and t- ratios were calculated for the analysis of the data.

Results:

Table 1

Mean, S. D. and t- ratio showing the difference in male and female students' three level of achievement in science and scientific attitude in intent and action

S. No.	Variables	Male (N= 240)		Female (N= 240)		t- ratio
		Mean	S. D.	Mean	S. D.	
1.	Achievement in science	19.60	4.59	19.53	4.47	.171
2.	Knowledge in science	9.73	3.02	9.56	2.92	.46
3.	Comprehension in science	4.90 5.28	2.03 2.43	5.00 6.09	1.83 2.34	.56 3.68**
4.	Application in science	19.92	5.76	20.95	5.64	1.97*
5.	Scientific attitude-	58.14	13.95	55.27	15.38	2.14*

6.	intent Scientific attitude- action					

*/**= significant at .05/.01 level

Table 1 shows that the value of t- ratios for overall achievement in science (= 1.97) is significant at .05 level and application in science (= 3.68) is significant at .01 level. It means that female students exhibit higher achievement in science related to application in science and more ability to apply their scientific knowledge than their male counterparts. Table 1 further shows that the value of t- ratio for knowledge (= .46) and comprehension (t= .56) is not significant at .05 level. It means that male and female students do not differ from one another in their knowledge and comprehension in science.

Value of t- ratios for scientific attitude- intent and action are significant at .05 level. It can be seen that IX grade female students' scientific attitude in intent is higher than their male counterparts (t= 1.97) and male students' scientific attitude in action is higher (t= 2.14) than their female counterparts.

Table 2

Correlation between achievement in science and intent and action components of scientific attitude for male and female students

S. No.	Achievement in science	Male	Female
1.	Scientific attitude in intent	-.07	.25**
2.	Scientific attitude in action	-.07	.17**

Table 2 show that for male students, the values of coefficients of correlation for intent and action components of scientific attitude and achievement in science are not significant at .05 level. For female students, the values of coefficients of correlation for the two components of scientific attitude and achievement in science are significant at .01 level. It means that scientific attitude in intent as well as scientific attitude in action are positively related to achievement in science (r= .25,

.17) among female students but scientific attitude in intent and action (r= -.07, -.07) is not related to achievement in science among male students.

Table 3 shows that for female students, out of three value of coefficient of correlation between scientific attitude in intent and three aspects of achievement in science, two are significant at .01 level and one value is not significant at .05 level. It means that scientific attitude in intent is positively related to knowledge (r= .18) and comprehension in science (r=.27) among female students but application in science is not related to scientific attitude- intent (r= .11) among female students.

Table 3

Correlation between different aspects of achievement in science and intent component of scientific attitude for male and female students

S. No.	Aspects of achievement in science	Male	Female
1.	Knowledge in science	-.07	.18**
2.	Comprehension in science	-.12	.27**
3.	Application in science	.02	.11

Table 3 further shows that for male students, all the three values of correlation between scientific attitude in intent and three levels of achievement in science are not significant at .05 level. It means that scientific attitude in intent is not related to knowledge (r= -.07), comprehension (r= -.12) and application aspects of in science (r= .02).

Table 4 shows that for male students, the value of correlation between scientific attitude in action and knowledge (r= -.04) is not significant at .05 level. For female students, the value of correlation between scientific attitude in action and knowledge in science (r= .17) is significant at .01 level. This means that scientific attitude in action is positively related to knowledge among female students but it is not related to knowledge in science among male students.

Table 4 further shows that for male and female students the value of correlation between scientific attitude in action and

comprehension aspect of achievement in science are -.14 and .14 respectively. Both the coefficients of correlation are significant at .05 level. This indicates that scientific attitude in action is negatively related to comprehension in science among male students while it is positively related to comprehension in science among female students.

The value of correlation between scientific attitude in action and application aspects of achievement in science for male students (r= .01) and female students (r= .10) is not significant at .05 level. It means that scientific attitude in action is not related to application in science among students.

Table 4

Correlation between different aspects of achievement in science and action components of scientific attitude for male and female students

S. No.	Aspects of achievement in science	Male	Female
1.	Knowledge in science	-.04	.17**
2.	Comprehension in science	-.14*	.14*
3.	Application in science	.01	.10

Table 5

Results of stepwise regression analysis for predicting scientific attitude in action for male students

S. No.	Aspects of achievement in science	B coefficient	Constant	F-ratio	R square
1.	Comprehension in science	-.32	21.17	5.03	.021

Observation of the table 5 shows that comprehension in science is the most powerful predictor in explaining scientific attitude in action. R^2 value is .021. It means that 2.1% of the variance in scientific attitude in action among male students can be explained by comprehension in science. The value of constant is 21.17. F- ratio is 5.03 which is significant at .05 level. The regression equation can be written as:

Scientific attitude- action= 21.17 - .32 comprehension in science

Table 6
Results of stepwise regression analysis for predicting scientific attitude in intent for female students

S. No.	Aspects of achievement in science	B coefficient	Constant	F-ratio	R square
1.	Comprehension in science	2.25	44.13	18.25	.072

Observation of the table 6 shows that for female students R^2 value is .072. Table 4 shows that comprehension level of achievement in science emerged as the best predictor of scientific attitude in intent. It means that comprehension in science explain 7.2 % of the variance in scientific attitude in intent. The value of constant is 44.13. F- ratio is 18.25 which is significant at .01 level. The regression equation can be written as:

Scientific attitude- intent = 44.13 + 2.25 comprehension in science

Table 7
Stepwise regression analysis for predicting scientific attitude in action for female students

S. No.	Aspects of achievement in science	B coefficient	Constant	F-ratio	R square
1.	Knowledge in science	.27	16.90	7.57	.031

Observation of the table 7 shows that for female students R^2 value is .031. Table 5 shows that knowledge aspect of achievement in science emerged as the best predictor of scientific attitude in action. It means that knowledge in science explain 3.1 % of the variance in scientific attitude in action. The value of constant is 16.90. F- ratio is 7.57 which is significant at .01 level. The regression equation can be written as:

Scientific attitude- action = 16.90 + .27 knowledge in science

Discussion:

Comparison between male and female students on overall achievement in science has shown that female students exhibit more achievement in science than their male counterparts. The

findings are contradictory to the findings of Fleming and Malone (1983), Lynn & Hyde (1989); Fraser, 1994; Campbell, Hombo & Mazzeo (2001) who reported that boys' achievement in science is significantly better than that of girls. This discards the traditional gender- stereotyped views of achievement in school science. Findings of comparison between male and female students on three aspects of achievement in science have shown that female students exhibit more ability to apply knowledge in science than their male counterparts but male and female students do not differ from one another in knowledge and comprehension in science. Findings have shown that male students exhibit more scientific attitude as manifested in action than their female counterparts and female students exhibit more scientific attitude as manifested in their intent than their male counterparts.

It was found that achievement in science is positively related to achievement in science among female students but it is not related to achievement in science among male students. It indicates that female students with high achievement in science are more likely to have high level of scientific attitude in intent as well as action while achievement in science do not influence scientific attitude in intent as well as action among male students. In previous studies, Sharma (2007) and Shinde (1982) provided evidence consistent with findings of present study that female students likewise showed better relationship between scientific attitude and achievement in science than male students. This might be due to the difference in their learning preferences. Male and female students differ in their learning preferences (Wigfield & Battle, 2002; Holden, 2002). From sex- differentiated expectations, encouragement and treatment in home as well as classroom arise the difference in learning preferences of male and female students. Female with high achievement in science might prefer development of scientific attitude while male students with high achievement in science might not prefer the development of scientific

attitude. It can be suggested to secondary science teachers to encourage female students' achievement in science to foster scientific attitude in them.

Findings of this study suggested that female students exhibit more ability to apply their scientific knowledge in new situations. It does not contribute to the development of scientific attitude in intent as well as action among them. This finding provides a strong evidence that the students' ability to apply their scientific knowledge does not necessarily lead to better scientific attitude. Due to highly competitive educational environment and immense family expectations, in traditional science classes, students are taught to work hard for their academic performance. This suggests that situations should be designed in the classroom where the students get the opportunity to learn the scientific attitude.

The study revealed that knowledge, comprehension and application in science do not contribute to the scientific attitude in intent among male students. Comprehension in science has been found to be a predictor of students' scientific attitude in their action. Findings indicate that male students with the more ability to comprehend in science are not likely to have better scientific attitude in their action. Perhaps male students perceive more stress in their environment and it might negatively affect the development of scientific attitude in action. So, science educators should provide more personal autonomy to male students and increase their motivation for learning science.

Among female students comprehension in science is found to be the best predictor of scientific attitude in intent and knowledge in science is found to be the best predictor of scientific attitude in their action. These imply that science teachers should emphasize these two aspects of achievement in science among female students.

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