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MEASURING STUDENTS' SCIENTIFIC ATTITUDE, APTITUDE AND KNOWLEDGE AT THE SECONDARY SCHOOL LEVEL: WHAT INTENDED TO STUDY AND WHY?

Pandiavadivu P.[1] and Sridhar R.[2]

Abstract

The present preliminary research work was intended to measure the scientific attitude, scientific aptitude and scientific knowledge of secondary school students in the selected schools of two districts in Tamilnadu, India. The normative survey method was applied and a total of six null hypotheses(gender, studying class, medium of instruction, board of affiliation, locality and type of management) were framed. The sample consisted of 76 secondary school students from seven different schools in Chennai and Thiruvallur districts. The standardized tools were used in the study. The data were collected, recorded and analysed using Statistical Package for Social Sciences (SPSS-19.0 version), IBM Corporation. The measuring scores (low, average and high) were prepared using Normal Probability Curve (NPC) method. The most statistically significant results were obtained for all selected variables except board of affiliation (State and Central Board of Secondary Education) towards scientific attitude and scientific knowledge. Hence the present study concluded that the samples drawn from the selected schools were standardized for conducting further experimental study.

Keywords: *Attitude, Aptitude, Secondary school students, Normal probability curve.*

INTRODUCTION

The importance of conducting scientific attitude, scientific aptitude and scientific knowledge are the vital parameters in order to determine the learners' quality and also significance in mastermind the experimental studies in the present scientific educational world. The significance of science learning is more important in the context of the scientific contemporary society and also helps learner to contribute significantly for the development of nation (Rajib Mukhopadhyay, 2013)[1].

To develop knowledge and field of science, inculcation of scientific attitude, scientific thinking and attitude towards science is essential (Ram Niwas *et al.,* 2015)[2]. Scientific attitude is a disposition to act in a certain way or a demonstration of feelings and/or thoughts. The attributes of scientific attitudes are honesty, objectivity, respect for evidence, open-mindedness, critical-mindedness, questioning attitude, tolerance of uncertainty, willingness to change opinion etc (University of Alberta)[3].

OBJECTIVES OF THE STUDY

1. To measure the scientific attitude, scientific aptitude and scientific knowledge of secondary school students towards standardisation of sample for conducting further experimental study.
2. To find out the significant difference among the variables such as gender, class studying, medium of instruction, board of affiliation, locality, and type of management.

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METHODOLOGY

Method: Normative survey method was applied in the present study. (Nouhi. E, Shakoori A & Nakhei N, 2009)[4]. The collected data was subjected to statistical analysis (SPSS, version 19.0, 2010)[5] such as 't' test, 'F' test, ANOVA (analysis of variance), percentage analysis, Normal probability curve method etc. (Gurumani, 2005)[6].

Hypothesis: Totally six null hypothesis was framed and they are non –directional hypothesis. There is no significant difference between Male and Female; Class 9 and class 10: Tamil and English medium of instruction; State and Central Board of Secondary Education (CBSE) board of affiliations; rural and urban; Government, Government aided and Private schools toward Scientific attitude, scientific aptitude and scientific knowledge.

Population: The Secondary (grade IX and X) School students who were affiliated to educational board such as State and CBSE consisted of population of the study.

Sample:The sample of the present study was school students (N=76), out of these 43 samples were drawn from grade IX and 33 were drawn from grade X. Total samples were collected from seven different schools from the selected districts(Chennai and Thiruvallur) of Tamilnadu, India.

Tool:The description of tools used in this present study as follows,

Scientific Attitude Scale (Avinash Grewal, 1978)[7]: The standard scientific attitude scale (Avinash Grewal, 1978) consisted of 20 statements. Out of these, 10 statements were positive and remaining 10 statements were negative which have to be checked on five point attitude scale. The arbitrary weights of response category for each positive statements are scored 5, 4, 3, 2 or 1 for strongly agree, agree, undecided, disagree or strongly disagree respectively. Scores are reversed for each negative statement.

Scientific Aptitude Test (Pandiavadivu et al, 2015)[8]: The scientific aptitude test for secondary school students were standardized using Cronbach's Alpha values and the reliability coefficients were found 0.874(Spearman-Brown) and 0.672(Guttmann Split-Half). The researchers were constructed and validated the test based on Science subject(Grade 9 and 10) according to Central board Secondary Education(CBSE) and Tamilnadu state board syllabus. The scientific aptitude test was mainly based on the five important aspects in scientific thinking such as Analogy, Scientific reasoning, Numerical ability, Logical reasoning and Comprehension based questions and consisted of 25 questions for secondary school students. There are four options in each subscale in the form of multiple choice questions except in analogy (pick the odd one out). The scoring was awarded one mark for each correct answer and zero for each incorrect answer.

Nature of Scientific knowledge Scale (Rubba & Anderson, 1978)[9]: The nature of scientific knowledge scale was originally invented by Rubba and Anderson, 1978. A total of forty eight statements were included, of which 24 statements were positive and remaining 24 statements were negative. This scientific knowledge scale consisted of six subscales-Amoral, Creative, Developmental, Parsimonious, Testable and Unified. The researchers were used five point attitude scale. The arbitrary weights of response category for each positive statements are scored 5, 4, 3, 2 or 1 for strongly agree, agree, undecided, disagree or strongly disagree respectively. Scores are reversed for each negative statement.

Normal Probability Curve (NPC) scoring for measuring students' scientific attitude, scientific aptitude and nature of scientific knowledge (Sridhar et al., 2014)[10]: Based on the normal probability curve (NPC) method the scoring was prepared with the help of maximum and minimum score obtained. (a) Scientific Attitude Scale; the maximum score of '100' and minimum score of '20' could be obtained and the respondents were grouped into three categories in the order as low (43-58), average (69-86) and high (87-

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100). (b) Similar method was employed to Scientific Aptitude Test; the maximum score of '25' and minimum score of '0' would be obtained. Therefore the respondents were segregated into three categories as low (11-14), average (15-20) and high (21-25). (c) Nature of Scientific Knowledge Scale: the maximum score of '240' and minimum score of '48' would be obtained. The respondents were grouped into low (121-153), Average(154-219) and high(220-252)

RESULT

Table 1. Characteristics of the Variables with respect to the Respondents

Sl.No.	Variables	Categories	Frequency	Percentage	Total
Students proforma					
1.	Gender	Male	45	59.2	76
		Female	31	40.8	
2.	studying class	IX	43	56.6	76
		X	33	43.4	
Institutional profile					
1	Board of affiliation	State	53	69.7	76
		Central(CBSE)	23	30.3	
2.	Type of management	Government	11	14.5	76
		Govt. Aided	10	13.2	
		Private	55	72.3	
3.	Locality	Urban	21	27.6	76
		Rural	55	72.4	
4.	Medium of instruction	Tamil	16	21.1	76
		English	60	78.9	

Table 2. T-scores of Male and Female Secondary School Students towards Scientific Attitude, Aptitude and Knowledge

Tools	Gender	N	Mean	Std. Deviation	Std. Error Mean	t-value (calculated)	t-value (table)	LS	Result
Science attitude	Male	45	83.76	10.836	1.615	2.982	2.617	.004	S
	Female	31	89.81	6.838	1.228				
Science aptitude	Male	45	23.07	2.816	.420	2.798	2.617	.007	S

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	Female	31	24.42	1.336	.240				
Science knowledge	Male	45	200.62	23.419	3.491	4.546	2.617	.01	S
	Female	31	220.90	15.465	2.778				
Total	Male	45	307.44	35.273	5.258	4.292	2.617	.01	S
	Female	31	335.13	20.800	3.736				

Table 3. T-scores of Class 9 and Class 10 Students towards Scientific Attitude, Aptitude and Knowledge

Tools	Studying class	N	Mean	Std. Deviation	Std. Error Mean	t-value (calculated)	t-value (table)	LS	Result
Science attitude	Class 9	43	89.07	6.559	1.000	3.036	2.617	.003	S
	Class 10	33	82.52	12.032	2.094				
Science aptitude	Class 9	43	24.19	1.500	.229	2.417	2.617	.05	S
	Class 10	33	22.88	3.110	.541				
Science knowledge	Class 9	43	216.07	16.097	2.455	3.343	2.617	.01	S
	Class 10	33	199.55	26.737	4.654				
Total	Class 9	43	329.33	20.733	3.162	3.409	2.617	.01	S
	Class 10	33	304.94	40.556	7.060				

Table 4. T-scores of English and Tamil Medium Students towards Scientific Attitude, Aptitude and Knowledge

Tools	Medium of instruction	N	Mean	Std. Deviation	Std. Error Mean	t-value (calculated)	t-value (table)	LS	Result
Science attitude	Tamil	16	79.13	13.918	3.480	3.486	2.617	.01	S
	English	60	88.12	7.495	.968				
Science aptitude	Tamil	16	20.56	3.204	.801	7.535	2.617	.01	S
	English	60	24.43	1.254	.162				
Science knowledge	Tamil	16	185.69	25.489	6.372	5.377	2.617	.01	S

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	English	60	215.08	17.562	2.267				
Total	Tamil	16	285.38	39.940	9.985	5.309	2.617	.01	S
	English	60	327.63	24.462	3.158				

Table 5. T-scores of Urban and Rural School Students towards Scientific Attitude, Aptitude and Knowledge

Tools	Locality	N	Mean	Std. Deviation	Std. Error Mean	t-value (calculated)	t-value (table)	LS	Result
Science attitude	Urban	21	90.67	6.110	1.333	3.161		.01	S
	Rural	55	84.53	10.472	1.412				
Science aptitude	Urban	21	24.71	.644	.140	3.884		.01	S
	Rural	55	23.20	2.697	.364				
Science knowledge	Urban	21	219.90	13.957	3.046	3.414		.01	S
	Rural	55	204.69	24.131	3.254				
Total	Urban	21	335.29	20.187	4.405	3.549		.01	S
	Rural	55	312.42	34.879	4.703				

Table 6. T-scores of State and CBSE School Students towards Scientific Attitude, Aptitude and Knowledge

Tools	Board of affiliation	N	Mean	Std. Deviation	Std. Error Mean	t-value (calculated)	t-value (table)	LS	Result
Science attitude	State	53	85.36	11.232	1.543	-1.535	1.98	-	NS
	CBSE	23	88.22	5.000	1.042				
Science aptitude	State	53	23.11	2.722	.374	-4.289	2.617	.01	S
	CBSE	23	24.78	.518	.108				
Science knowledge	State	53	207.34	25.932	3.562	-1.163	1.98	-	NS
	CBSE	23	212.48	12.551	2.617				
Total	State	53	315.81	37.877	5.203	-1.562	1.98	-	NS
	CBSE	23	325.48	16.079	3.353				

Table 7. F-scores of Government, Government Aided and Private School Students towards Scientific Attitude, Aptitude and Knowledge

Tools	Type of management	N	Mean	Std. Deviation	Std. Error Mean	F-value (calculated)	F-value (table)	LS	Result
Science attitude	Govt.	11	70.91	12.926	3.897	27.014	19.00	.01	S
	Govt. Aided	10	86.50	6.187	1.956				
	Private	55	89.24	6.304	.850				
	Total	76	86.22	9.826	1.127				

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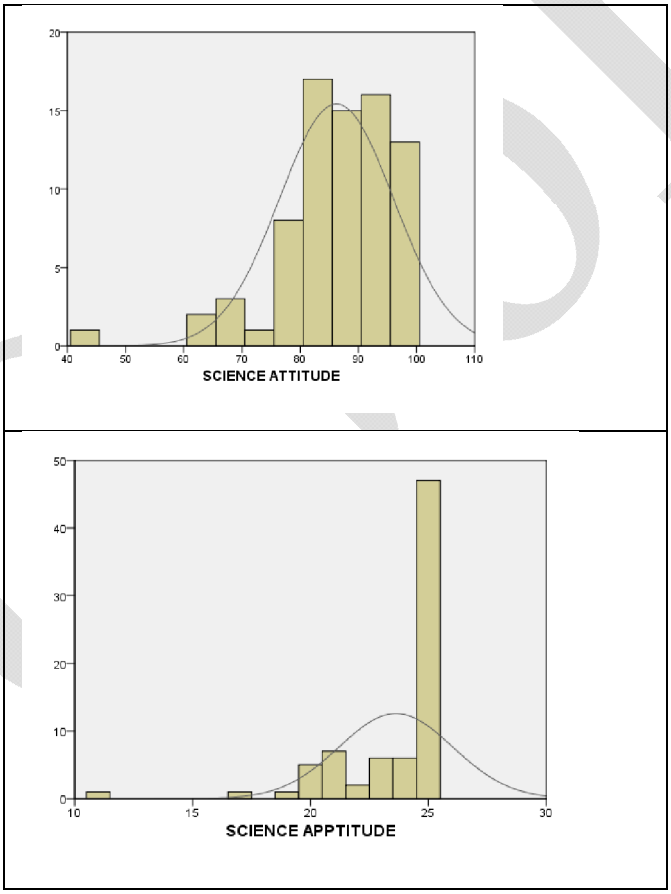
Science aptitude	Govt.	11	19.36	3.075	.927	78.408	19.00	.01	S
	Govt. Aided	10	22.00	1.700	.537				
	Private	55	24.76	.576	.078				
	Total	76	23.62	2.411	.277				
Science knowledge	Govt.	11	170.09	19.455	5.866	48.789	19.00	.01	S
	Govt. Aided	10	199.90	14.866	4.701				
	Private	55	218.29	14.178	1.912				
	Total	76	208.89	22.762	2.611				
Total	Govt.	11	260.36	33.845	10.205	53.593	19.00	.01	S
	Govt. Aided	10	308.40	15.393	4.868				
	Private	55	332.29	19.027	2.566				
	Total	76	318.74	33.023	3.788				



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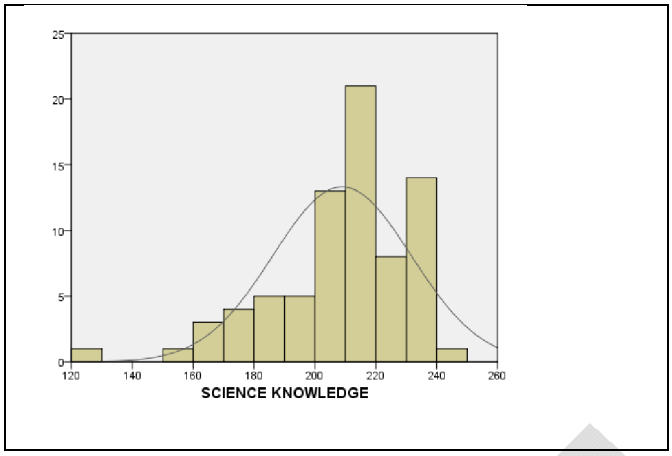

Figure 1. Graphical Representation of Normal Probability Curve and Measuring Scores (Low, Average and High) for Scientific Attitude, Scientific Aptitude and Scientific Knowledge among Secondary School Students

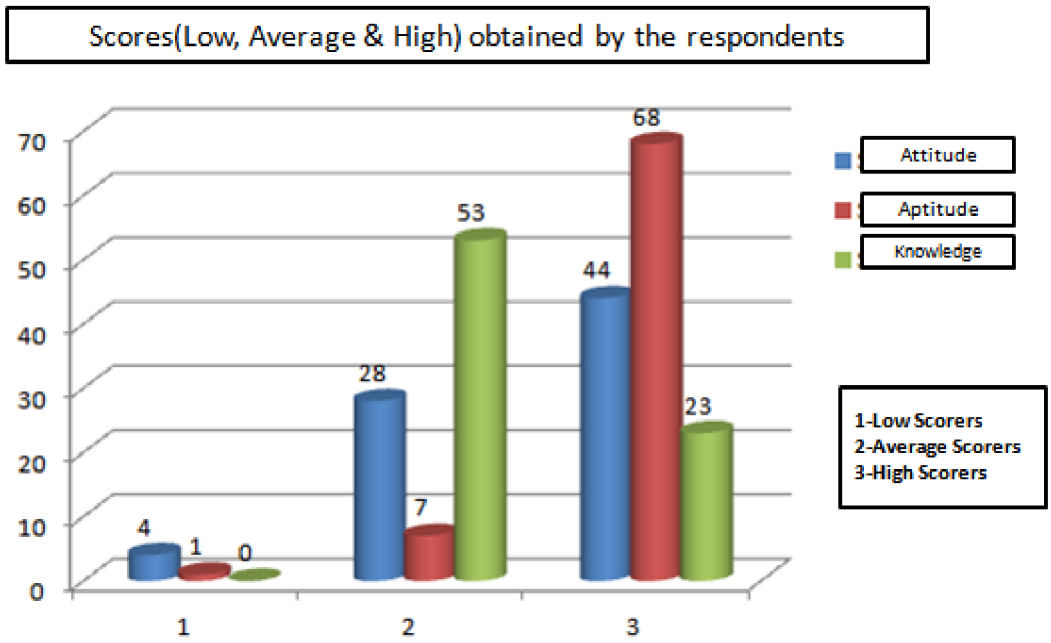

Figure 2. Graphical Representation of Scores Obtained by the Respondents

The results were analysed using descriptive statistics and differential statistics. The main purpose of the descriptive research in description of the state or affairs as it exists at present. It involves calculation of one of the measure of central tendency and variability. On other hand, the differential analysis involves the most important by which the researcher is determine the statistical significance difference between groups.- 't' test, 'F' test, ANOVA (analysis of variance) etc, used. The Characteristics of the variables with respect to the respondents are shown in the Table-1

Daisy Nambikkai and John Louis Manoharan (2014)[11] had studied the attitude towards science of secondary school students in puducherry region. The researchers reported the relevance of learning by doing method with theoretical learning from the secondary school stage.

The percentage of the respondents (N=76) with respect to Scientific attitude by Normal Probability Curve (NPC) method in the order as low 5% (n=4), average 37% (n=28) and high 58% (n=44). Similarly for Scientific aptitude among secondary school students were found in the order as low % (n=1), average 9%

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(n=7) and high 90% (n=68). The percentage of Scientific knowledge of the secondary school students in the present study was found to in the order as low 0% (n=0), average 70% (n=53) and high 30% (n=23) respectively. The graphical representation of NPC is shown in the Figure-1 and the overall scores obtained by the respondents were illustrated in the Figure-2. The t-scores and F-scores (calculated and table values) are shown in the table (2-7) to prove/disprove the framed hypotheses.

CONCLUSION

Hence this study attempts to know the students' attitude, aptitude and knowledge among secondary school level and the most statistically significant results were obtained in this preliminary study. Therefore, the present study concluded that the samples drawn from the selected schools were standardized for conducting further experimental study.

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