MOTIVATION AND SCIENCE PERFORAMNCE: INFLUENCE ON STUDENT LEARNING IN SCIENCE

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ABSTRACT: *The major aim of this study was to explore cause effect relationship between students' motivation for learning, interest and academic performance in science at grade 8. For this purpose, data were collected from 800 students of randomly selected schools in big city of the country. Student Motivation towards Science Learning (SMTSL) questionnaire by Tuan, Chin & Shieh [1] was used. Factor analysis was used to confirm the sub-factor of the motivation in suggested in questionnaire by applying principal axis factoring with promax rotation using the data from this study. The result of ANOVA confirmed that student motivation for learning science has significant effect on academic performance. Researchers found significant positive relationships among different categories of motivation towards science learning and achievement. Gender and interest of students was found a significant source of variation in student performance. Similarly, researchers found students' interest in science also has significant effect on their motivation towards learning science.*

Keywords: *Motivation, Student performance, Science learning*

INTRODUCTION

Science education occupies a very distinguished place at school, college, and university stages of education all over the world. It is the area of professional education, including facilities, curriculum and teacher education as these relate to education in science [2,3,4,5]. In its early stages, the major focus of research on science education was in cognitive domain, and the research in the area of affective domain on science education is relatively new. Now, the affective domain has not only been accepted as a relevant part of education, but also became the focus of considerable research [6].The literature indicated that the affective domain related to science education was primarily concerned with motivation, attitudes, and interest related to science [7,8,91,10,11,12].

Bandura [13] by explaining sociocognitive theory discussed that student's motivation is a concept that emerged from an individual's learning activities and experiences, and it varies from situation to situation or context to another context. Presently, research on student motivation occupies an eminent place in research in the context of learning and teaching in science [14]. Rana[15] have the opinion that motivation is a key factor of learning. Young [16] have the opinion that motivation is one of the most important and foremost variable that influences students' achievement. Research studies bySkaalvik [17]; Skaalvik& Rankin [18]; Wong &Csiksezentmihalyi [19]; Yong [20] reported that motivation is significantly correlated with achievement and academic performance.Ayub[21] on the basis of her study conducted on Pakistani students concluded that motivation is key factor responsible for improving academic performance. A study by Tella[22]reported a significance mean difference in the academic achievement of low and highly motivated students in mathematics at secondary school level.Elliot and Dweck [23] discussed that motivation is a key factor which is accounted for variation in students' academic learning and achievement right from early stage of education to higher level.

Research literature [24,25] indicated that motivation is one of the important factors with other factors like self-efficacy and value-expectancy which influence student academic behaviour. Research studies by Joo, Bong & Choi [26] and Schoon& Boon [27] had discussed that self-efficacy is one of the motivational factor which affects students science learning. Matuga[28] discussed that motivation is one of the factor with other factors like self-regulation, goal orientation which influenced secondary students' academic achievement in science.

Tuan, Chin and Shieh [1] on the basis of their study conducted in 15 senior high schools for grade 8 and 9 science students' in central Taiwan concluded that different factors of motivation which includes: self-efficacy, active learning strategies, science learning value, performance goal, achievement goals, achievement goals, and learning environment situation affects student learning in science. An experimental study conducted by Patric, Kpangban, and Chibueze [29] on a sample of 600 senior secondary science students revealed that motivation significantly contributed towards variation in students test results in science.Peiei, and Guirong[30] discussed that students' with high level of motivation have a tendency of having more success in performance.

Patrick *et al.* [31] by studying young children motivational pattern for science learning discussed that children with positive motivational beliefs were good in science. Talib, Luan, Azhar and Abdullah [32] conducted a study to explore students' motivation for learning science in Malaysia and concluded that successful science learning depends upon many factors which includes students ability and talent (motivation to learn), language proficiency and positive attitude towards science learning. Täht and Must [33] conducted their study in five countries including Estonia, Russia, Latvia, Sweden, and Finland. The basic purpose of their study was to explore relationship between general educational performance, and non-cognitive characteristics of students' self-evaluation and motivation in science in these countries and researchers found moderately positive

relationship between students' general educational performance and their motivation for science. Anderman [34]on the basis of literature review concluded that students' motivation for learning and cognitive processes varies among different subject areas. Luke and Young [35]conducted a study to examine the contextual and personal factors related to the use of cognitive strategies by undergraduate students concluded that motivation as a personal factor plays an important role in the learning performance of students. Struthers,Perry and Menec[36] on a basis of research study concluded that students' academic stress and performance in course (grades) were affected by their academic coping style and motivation.Akbas and Kan[37] on the basis of their research study concluded that motivation and anxiety for Chemistry lesson is a significant predictor of chemistry achievement. Straits[38]discussed that student's motivation and learning in science is influenced by teacher's caring instructional styles Research study conducted by Faircloth and Hamm [39] to investigate the dimensions and mechanisms of belonging relevant to motivation(with respect to efficacy and assessment of value of school work by students' themselves) and achievement among high school students revealed that belonging construct contributed significantly for relationship between student motivation and success.

Research literature indicated that interest can be considered as predictor of students' achievement. Schiefele and Csiksezentmihalyi[40]explored the relationship between students' motivation and interest in subject and their learning and reported that interest was major contributor for predicting students' academic performance at secondary school level.

With respect to relationship between students' interest and achievement, Chang and Cheng [41] on the basis of their study found a positive and statistically significant correlation between students' science achievement and their interest in science. A study by Jones, Howe, and Rua[42] to explore students' interest, experience, and their attitude towards science on the basis of their gender revealed that there is a significant mean difference on the basis of students' gender in their science interest for courses, experiences and attitudes. Olatoye, and Ogunkola [43]reported a positive and significant relationship between science achievement students' achievement in science and their interest in schooling. Peiei, and Guirong[44] discussed that students' with high level of motivation have a tendency of having more success in their academic life . They further discussed that interest can be considered a foundation for their motion to learn.

Skaalvik and Skaalvik[45] explored impact of students' motivation on academic achievement of on the basis of gender and concluded that gender of students has its effects on student motivation as well academic achievement.

Keeping in view the above discussion, it can be concluded that motivation for learning science can be considered as one of the important factors which significantly contributing towards effective science learning of students at school level. So, this study is an effort to explore impact of motivation on students' academic achievement/performance in science.

METHODS

The major aim of this study was to explore cause effect relationship between students' motivation for learning, interest and academic performance in science at grade 8. To achieve this purpose, a sample of about 800 students was selected from five randomly selected secondary schools in one of the big city. Students' motivation towards science learning scale (SMTSL) developed by Tuan, Chin and Shieh (2005) was used with the permission of author to collect data about student motivation for science learning. This Likert type scale is comprised of 35 statements. This instrument was classified by the original authors into six factors. These were self-efficacy (7 statements); active learning strategies (8 statements); science learning values(5 statements); performance goal (4 statements); achievement goals (5 statements), and learning environment situation (6 statements). The data about student academic performance, interest in science and for other demographic variables was collected through demographic variable information proforma. The Cronbach Alpha reliability coefficient for the scale and its sub-scales were calculated. Table 1 shows the descriptive statistics and reliability coefficients for total scale and its sub-scales. This table also exhibit discriminative validity.

Results about mean and standard deviation, Cronbach Alpha reliability and discriminative validity are mentioned in table 1.

It is evident from table 3 that boys have higher motivation and achievement mean scores in science than girls at grade 8 level except learning environment situation where there is no significant mean difference in mean scores of boys and girls.

Reliability of the total scale is 0.864 and for each scale is ranging from 0.809 to 0.899 for learning environment situation to self-efficacy scale respectively. Discriminative validity is used to measure the extent to which each scales measured a dimension which is different from other scales (Tuan, Chin and Shieh, 2005). Table 1 also indicated discriminative validity in terms of mean correlations ranging from 0.12 to 0.39, which showed the independence of each scale.

Table 1: Descriptive Statistics, Reliability Coefficients and Discriminative Validity (in terms of mean correlations with scales)

Variable	No. of Items	Mean	SD	Cronbach Alpha	Mean Correlations
Self-efficacy	7	20.17	2.88	0.899	0.39
Active learning strategies	8	29.04	8.21	0.943	0.36
Science learning values	5	18.67	4.71	0.892	0.12
performance goal	4	11.94	4.96	0.895	0.39
Achievement goals	5	15.82	4.94	0.914	0.35
Learning environment situation	6	20.97	5.11	0.809	0.25
Motivation towards learning science- Scale	35	125.67	15.43	0.864	

Table 2: Factor loading for students' motivation towards science learning

Questions	Factor 1 Self-Efficacy	Factor 2 Active learning Strategies	Factor 3 Science Learning Values	Factor 4 Performance Goals	Factor 5 Achievement Goals	Factor 6 Learning Environment Situation
Q1	0.988					
Q2	0.615					
Q3	0.734					
Q4	0.955					
Q5	0.586					
Q6	0.623					
Q7	0.769					
Q8		0.585				
Q9		0.614				
Q10		0.565				
Q11		0.859				
Q12		0.943				
Q13		0.825				
Q14		0.501				
Q15		0.889				
Q16			0.941			
Q17			0.836			
Q18			0.803			
Q19			0.683			
Q20			0.779			
Q21				0.664		
Q22				0.611		
Q23				0.870		
Q23				0.870		
Q25					0.897	
Q26					0.922	
Q27					0.939	
Q28					0.904	
Q29					0.567	
Q30						0.549
Q31						0.801
Q32						0.772
Q33						0.508
Q34						0.410
Q35						0.783

Table 3: Difference between students' motivation towards science learning and achievement in science on the basis of gender.

Variables		N	Mean	d*f*	t-value	Sig.
Self-efficacy	Boys	587	20.34	798	2.868	0.000
	Girls	213	19.69			
Active learning strategies	Boys	587	29.84	798	4.630	0.000
	Girls	213	26.84			
Science learning values	Boys	587	19.05	798	3.825	0.000
	Girls	213	17.62			
Performance goals	Boys	587	16.17	798	3.419	0.000
	Girls	213	14.83			
Achievement goals	Boys	587	19.97	798	3.650	0.000
	Girls	213	18.70			
Learning environment situations	Boys	587	21.05	798	0.761	0.447
	Girls	213	20.74			
Science Achievement	Boys	587	65.37	798	4.002	0.000
	Girls	213	59.81			
Motivation towards science learning	Boys	587	127.17	798	4.639	0.000
	Girls	213	121.52			

Table 4: Difference between students' motivation towards science learning and achievement in science on the basis of students' interest in science (Do you have interest in science) .

Variables	Response	N	Mean	*df*	t-value	Sig.
Self-efficacy	Yes	584	20.55	798	6.288	0.000
	No	216	19.14			
Active learning strategies	Yes	584	30.76	798	10.379	0.000
	No	216	24.38			
Science learning values	Yes	584	19.44	798	7.784	0.000
	No	216	16.62			
Performance goals	Yes	584	16.80	798	9.804	0.000
	No	216	13.15			
Achievement goals	Yes	584	20.32	798	7.467	0.000
	No	216	17.97			
Learning environment situations	Yes	584	22.20	798	12.192	0.000
	No	216	17.64			
Science Achievement	Yes	584	70.47	798	22.162	0.000
	No	216	46.11			
Motivation towards science learning	Yes	584	130.76	798	18.265	0.000
	No	216	111.89			

Table 5: Relationship of science achievement with students' motivation towards science learning.

Variables	Pearson 'r"	Sig.
Self-efficacy and Science achievement	0.615	0.000
Active learning strategies and Science achievement	0.560	0.000
Science learning values and Science achievement	0.377	0.000
Performance goal and Science achievement	0.615	0.000
Achievement goal and Science achievement	0.413	0.000
Learning environment situation and Science achievement	0.523	0.000
SMTSL and Science achievement	0.847	0.000

Table 6:ANOVA for variation in science achievement scores on the basis SMTSL levels

Sources of variation	Mean	F-ratio	Sig.	Scheffe
Highly motivated (A)	87.57	595.81	0.000	A, B, C
Moderately motivated (B)	64.42			B, C
Low motivated (C)	39.23			

Table 7: Stepwise Regression Analysis

Stepwise	Predictors	R^2	R^2 Change	F-Change	β	Sig.
1.	SMTSL-Scale	.717	.717	2020.805	.847	0.000
1.	SMTSL	.783	.067	245.046	.715	0.000
2.	Performance Goals				.290	0.000
1.	SMTSL	.804	.021	85.219	.659	0.000
2.	Performance Goals				.222	0.000
3.	Self-efficacy				.179	0.000
1.	SMTSL	.825	.020	92.363	.783	0.000
2.	Performance goal				.242	0.000
3.	Self-efficacy				.213	0.000
4.	Active learning strategies				.211	0.000
1.	SMTSL	.834	.010	46.152	.838	0.000
2.	Performance goal				.327	0.000
3.	Self-efficacy				.183	0.000
4.	Active learning strategies				.248	0.000
5.	Science learning values				.133	0.000
1.	SMTSL	.836	.002	9.487	.766	0.000
2.	Performance goal				.331	0.000
3.	Self-efficacy				.178	0.000
4.	Active learning strategies				.202	0.000
5.	Science learning values				.123	0.000
6.	Learning environment situations				.066	0.002
1.	SMTSL	.838	.002	7.351	.766	0.000
2.	Performance goal				.322	0.000
3.	Self-efficacy				.199	0.000
4.	Active learning strategies				.175	0.000
5.	Science learning values				.118	0.000
6.	Learning environment situations				.064	0.003
7.	Achievement goal				.054	0.007

In the table 5, relationship between students' motivation towards science learning and their science achievement has been discussed. This relationship was found by applying Pearson "r'.

Table 2 shows the results of exploratory factor analysis which were used to establish the construct validity of motivation towards science learning scale. Principal Axis Factoring with Promax rotation was used for exploratory factor analysis. Its pattern Matrix is given in table 2. These results of factor loading are consistent with results of Tuan, Chin and Shieh [1]. Total variance explained by these six factors was 74%.

To explore difference between students' motivation for learning science and achievement in science on the basis of their gender and interest in science, independent sample t-test was applied. Results are discussed in table 3 & 4 respectively.

Table 4 shows pattern of difference in students' motivation towards learning science and academic achievement in science on the basis of their interest in science. The students' who have interest in science are more motivated for science learning and their achievement scores also better than those who have no interest in science at grade 8 level.

It is evident from table 5 that there is a significant and positive relationship exists between students' motivation towards science learning and their science achievement at grade 8. The Pearson "r" value for SMTSL overall scale and science achievement is 0.847 which indicates a strong and positive relationship. On the other hand, relationship between sub-scales of SMTSL and science achievement ranged between a significant, but somewhat week value of 0.377 (Science learning values and Science achievement) to a moderate value of 0.615 (Self-efficacy and Science achievement and Performance goal and Science achievement).

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Researchers explored the levels of motivation of students towards science learning by applying the criteria of Mean ± 1SD. The mean and standard deviation values of motivation score on SMTSL overall scale are (mean=125.67 and Standard Deviation=15.43). On the basis of this criterion, students were classified into three categories. Highly motivated (n=122), moderately motivated (n=549), and low motivated (n=129). ANOVA was applied to explore significant difference in science achievement scores of students on the basis of their motivation level. This result is given in table 6.

Table 6 shows that different levels of students' motivation towards learning have significant effect on science achievement. Scheffe Post hoc test of multiple comparison shows that science performance of highly motivated students is significantly differing from students' with moderate and low level of motivation ($p < .01$). Similarly, moderately motivated students are significantly differing in science achievement than low motivated students.

The results of Pearson Correlation which shows a positive and significant relationship between students motivation towards science learning (table 5) and Analysis of variance results from table 6 indicating effect of different levels of SMTSL on science achievement, which leads the researchers to explore the response of question that "is motivation towards science learning can predict science achievement"? The results are discussed in table 7 which indicate that "yes" students motivation towards science learning predicted their science achievement. Table 7 shows the results of stepwise regression analysis.

It is evident from above table 7, that SMTSL and its all subscale were significant predictors of students' achievement in science. These factors have accounted for 83% variance in students' science achievement scores.

DISCUSSION

The discussion on the findings of this study will be spelled out from two perspectives i.e. psychometric properties of the instrument used in the study and results of the study.

As sated already that instrument was developed by Tuan, Chin and Shieh in 2005. Although the instrument was selected for its comprehensiveness of addressing the construct (motivation to learn), contextual relevance of the items used for measuring sub-constructs and strength of psychometric measures reported in other researches [1,16, 17,18, 20, 21, 22 , 23,24, ,29, 30, 41, 46 ,47,]. The data from this research have also confirmed the psychometric properties already used as basis of selection of this instrument which increased trust in use of instrument and results produced subsequently (Table 1 and 2). The independence of sub-factors, their correlation with the main construct and strength of factor loadings in each factor being confirmed through data set collected or this research justified the selection of instrument and provided ground for considering, 'motivation to learn' as a non-linear construct.

An argument has already been built in the introduction of this paper that motivation is one important contributor in causing variation in the achievement of the students besides many other variables and the results of this study have also pointed out that motivation towards learning is important contributor in determining achievement of the students. Moreover, this research has highlighted that motivation is not a unidimensional construct but comprises of six distinct sub-constructs. These constructs contribute in determining the motivation to learn to varying extent.

Knowledge of performance goal i.e. awareness among the students about what is being expected of them is a most prominent determinant of motivation to learn. If the students have consciously set pre-determined goals for their studies or what is expected of them has been implicitly communicated to them, it plays a vital role in shaping their motivation to learn. Other than this having confidence in one's abilities (self-efficacy), adoption of active learning strategies, science learning value, learning environment situation and achievement goals also appeared as determining factors in

motivation to learn. Although all these are statistically significant determinants of motivation to learn but their relative size of contribution varies.

'Learning environment situation' and 'achievement goal' are weak contributors in determining motivation to learn which is not consistent with the results of the study reported in the review. This is a reflection of inappropriate school environment in our country. The data for this study was collected from public sector schools where both physical and human support to students for encouraging them to learn is far below acceptable level. The schools in our country at times can be compared with prisons where children are forced to come and this cannot be regarded as there place of choice. Students usually have to confront unconcerned teachers, ill equipped classrooms, authoritative behaviour of teacher in class and teaching to exam in classrooms/schools. These environmental factors promote disinterest towards learning rather than motivating students towards learning. Although learning environment has not appeared as main determinant of motivation to learn by size but, its statistical significance showed the potential of learning environment as an interactive component in creating motivation to learn among students and highlighted the importance of setting classes/school learning environment as a place of willingness for students. Thus, we need to focus on making schools and their learning environment conducive by promoting them as place of dialogue, free expression and equipped with gadgets required for meaningful learning.

Moreover, another very reflective finding is about the lower contribution of 'achievement goals' as determinant of motivation to learn points towards an important reality of our social life. Students are rarely considered competent to decide about their achievement goals in studies. Most of the academic decisions are made on their behalf by parents/guardians without any consideration to students' aptitude, willingness and interest often. This has become an accepted social norm and students have never learned to debate or argue but to accept decision of parents/guardians. The schools offer very little option to students in deciding their achievement goals but force them to follow the pre-decided pattern thought to be useful for their future. The compliance by the students to these norms is assumed as appreciative behaviour. These traditions have denied students opportunity to think about their achievement goals. As pointed in case of learning environment in earlier paragraph, the significant contribution of achievement goals, despite being small in size, encourages inculcating this important trait in students by changing our school and home culture. The schools needs to provide ample choice to the students for selecting subjects/combination of subjects for their study at secondary level to promote their interest and let them excel in fields of their choice will make the schooling a meaningful contributor in national development. In addition, schools need to shift away from teaching to examination because it is too narrow an objective of teaching and learning. An exaggerated focus on it has taken away the time from students to pursue their interest but stressed them to secure higher grades even without fulfilling their quench to learn.

Resolving the issues mentioned above regarding our schooling will enable us to have graduates of high competence and willingness to excel in their respective fields. This will be helpful in addressing frequently debated issue that our educational institutions are producing graduates with far less competence and relevant skills demanded of them in the practical life.

Another interesting finding which has been consistently reported in various studies in Pakistan is the gender difference with reference to students' achievement, but it is usually in favour of girls in contrast to finding of this study where boys mean score is more than girls in all sub-constructs of motivation to learn and achievement. The probable reason for this may the subject as it is usually seen that girls are more interested and also encouraged to study soft subjects like social sciences etc. The expectation of parents from girls is to study for earning qualification and not joining any profession while on the other hand boys are expected to study subjects having potential to provide them opportunity of respected and well paid jobs after completion of the study. The results have explicitly highlighted this disparity and implicates urgent need to promote the girls are equal partners in social development and their education cannot be limited to just earning a degree but needs to be utilized for equity based professional careers in all spheres of the society.

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