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**RESEARCH PAPER**

**Impact of Learning Motivation on Students' Academic Achievement: Mediating Role of Constructive Feedback**

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**ABSTRACT**

The study aimed to find out the impact of learning motivation after the intervention of constructive feedback on students' academic achievement. A true-experimental research with randomization pretest-posttest control group design was used in the study. The study sample comprised 97 students of grade IX that was selected purposively. The chemistry achievement test was used to measure the academic achievement. Learning motivation in the Chemistry questionnaire was used to measure learning motivation. Both the instruments were administered twice, as pretest and posttest before and after the intervention. Overall learning motivation through constructive feedback was found a significant impact on students' academic achievement. Students' task-value was found as the best predictor of students' academic achievement, whereas the students' self-efficacy and students' self-regulation also showed significant impact on students' academic achievement in Chemistry subject. It is recommended that constructive feedback should be incorporated in daily formative assessment practices in the classroom setting.

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**Introduction**

In Pakistani classroom, science subject teachers create an environment for the students to exhibit their understanding and apply their knowledge, however, still lack of motivation among students is observed, and the performance graph of students is also decreasing day by day (Javed, 2017). Students' need accurate information about their performance in the form of constructive feedback from their teachers to reach a mastery level and to increase motivation (Aslam, Khan, & Oad, 2021). According to Hattie and Timperley (2007), constructive feedback is a combination of feeding up, feeding back, and feeding forward, and it addresses

three main questions. Feeding up clarifies students "Where am I going?", feeding back answer students "How am I going?", and feeding forward highlights students "What do I have to do next?".

The standard-based education system of any country cannot be developed without the alignment of assessment with educational standards (Gulzar & Mahmood, 2019). Learning motivation, academic performance and attaining learning outcomes not only depends on the teachers' teaching methodologies but also depends on the quality of the feedback provided after the assessment (Aslam & Khan, 2021). However, students' performance and quality of education in Pakistan at the secondary level are insufficient and unsatisfactory (Ahmed et al., 2020; Din & Saeed, 2018).

Studies in previous decades indicate that constructive feedback which is provided during the formative assessment to schoolchildren is one of the essential strategies to enhance self-efficacy among students (Aslam & Khan, 2020; 2021), to boost "learner' motivation for task value" (Nicol & Macfarlane-Dick, 2006; Zumbrunn et al., 2016), and to increase students' self-regulation (Aslam, Khan, & Oad, 2021; Thompson et al., 2020; Zumbrunn et al., 2016) which eventually aid learners to attain their learning outcomes (Hattie, 2009, 2012) results, the better performance in exams (Aslam, Khan, & Oad, 2021; Hattie & Timperley, 2007; Javed, 2017; Tahir et al., 2015; Din & Saeed, 2018). Thus, as a concern in the Pakistani educational setting, education policies have emphasized formative assessment, in which feedback is an integral part. For example, the National Professional Standards for Teachers in Pakistan (NPSIP, 2009) sets standards for teachers, where providing feedback to students is one of the core components of their fifth standard.

However, Pakistan's examination system doesn't provide an opportunity for the students to interact with the teachers and develop their understanding of the purpose of the course. This gap can be filled by using formative assessment, which follows the repeated cycle of Test - feedback - adjust for students' improvement (Government of Sindh, 2017; p. 59); in this cycle, feedback is the backbone; therefore, there is a need to implement successful teaching (as feedback) techniques (Batool, 2020) that can motivate students and aid in improving students' performance in Chemistry, which is the key theme of the Sindh Curriculum for Chemistry Grade IX-X (Government of Sindh, 2017) and National Curriculum for Chemistry Grades IX-X (Government of Pakistan, 2006).

Students learn best when they are motivated. Motivation through feedback plays a vital role in determining students' achievements and can also influence students' self-efficacy and self-regulation (Javed, 2017; Petre, 2017). The issue related to learning motivation and teachers' feedback during the teaching and learning process is not often addressed according to secondary school children's requirements in the Pakistani education system (Din & Saeed, 2108). The teaching and learning process is incomplete without the active involvement of both teachers and students. Constructive feedback is a way to increase learning motivation in terms of learning

goal orientation, task-value, self-efficacy, self-regulation, and critical thinking disposition (Aslam & Khan, 2020).

Finding from Ghani and Ahmed (2016) revealed that “teachers do not follow any model (guiding principles) for providing feedback to students’ writings” (p.10) that is the reason that Pakistani secondary school teachers are using traditional method of providing feedback which is usually in the form of tick or cross on students’ work and/or providing grades or numbers on students’ assignment (Aslam & Khan, 2021; Aslam, Khan, & Oad, 2021). Therefore, there is a need to investigate the effect of constructive feedback through Hattie and Timperley’s (2007) model of constructive feedback on students’ learning. In their model, Hattie and Timperley identified three feedback stages, in which the first stage clarifies the learning purpose (Hattie and Timperley, 2007). The national curriculum of Pakistan is also based on students’ learning purpose, i.e., students’ learning outcomes (SLOs), which specify the students' ability at a certain level for each topic. In the chemistry curriculum, teachers are emphasized to provide students’ centered knowledge to their students and help them create a conceptual understanding of Chemistry by clarifying learning outcomes with them (Government of Pakistan, 2006; Government of Sindh, 2017). It was also emphasized in the curriculum to make students self-regulate so that they would be capable of “*doing independent thinking, asking questions, and looking for answers on their own*” (Government of Sindh, 2017, p. 1), and 3<sup>rd</sup> level, i.e., “Self-regulatory level” of Hattie and Timperley’s model of feedback enhance self-regulatory skills among learners. Therefore Hattie and Timperley’s feedback model can be used, which provides constructive feedback to students to enhance learning and motivation (Brooks et al., 2019).

Considering the national curriculum for Chemistry standards, the main purpose of this experimental research is to use feedback more constructively in the teaching and learning process to motivate and improve students' performance in Chemistry subject. To fulfill the Chemistry curriculum requirements and move towards a student-centered learning approach, the present study empirically examined the need for constructive feedback in Chemistry at the secondary school level in Karachi, Pakistan. The researcher investigated the role of constructive feedback through the experimental study to overcome the issues related to learning motivation and academic achievement in Chemistry subject, which the government secondary school students of Sindh, Pakistan, face in Chemistry subject and which was identified by Bhutto et al. in 2018. Based on findings, the researcher would recommend an alternative feedback technique, i.e., constructive feedback that can be adopted at the secondary school level to motivate and enhance students’ academic performance in Chemistry.

## **Material and Methods**

A true-experimental research design in which the randomization pretest-posttest control group design was used in the study. The population included all the female students studying chemistry as a major subject in grade IX in government girls’ higher secondary schools of district Karachi, Pakistan. For the intervention, one

public secondary school of Lyari town Karachi was selected by using the purposive sampling technique. The sample size of this study was all of the students that have registered in the grade IX bio-science group. The study sample comprised 97 students of grade IX and three chemistry subject teachers of the academic year of 2020-2021, selected purposively from the selected school. This selection was based on institutional and participants' willingness.

Before the intervention, teachers were also given four days training on constructive feedback. The teacher training module was used to provide training sessions to three participant Chemistry subject teachers. This module was designed on "A matrix for feedback for learning" (adopted from Hattie, 2007 cited by Brooks et al., 2019). The constructive feedback intervention was planned for three months with thirteen weeks of 77 working days. Constructive feedback intervened in 77 classes of 30 minutes and six days in a week, i.e., from Monday to Saturday. Total five chapters (Unit 02: Chemical combination; Unit 03: Atomic structure; Unit 04: Periodicity of Elements; Unit 05: Chemical Bonding; Unit 09: Acids, Bases, and Salts) from grade IX chemistry STBB were taught in the period of intervention. To equate teaching conditions for both the groups in the school, teachers' characteristics, teaching materials, worksheets, time duration, and days were kept the same. The same teachers taught similar content to both the groups in her class.

With the help of participant teachers, the researcher randomly assigned students into experimental and control groups. Four sections of grade IX of public secondary school were selected for this study. 97 students of grade IX of the public secondary school took part in this study. 48 students were randomly assigned experimental group, while 49 students were in the control group. Treatment of constructive feedback was only given to the experimental group, whereas the control group only received traditional feedback comments. The self-developed chemistry achievement test (CAT) was used to measure the academic achievement. Learning motivation in the Chemistry questionnaire (SMCQ) adopted from Velayutham et al. (2011) was used to measure learning motivation. All the research instruments were translated into Urdu, and all were piloted and validated. The SMCQ instrument's reliability was determined through Cronbach alpha and found the reliability of SMCQ was 0.905. Whereas, the split-half method was used to calculate the reliability of the Chemistry achievement test (CAT). The reliability value of CAT is calculated by the Spearman-Brown formula and found the reliability of CAT was 0.916 for objective type items (MCQs) and 0.935 for subjective type items (RRQs). The difficulty index and discrimination index of all the items were in the range of 0.2 to 0.7, which is considered suitable for retaining the item in the test (Kheyami et al., 2018).

Chemistry achievement test (CAT) and Learning motivation in Chemistry questionnaire (SMCQ) were administered twice, as pretest and posttest before and after the intervention. The same questionnaire with the same items was used in

pretest and posttest; only the order of the posttest items was changed. Pretest was conducted to measure the equivalency of both groups.

### Analysis of Data

*Ho: After the intervention of constructive feedback, learning motivation in terms of learning goal orientation, task-value, self-efficacy, self-regulation, and critical thinking disposition towards the Chemistry subject has no significant impact on students' academic achievement in Chemistry subject.*

Simple linear regression was run to analyse the relationship of independent variable (posttest scores of learning motivation) with dependent variable (post academic achievement scores). Table 1 shows a model summary. Here, *R* is representing the multiple correlation coefficient in between the dependent variable with predictor variable. In the below mentioned model (Table 1), *R* value is 0.317, which is the indication of a great deal of mutual change by the dependent variable & independent variable. In the next column, *R* Square value is describing the amount of variance or the goodness-of-fit described by a given by a predictor variable that is learning motivation. Here, the *R* square value is 0.100, which is indicating that there is 10% variance in dependent variable i.e. students' academic achievement due to independent variable i.e. learning motivation, or simply it can be said that students' academic achievement is 10% explained by learning motivation in the model. It is also found on the basis of Anova Table 2 that the variable is statistically significant ( $p < .05$ ). The regression Anova model shown in Table 2 is associated with the *F* ratio i.e.  $F(1, 95) = 10.606$ ;  $p = .002$ , indicates that the model is statistically significant ( $p < 0.05$ ). The eta square value is  $476.285/4742.557$  or .100, the same value shown in Table 1 for  $R^2$

**Table 1**  
**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.317 <sup>a</sup>	.100	.091	6.7014	.100	10.606	1	95	.002

a. Predictors: (Constant), Motivation Posttest

**Table 2**  
**ANOVA<sup>a</sup>**

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	476.285	1	476.285	10.606	.002 <sup>b</sup>
	Residual	4266.272	95	44.908		
	Total	4742.557	96			

a. Dependent Variable: Post Academic Test

b. Predictors: (Constant), Motivation Posttest

Table 3 shows the regression coefficient analysis. The unstandardized multiple regression model with posttest of learning motivation is as follow:

$$Y = \alpha + \beta_1 X_1 + \varepsilon$$

$$Y = \alpha + \beta_1 (\text{K of Learning motivation}) + \varepsilon$$

$$\text{Students' academic achievement} = 10.379 + 5.806 (\text{Learning motivation})$$

The zero-order, partial, and semi partial correlation value in Table 3 are the same ( $r = .317$ ) because they represent Pearson  $r$  in simple linear regression with a single predictor. The standardized beta regression coefficient is also equal to the Pearson  $r$  and the beta unstandardized regression value is 5.806. Thus, it can be said on the basis of unstandardized model that every unit gain in learning motivation is associated on average with approximately 6 (5.8) more change in students' academic achievement.

**Table 3. Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
	B	Std. Error	Beta			Zero-order	Partial	Part
(Constant)	10.379	7.595		1.366	.175			
1 Motivation Posttest	5.806	1.783	.317	3.257	.002	.317	.317	.317

a. Dependent Variable: Post Academic Test

Hierarchical multiple linear regression was run to analyse the relationship of independent variables i.e. constructs of learning motivation (learning goal orientation, task-value, self-efficacy, self-regulation, and critical thinking disposition) with dependent variable (Students' academic achievement). Table 4 shows a model summary. There are three models, with the second built on the first model. Footnote to the model summary table 4 shows the variables which is contained in each model. The first model contain the students' task-value as the best predictor of students' academic achievement; the second model added students' self-efficacy, while the third model added students' self-regulation. As there is no addition models, it is assumed that no additional predictors could improve the  $R^2$  significantly based on these three predictors.

The first model explained close to 11% of the variance ( $R^2 = .105$ ) and the from the coefficient table6, it is also found that the variable is statistically significant ( $p < .05$ ). The addition of students' self-efficacy, the second model boosted  $R^2$  by .049 (R square change) to give a final  $R^2$  of .154 and an adjusted  $R^2$  of .136, therefore it explained 15% of the variance of students' academic achievement with just two predictors. The prediction contribution of students' self-efficacy was statistically significant ( $p < .05$ ; i.e.  $p = .022$ ) controlling for students' task-value; at the same

time, students' task-value became a best marginal predictor ( $p < .05$ ; i.e.  $p = .008$ ) with students' self-efficacy in the model. In the third model, students' self-regulation variable is added and it incremented  $R^2$  by .014 (R square change) to provide a final  $R^2$  of .168 and an adjusted  $R^2$  of .141, hence it explained 17% of the variance of students' academic achievement with three predictors and it also contributed a statistically significant ( $p < .05$  i.e.  $p = .012$ ) amount of prediction over and above the effects of students' task-value and students' self-efficacy. The effect of students' self-efficacy remained statistically significant ( $p < .05$  i.e.  $p = .043$ ) but the other hand, the effect of students' task-value in the full model becomes insignificant ( $p > .05$  i.e.  $p = .070$ )

**Table 4.**  
**Model summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.323 <sup>a</sup>	.105	.095	6.6859	.105	11.095	1	95	.001
2	.392 <sup>b</sup>	.154	.136	6.5346	.049	5.450	1	94	.022
3	.410 <sup>c</sup>	.168	.141	6.5145	.014	1.581	1	93	.012

a. Predictors: (Constant), Posttest of Task-Value

b. Predictors: (Constant), Posttest of Task-Value, Posttest of Self-Efficacy

c. Predictors: (Constant), Posttest of Task-Value, Posttest of Self-Efficacy, Posttest of Self-Regulation

Table 5 shows the ANOVA result. The degrees of freedom for Regression analysis is a count of the predictors in the model. In the first model, there is only one predictor, hence the first model has 1 and 95 degree of freedom, and the regression model is associated with the F ratio i.e.  $F(1, 95) = 11.095$ ;  $p = .001$ , indicates that the model is statistically significant ( $p < 0.05$ ). The eta square value is  $495.943/4742.557$  or .105, the same value shown in Table 4 for  $R^2$ . The second model has two predictors so it has 2 and 94 degree of freedom, and the regression model is associated with the F ratio i.e.  $F(2, 94) = 8.532$ ;  $p = .000$ , indicates that the model is statistically significant ( $p < .05$ ). The eta square value is  $728.661/4742.557$  or .154, the same value shown in Table 4 for  $R^2$ . The third model has three predictors so it has 3 and 93 degree of freedom, and the regression model is associated with the F ratio i.e.  $F(3, 93) = 6.250$ ;  $p = .001$ , indicates that the 3<sup>rd</sup> model is also statistically significant ( $p < 0.05$ ). The eta square value is  $795.749/4742.557$  or .168, the same value shown in Table 4 for  $R^2$ . Hence, all the three models are statistically significant ( $p < .05$ ).

**Table 5.**  
**ANOVA<sup>a</sup>**

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	495.943	1	495.943	11.095	.001 <sup>b</sup>
	Residual	4246.614	95	44.701		
	Total	4742.557	96			

2	Regression	728.661	2	364.330	8.532	.000 <sup>c</sup>
	Residual	4013.896	94	42.701		
	Total	4742.557	96			
3	Regression	795.749	3	265.250	6.250	.001 <sup>d</sup>
	Residual	3946.808	93	42.439		
	Total	4742.557	96			

a. Dependent Variable: Post Academic Test

b. Predictors: (Constant), Posttest of Task-Value

c. Predictors: (Constant), Posttest of Task-Value, Posttest of Self-Efficacy

d. Predictors: (Constant), Posttest of Task-Value, Posttest of Self-Efficacy, Posttest of Self-Regulation

Table 6 shows the regression coefficient analysis. The unstandardized multiple regression model with students' task-value, students' self-efficacy, and students' self-regulation is 4.718, 3.837 and 2.178 respectively. In the first regression model, the zero-order, partial, and semi partial correlation value in Table 6 are the same ( $r = .323$ ) because they represent Pearson  $r$  in simple linear regression with a single predictor. The standardized beta regression coefficient is also equal to the Pearson  $r$  and the beta unstandardized regression value is 4.718. Thus, it can be said on the basis of unstandardized model that every unit gain in students' task-value is associated on average with approximately 5 unit (4.7) more change in students' academic achievement. In the second regression model, the zero-order, partial, and semi partial correlation value in Table 6 are different because they represent Pearson  $r$  in multiple linear regression with more than one predictor. The standardized beta regression coefficient for students' task value is .264 and for students' self-efficacy is .229. The beta unstandardized regression value for students' task value and students' self-efficacy is almost equal i.e. 3.8. Thus, it can be said on the basis of unstandardized model that every unit gain in students' task-value and students' self-efficacy are associated on average with approximately 4 unit (3.8) more change in students' academic achievement. In the third model when self-regulation is added as a predictor, the unstandardized beta regression value for students' task-value is changed to 2.942; students' self-efficacy is changed to 3.310; and students' self-regulation unstandardized beta regression value is 2.178, it means that every unit gain in students' self-regulation is associated on average with approximately 2 unit (2.178) more change in students' academic achievement.

**Table 6**  
**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
	B	Std. Error	Beta			Zero-order	Partial	Part
(Constant)	6.384	6.234		1.024	.308			
1 Posttest of Task-Value	4.718	1.416	.323	3.331	.001	.323	.323	.323



	(Constant)	19.597	8.316		2.356	.021			
2	Posttest of Task-Value	3.859	1.432	.264	2.694	.008	.323	.268	.256
	Posttest of Self-Efficacy	3.837	1.644	.229	2.335	.022	.297	.234	.222
	(Constant)	22.486	8.603		2.614	.010			
	Posttest of Task-Value	2.942	1.603	.202	1.835	.070	.323	.187	.174
3	Posttest of Self-Efficacy	3.310	1.692	.198	1.957	.043	.297	.199	.185
	Posttest of Self-Regulation	2.178	1.732	.142	1.257	.012	.309	.129	.119

a. Dependent Variable: Post Academic Test

## Conclusion

Findings of the study conclude that overall learning motivation through constructive feedback has a significant impact on students' academic achievement in Chemistry subject. This findings are aligned with Fatima et al. (2021) who argued the same that feedback is an integral part of any performance test. Students take constructive feedback positively in the evaluation and perform better as they know that learning happens with practice (Selvaraj et al., 2021). Finding of the study also suggest that the feedback that is delivered effectively has the power to increase effort, motivation, and engagement (Aslam, Khan, & Oad, 2021). This findings is also supported by Omer and Abdularhim (2017) that constructive feedback provokes learners, enhances learning and boosts their professional development. Quality feedback may improve students' perceptions of their ability and increase motivation to participate in learning (Deci & Ryan, 1985), but the feedback must be successfully processed to be effective. Kiemer et al. (2015) found the same result that constructive feedback increased competence and learning motivation in students. Teachers' feedback increases learning motivational behaviour towards their homework which ultimately results a better performance in academic (Núñez et al., 2015). Teachers' positive feedback is the strongest predictor of students' intrinsic motivation (Koka & Hein, 2005).

In the study, students' task-value was found as the best predictor of students' academic achievement, whereas the students' self-efficacy and students' self-regulation also showed significant impact on students' academic achievement in Chemistry subject. However, students' learning goal orientation and critical thinking disposition factors can be excluded from the regression model. Findings are aligned with Gniewosz et al. (2015), according to them, feedback has a significant effect on students' task-value, and the association of academic feedback with students' task value is mediated through the students' academic self-concepts. Berger et al. (2020) also found that task-values were stronger predictors of motivation to continue studying science, while task-value served as stronger predictors of academic achievement. Students' self-efficacy and motivation though feedback play a vital role

to increase students' performance in science subject (De-Silva et al., 2018). Aslam, Khan, and Oad, (2021) also argued that constructive feedback intervention increases students' self-efficacy and self-regulation due to which students show better performance in their Chemistry examination. Schillings et al. (2020) also confirmed that teachers' provided feedback improved students' understanding of the assessment criteria (feedback) and offered suggestions for improvement (feed forward). Written feedback from high-quality teachers was regarded as an important criterion in terms of improving learning motivation and understanding of how to improve their academic writing assignments.

Thus, it is concluded that constructive feedback is more effective than traditional feedback to boost learning motivation and to increase their performance in Chemistry subject at grade IX.

### **Recommendations**

This study will include the richness of an experimental research situation to support constructive feedback on the involvement and achievement of Bioscience students of grade IX in Chemistry subject. Teachers make their students responsible for learning by motivating them through implementing constructive feedback practices in the classroom regularly. Based on the findings of the present study, it is recommended that the provision of constructive feedback should be part of the assessment policy. It is also recommended to arrange a series of workshops for in-service teachers with the help of teacher education departments of Universities, sponsored by the Directorate of Staff Development (DSD) and Directorate of Curriculum and Teacher Education (DCTE) to enhance teachers' knowledge about effectiveness and provision of constructive feedback. Furthermore, the intervention of constructive feedback was planned for girls' school. It may be intervened for boys' school, and the comparison may also be made to investigate the gender effects on Intervention. This study was also limited to the Chemistry subject of Grade IX, the intervention may also be planned for other subjects and other classes, and then effects of age and subjects on intervention may be investigated.

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