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Title: **Constructive Feedback Intervention for Students' Academic Achievement in Chemistry: A Case of Public Secondary Schools of Pakistan**

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Constructive Feedback Intervention for Students' Academic Achievement in Chemistry: A Case of Public Secondary Schools of Pakistan

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Abstract

Generally, Chemistry is the backbone of manufacturing industries, but unfortunately in Pakistan, it is considered a difficult subject for many students, therefore they have found less motivation toward this subject and show poor performance in examinations. Constructive feedback is a technique utilized by teachers in the classroom globally to increase students' academic performance. From the previous research, it was found that Pakistani teachers use the traditional methods of feedback to access their students' performance. Hence, the current study aims to investigate the effects of constructive feedback on students' academic achievement, especially in the chemistry subject. Therefore, by deploying a true-experimental research design, a sample size of 97 students of grade-IX were selected through a purposive sampling technique. Students' academic achievement was measured through a self-made chemistry achievement test (CAT). The findings inidicated a significant result of constructive feedback on students' academic achievement. Students' ability group result was also found significant for academic achievement, which proved that low score achievers performed better when they received proper constructive feedback. Furthermore, these findings may contribute toteachers' ongoing professional development in terms of constructive feedback and teacher-student centered learning process.

Keywords: academic achievement, constructive feedback, chemistry subject, formative assessment, traditional feedback

Introduction

Chemistry is one of the fundamental disciplines of pharmaceutical and health science, where it is regarded as the backbone of manufacturing industries (Bhutto et al., 2018). In Pakistan, generally students struggle a

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lot to completely attempt the paper in chemistry especially in annual examinations (Bhatti & Qazi, 2017), which negatively affects their performance in chemistry examination (Akram et al., 2017). They also lack motivation for the chemistry subject and perceive it as a tough topic (Chishti & Rana, 2021; Din & Saeed, 2018; Khan & Saad, 2017). Academic success and learning objectives are dependent on both the instructional strategies used by the teachers and the quality of their feedback to the students during the formative assessment (Ahmed et al., 2020; Aslam & Khan, 2020; Din & Saeed, 2018). It is a very common perception in Pakistan that only "awarded marks" or "providing grades" are sufficient feedback for our students (Batool, 2020), therefore, the teachers who are following these traditional practices need to be trained forproviding constructive feedback to students (Bing-You et al., 2017; Ghazali et al., 2020).

Furthermore, in the national curriculum of chemistry, teachers are encouraged to provide knowledge, which is student-centered and assist their students in developing a theoretical understanding of chemistry by discussing the learning objectives with their students (Government of Sindh, 2017; Government of Pakistan, 2006). However, in Pakistan, teachers follow the traditional teacher-centered approach in the teaching and learning process at the secondary school level to teach science subjects, which ultimately hinder the students to use their learning abilities as they could be (Bakar & Ali, 2017). This gap can be overcomed and the requirement of the curriculum can be achieved by integrating the constructive feedback model proposed by Hattie and Timperleys in 2007 in the teaching-learning process for the chemistry subject, which helped to enhance students' motivation toward the task , and students will perform better in examinations (Brooks et al., 2021).

Research Objective

The current study aimed to investigate the current feedback practices at the secondary school level in Karachi, Pakistan to determine the effects of constructive feedback on students' academic performance in chemistry subject. This aforementioned aim of the study was achieved through the following objective:

- To determine the effect of constructive feedback intervention on students' academic performance in chemistry across the treatment and control groups and ability groups.

Review of the Literature

Constructive Feedback

In 2007, Hattie and Timpereley defined constructive feedback as follows:

- Feed-up: Where is the student going? Students get the answer to this question by learning about their clear goals and to where they are moving foward.
- Feedback: How is the student going? Students can get the answer by getting effective, honest, and timely feedback.
- Feed-forward: Where to next? Students can get answer of this question through a timely and effective response, which would show them the path, which they have to achieve.

All three questions helped the learners to understand the performance's quality (feed-up), the chance to decrease the performance gap between the actual and anticipated performance (feedback), and the subsequent learning stages and potential implementation strategies (feed-forward) (Hattie & Timperley, 2007; Moallem & Webb, 2016; Nicol & Macfarlane- Dick, 2006).

This feedback indicated a gap between the desired and the current performance. Fixing this gap can encourage greater effort for the students (Dawson et al., 2019). Feedback gives a clear idea about the student's performance in certain tasks (Moallem & Webb, 2016). Feedback is to have a reasonable prospect of achieving its formative purpose, it has to be both specific (referring, as it necessarily does, to work just appraised) and general (identifying a broader principle that could be applied to later works) (Sadler, 2010, p. 3).

Before students, undertake their assessment task, feed-forward students with clear instructions (Dann & O'Neill, 2020). By definition, "feed-forward is timely and task-focused in the future. It entails advising or directing students based on their earlier performance and assessing the calibre of their work" (Nicol & Macfarlane-Dick, 2006).

Feedback, feed-forward, and feed-up can be offered in a variety of ways, such as verbal interaction, in writing, or in a dialogical setting. It can be given regularly or infrequently, with a variety of purposes (including directive, facilitative, and particular), which are derived from a variety of

sources (peers and self, small group contact, and one-on-one teacher interaction) (Moallem & Webb, 2016).

Theoretical Framework

The theoretical framework for the current study is rooted in the theories of learning as presented by social constructivism theory (Vygotsky, 1978). Globally, many researchers conducted studies to investigate the role and the effects of feedback on learning outcomes. Similarly, social constructivism theory by Vygotsky (1978) viewed feedback as a prime source to transfer knowledge from the experienced person to the novice one, to facilitate the learning process (Brooks, Carroll et al., 2019; Brooks, Huang et al., 2019). Vygotsky's social-constructivism theory highlighted the cultural and social interactions, which play a key role in the learning process. According to this theory, knowledge is constructed and learners learn from each other. Social constructivist theory is a sociological theory of knowledge and human development, which occur through environment and is socially constructed through human interactions. In this process, the experts or the adults can be teacher guides for the students, which can provide feedback on students' tasks. A fundamental aspect of Vygotsky's (1978) theory is the Zone of Proximal Development (ZPD), where tasks can be mastered with the help or guidance of a grown person or more-skilled people, such as, teachers. He further presented a treatment of his problem by indicating that this mastery can be achieved by "Scaffolding," which provides timely assistance to the learner to complete the task. This implies that the learner can perform a task when provided constructive feedback and then the learner is closer to performing better in his/her mastered skill. Later on, they can also perform a certain task on their own (Lundstrom & Baker, 2009). Therefore, it is important to establish an environment, which supports feedback as a part of the learning process, which involves an understanding of the significance of teacher-student interactions (Stiggins, 2005). In this way, feedback becomes an essential part of the teaching-learning process. Constructive feedback improves students' academic achievement when social constructivist theory is correctly and consistently implemented and utilized by the teachers (Black & Wiliam, 1998).

Constructive Feedback and Students' Academic Achievement

Academic achievement is referred to the students' ability to succeed in school and society in terms of oral, reading, writing, science, mathematics,

social sciences, and reasoning skills and competencies. Although these achievements can not be easily evaluated, most researchers depend on a smaller concept, which is generally restricted to traditional performance tests (Lindholm-Leary & Borsato, 2006). Feedback is an essential part of a performance test (Fatima et al., 2021). Students are well-aware that learning occurs through practise, thus they positively respond to constructive feedback during evaluations (Selvaraj et al., 2021). Omer (2020) suggested that feedback on evaluation should be constructive for effective teaching and learning process. Instead Wisniewski et al. (2020) analysed 435 studies the effect of effective feedback on students' academic progress. Results supported Hattie's (2009) meta-analysis, which found that because of its cognitive impacts, feedback is crucial in all aspects of the teaching-learning process. When it comes to helping students' respond to new methods or comprehend their learning and academic achievement during the learning process, constructive feedback is useful as it aids students to make changes in their learning methodology, which can be successful and productive for their academic achievements (Forsythe & Johnson, 2017). The perspective was in line with Brown et al. (2012) study who claimed that students value their feedback since they understand how much it aids their academic pursuits. Moreover, the effect of feedback on students' academic performance and motivation was supported by Ahmed et al. (2013), Chua et al. (2017), Das et al. (2017), Evans (2013), Fatima and Akbar (2020); Kayima and Mkimbili (2019), Orsmond and Merry (2011); Özkale and Kanadlı (2021); Núñez-Peña et al. (2015), and Ropohl and Rönnebeck (2019).

Ahmed et al. (2013) conducted a study to examine the effects of corrective feedback on students' academic achievement. For this purpose, a sample size of 200 secondary school teachers were selected for the survey. A very close association between teachers' feedback and students' academic achievement was found. It was also found that students who received feedback performed well in their exams and had a better understanding of their topics, participated actively in classroom activities, completed their classroom assignments on scheduled deadlines, and effectively expressed their opinions in the class discussions.

Moreover, previous literature also investigated the achievement in English subject as a foreign language through feedbacks. For instance, Fatima and Akbar (2020) conducted an experimental study using quasai

experimental research design with 40 students of grade 10th to show continuous feedback for developing English writing skills in their students. The findings revealed that continuous feedback enhances students' writing skills at the matriculation level. Similarly, Ghani and Ahmed (2016) conducted a survey on 107 primary school teachers to find the preferences and practices of teachers to deliver feedback on students' writing and found that teachers' corrective feedback was not included in their teaching practices; therefore, students were badly performing in their writing skills.

Núñez-Peña et al. (2015) conducted an experimental study with 166 students enrolled in psychology courses at the university level and found that feedback reduced anxiety in students; therefore, an increase in students' performance was noticed as a prime outcome of constructive feedback. Bono et al. (2017) indicated similar findings by identifying that students who received feedback had less anxiety about their exams and obtained higher grades.

Research literatures indicates that like language subjects, feedback also has a great impact on student's performance in science-related subjects. A study conducted by Özkale and Kanadlı (2021) investigated the feedback strategies used by science teachers in their classroom setting by using exploratory sequential mixed method research design with 1696 students of elementary level along with 51 teachers. Moreover, it was found that this kind of teaching aligns with a good learning process in terms of feedback, which is known to be a processoriented education, which involves guiding and facilitating student learning. This finding aligned with Das et al. (2017), in which a sample size of 142 students were analyzed for the survey and it was found that students who received feedback during formative assessment can overcome their learning gap.

A qualitative study conducted in Tanzania by Kayima & Mkimbili (2019) explored effective feedback practices by conducting interviews and observing three chemistry teachers in real-world situations, came to the conclusion that the teachers' effective questioning and feedback-giving strategies had a significant impact on the student's ability to reflect and think critically as well as use their diverse viewpoints to accomplish their learning objectives.

Another exploratory study was conducted in Germany by Ropohl and Rönnebeck (2019) to investigate pre-service chemistry teachers' practices

regarding the judgment of students' level of achievement and the provision of feedback in the context of the control-of-variables strategy. Forty (40) bachelor's and master's degree programs were asked to evaluate students' work and provide feedback. It was concluded that only a few of the pre-service teachers could correctly judge students' current levels of achievement and provide feedback, which is expected to be effective for their learning goals.

Action research was conducted in a secondary school in Singapore by Chua et al. (2017) to investigate the impact of giving students feedback in chemistry and maths in teachers' written and descriptive remarks, then scores, on their performance, and learning. Sixty- (60) students participated in this study. The findings suggested that descriptive comments showed a significant difference in students' performance in science and mathematics subjects.

Therefore, from the aforementioned literature, the following hypotheses are formulated, which can be concluded as feedback given constructively has a significant effect on the student's academic achievement or performance.

H_o1: Constructive feedback has no significant effect on the mean academic achievement scores of students in the chemistry subject

H_o2: Constructive feedback has no significant effect on mean academic achievement scores among the high, average, and low-score students in the chemistry subject.

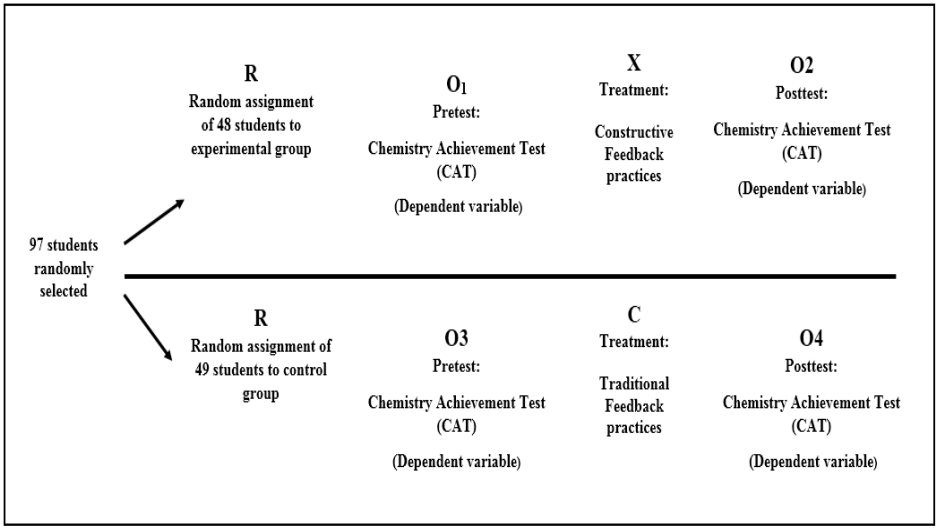
Research Methodology

The current study was grounded in the post-positivist paradigm, which assumes that the observable world can be studied, interpreted, and results can be generalized for a broader population. Therefore, the researcher used the quantitative research approach to conduct the study. In true-experiment design, the experiment was conducted as a Pre-test and Post-test with the control and experimental groups (Creswell & Creswell, 2017). The population consists of all female students enrolled in grade IX of the government girls' upper secondary schools in the district of Karachi, Pakistan, for the academic year of 2020–2021. Using the purposive sampling method, a potential public school in Karachi was chosen for intervention to collect the sample of the respodents. The total sample size of 97 students was used, which comprised a total number of 4 sections of

Grade IX. A total number of 49 students were selected in the control group and 48 were selected in the experimental group. Only the experimental group students received constructive feedback, however, a traditional feedback was given to the control group sudents. The study was a single-blind experiment, as the students were not informed about their groups. Both groups were measured twice. A self-made *Chemistry Achievement Test (CAT)* was used to evaluate the student's performance through constructive feedback. The tool was used twice, the first measurement served as the pretest, while the second measurement served as the post-test. Data were collected at the same time from both groups. Figure 1 presents a diagram of randomization pre-test and post-test control group designs, which were used in this study.

Figure 1

Pre-Test-Post-Test Control Group Design

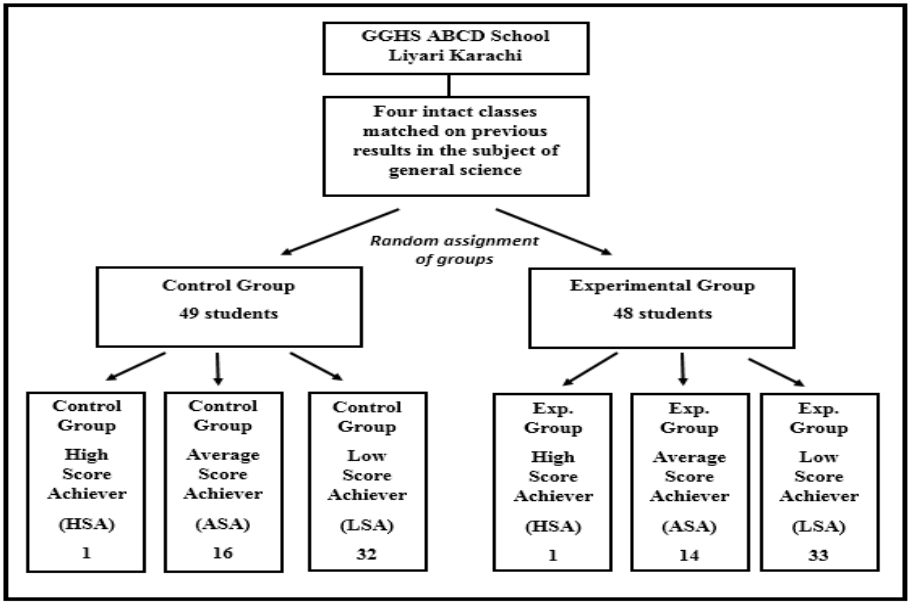


All three participant teachers have the same characteristics, such as same gender, same educational level of B.Sc. and B.Ed., and with same teaching experience (of more than 5 years), and the same age group (30 – 35 years). Initially, 120 students were divided into experimental and control groups randomly. A total number of 23 students were noticed who did not complete their experiment, so they were excluded from the analysis; the remaining 97 students' data were used to conduct the analysis. The control and experimental groups were further classified into three categories of high

score achievers, average score achievers, and low score achievers according to their abilities. For this analysis the researcher took help from the school's headmistress and Grade VIII general science subject teachers for the academic year of 2019-2020. Students were categorized carefully by scrutinizing their last academic year's performance in a general science subject. Students who scored above than 70% marks were classified as high score achievers, students with 40-69 marks were classified as average score achievers, and students with below than 40% marks were low score achievers. Figure 2 shows the classification.

Figure 2

Classification of Sample



Classroom assessment techniques (CAT) comprised of multiple-choice questions (MCQs) and subjective type test, i.e., restricted response questions (RRQs) (paper pattern used in BISE Examinations). In CAT, the objective type test has 30 multiple-choice questions (MCQs) and the subjective type test has nine restricted response questions (RRQs). CAT followed SLOs of the selected chapters and covered the first four levels of Bloom's taxonomy: remember, understand, apply, and analyze. These four levels were chosen because students' learning outcomes (SLOs) mentioned in the revised curriculum for the grade IX – X chemistry (Government of

Sindh, 2017) covered only these four taxonomy levels for measuring cognitive development. The cognitive domain of remembering, understanding, and applying was covered in the objective type test (MCQs), while the cognitive domain of analyzing was covered in RRQs. Five chapters were selected for intervention. As the medium of instruction in school is Urdu, therefore, CAT was developed in the Urdu language. A table of specification was constructed to confirm the content validity of CAT. The experts' committee comprised eight members, which confirmed the content validity and face validity of the research instrument namely CAT. The experts also validated the teaching training module, formative assessments' activity sheets, and the constructive feedbacks comments, which were given during the class.

A pilot study was conducted on 55 female students of grade X, who were not the targeted sample of this study. Participants of grade X for the academic year of 2020-2021 were selected for the pilot study because the students of grade X had already studied the exact content of chemistry in grade IX. The discrimination and difficulty index of each item of the chemistry achievement test were determined by item analysis. All of the items' difficulty and discrimination indices fell between 0.2-0.7, which was considered for keeping the items in the exam (Kheyami et al., 2018). Items with a discrimination range are above than 0.3 level, considered excellent, whereas 0.1-0.29 were considered good and items with a discrimination range below than 0.1 level are considered poor (Kheyami et al., 2018). The chemistry accomplishment test's dependability was determined using the split-half approach. The spearman-Brown formula was used to calculate the results of the CAT. MCQs reliability was 0.916 and RRQs reliability was 0.935. The reliability value of the chemistry achievement test was more than 0.7, showing that the items are reliable for the effective use (Hair et al., 2011). The experiment was scheduled to last for 3 months, with 13 weeks of 77 working days from 21st September 2020-19th December 2020. Constructive feedback intervention was used in 30-minutes classes, which were held six days a week, from Monday to Saturday. During the intervention, five chapters of grade IX chemistry STBB were taught during the classes. Teachers' traits, teaching aids, worksheets, lesson lengths, and days were same which maintained equal learning environments for the two groups of students. The same teacher taught both groups in the class with same identical material. The experimental group received constructive feedback, while the control group received traditional feedback. Teachers'

verbal constructive feedback comments had given to students during lectures. Participants' and teachers were requested to record their lectures and then those recordings were further analysed for the curret research with the due consent of the participant teachers. All the ethical guidelines were strictly followed by the researcher for the intervention.

Analysis of Intervention Results

The current study deployed an experimental research design in which participants were assigned randomly to experimental and control groups groups. In the experimental design, performance or outcomes may be affected by several extraneous variables; therefore, an analysis of covariance (ANCOVA) was used to test the following hypotheses of this study, for this purpose, all the six assumptions of ANCOVA were ensured.

Descriptive statistics of pre and post CAT scores with control and experimental groups are shown in Table 1. A total number of 49 students from the control group appeared in pre-CAT and post-CAT, whereas a total number of 48 students appeared in the pre and post-CAT tests from the experimental group. Mean value of pre CAT of control group (M = 3.490, SD = 3.2858) and mean value of experimental group (M = 3.479, SD = 3.2485) shows that both the groups are equal. In the post-academic test mean value of the control group (M = 11.122, SD = 4.8418) is much lesser than the mean value of the experimental group (M = 17.458, SD = 7.5002), which demonstrates a significant difference between the experimental group's and control group's academic performance.

Table 1

Pre and Post-Chemistry Academic Test (CAT) Scores

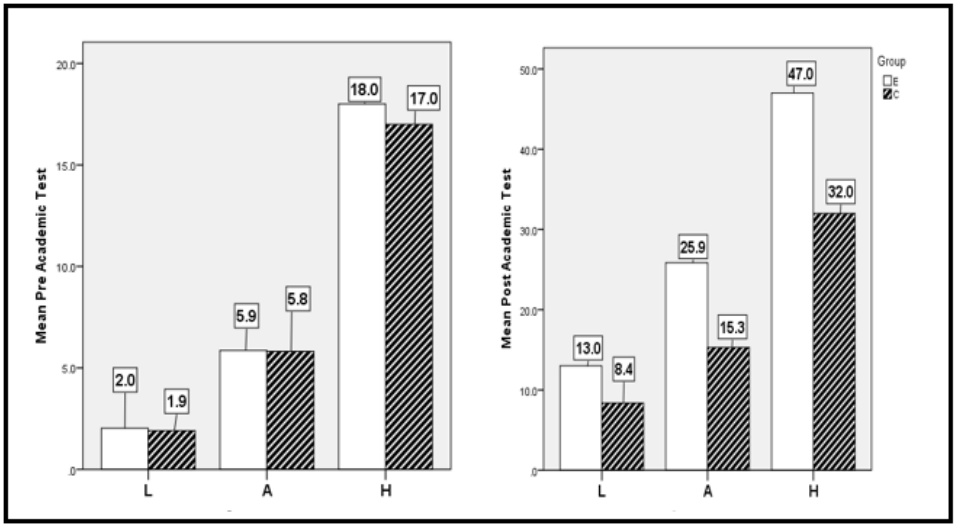
	Control Group			Experimental Group		
	N	*M*	*SD*	*N*	*M*	*SD*
Pre Academic Test	49	3.490	3.2858	48	3.479	3.2485
Post-Academic Test	49	11.122	4.8418	48	17.458	7.5002
Valid *N* (listwise)	49			48		

The graph in Figure 3 shows the pre and post academic test scores of the control and experimental group concerning students' ability (high,

average, and low score achievers). The left side graph in Figure 3 shows the pre-academic test. Moreover, mean of pre-academic scores of low-score achievers of both control and experimental groups are 1.9 and 2.0, respectively, which are quite similar to each other. Similarly, the mean pre-academic scores of average score achievers of both control and experimental groups are 5.8 and 6.9, respectively, which are almost similar to each other and showed no big differences in their scores. In a likewise manner, the mean pre-academic scores of high-score achievers of both control and experimental groups are 17.0 and 18.0, respectively, which are almost similar to each other and showed almost no differences in their scores.

Figure 3

Pre and Post-Academic Test Scores of Control and Experimental Group concerning the ability of students



The graph on the right side of Figure 3 shows the post-academic test. It can be seen that the mean post-academic score of low score achievers in control and experimental groups are 8.4 and 13.0, respectively, which shows differences in their performance. The experimental group's low scorers performed better than the control group's low scorers. Similarly, the mean post-academic scores of average score achievers of control and experimental groups are 15.3 and 25.9, respectively, which again shows differences in students' performance in the chemistry achievement test. The average score of students of the experimental group performed better than

the average score of students of the control group. In a likewise manner, the mean post-academic score of high score achievers in control and experimental groups is 32.0 and 47.0, respectively, which again shows differences in high score achiever students' performance. It indicated that high score achievers in the experimental group performed better than high score achievers of the control group in their chemistry tests.

In order to evaluate the impact of the intervention relative to the control group and the interaction of the intervention among the students' ability group, a two-way ANCOVA analysis would be appropriate to conduct this study. Additionally, the variability that cannot be accounted for in terms of the covariate decreased by the selected statistical approach.

Table 2

ANCOVA Analysis Summary of Between-Subjects Effect Concerning the Students' Academic Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4595.936[a]	6	765.989	470.187	.000	.969
Intercept	1069.876	1	1069.876	656.722	.000	.879
Pre-Academic test	148.031	1	148.031	90.866	.000	.502
Group	391.740	1	391.740	240.462	.000	.728
Stu_category	538.180	2	269.090	165.176	.000	.786
Group * Stu_category	213.057	2	106.529	65.391	.000	.592
Error	146.620	90	1.629			
Total	24461.000	97				
Corrected Total	4742.557	96				

Note. R Squared = .969 (Adjusted R Squared = .967)

Both the covariate, namely the pre-academic test and the effect of independent variables (groups and students' category), show significant results. The partially eta squared value for the group is .728 and the students' category is .786. The partially eta squared value for the covariate variable is .502 (Ref. Table 2).

By looking at the statistical result of interaction between both groups (experimental and control) by students' category (high score achievers, average score achievers, and low score achievers), F (2, 90) = 65.391; p = 0.000, shows a significant effect as the p-value is less than .05 level. It also means that this interaction of groups by students' category positively affects the outcome variable (post-academic test). Table 2 also shows that when controlling the covariate, pre-academic test in chemistry subjects across both control and experimental groups, F (1, 90) = 240.462; p = .000, the intervention is statistically significant. These significant results show that post-test academic result of the experimental group differs from the post-test academic result of the control group, while adjusting the pre-test scores in the same variable. Additionally, while looking at students' category, the result F (2, 90) = 165.176; p = .000, indicates that this factor is also significant. This means that students' category factors cannot be ruled out and it affects the dependent variable, namely post-academic score.

Figure 4

Estimated Marginal Mean of Pairwise Comparison of the Post-Academic Scores

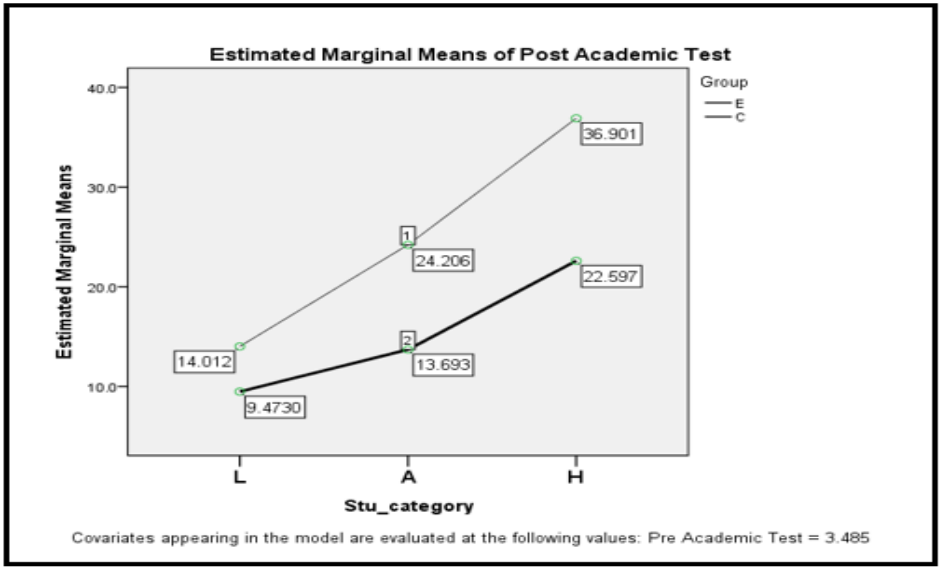


Figure 4 shows the estimated marginal mean of pairwise comparison of post-academic scores of experimental and control group students. Whereas, Table 3 shows the Bonferroni corrected pairwise comparison of the

estimated marginal mean. Each major row shows one of the three categories of students and compares the other two with it.

The first major row focuses the low score achiever students (L) category. The estimated marginal mean of low score achiever students (L), and the estimated marginal mean for the average score achiever (A) students is -9.897, whereas this difference is statistically significant (p = .000). In a likewise manner, the estimated marginal mean of low score achiever students (L) and the estimated marginal means for the high score achiever (H) students is -28.813, whereas this difference is again statistically significant (*p* = .000).

Table 3

Bonferroni Corrected the Pairwise Comparison of the Estimated Marginal Post-Academic Score of the Control and Experimental Group

(I) Stu_category	(J) Stu_category	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
L	A	-9.897	.398	.000	-10.868	-8.927
	H	-28.813*	1.292	.000	-31.963	-25.662
A	L	9.897*	.398	.000	8.927	10.868
	H	-18.915*	1.314	.000	-22.121	-15.710
H	L	28.813*	1.292	.000	25.662	31.963
	A	18.915*	1.314	.000	15.710	22.121

Note. *. The mean difference is significant at the .05 level.
[b]Adjustment for multiple comparisons: Bonferroni.

Based on the ANCOVA, it can be concluded that low score achiever students, average score achiever students, and high score achievers are significantly different in their pre-academic scores.

Discussion

The current study's aim was to determine the impact of providing students with constructive feedback on their academic performance across the control, experimental, and ability groups. Concerning the possible treatment of constructive feedback, the intervention was statistically significant because it showed the post-test academic results of the experimental group,

which were different from the post-test academic results of the control group, while adjusting the pre-test scores in the same measure. In a likewise manner, Fatima et al. (2021) claimed that inculsion of constructive feedback to access academic performance is essentially significant to improve teacher-leraning environment. Moreover, it was observed that students perform better when they get constructive feedback because it enables them to understand the idea that learning occurs through practice (Selvaraj et al., 2021).

Hatties' meta-analysis conducted in 2009 viewed the cognitive impact of feedback on academic performance; Wisniewski et al. (2020) supported this idea that feedback is crucial to any teaching-learning process. Feedback is helpful in assisting students in making changes to their learning that are successful and productive and help them grow academically. Reportedly, it helps students to better understand and adapt the new approaches to expand their learning and academic achievement during their learning process (Forsythe & Johnson, 2017). Brown et al. (2012) also supported this idea by emphasizing the fact that students value their feedback since they understand its importance and relevance, which aids their academic pursuits. The effect of feedback on students' academic performance has also been supported by earlier experimental studies conucted by Ahmad et al. (2013), Evans (2013), Fatima and Akbar (2020), Ghani and Ahmed (2016), and Orsmond and Merry (2011). The study findings were also aligned with the findings of Chua et al. (2017), Das et al. (2017), Kayima & Mkimbili (2019), Özkale and Kanadlı (2021), and Ropohl and Rönnebeck (2019). According to them, effective questioning and constructive feedback from teachers have a significant impact on students' academic performance, which would help in developing key competencies, including the capacity to elicit students' reflections and thinking to utilise students' diverse viewpoints to achieve the learning objectives. The study results for academic achievement and students' category were significant.. It means that students' category factor has affected the dependent variable, namely post-academic score.

Hussain et al. (2017) and Lucas (2001) also supported these similar results by claiming that effective feedback received by low achievers encourages their attention towards the task and significantly, they perform better than the ones who were unable to receive effective feedback.

Conclusion

The current study's findings reported that the constructive way for feedback intervention plays a significant role in increasing students' performance in the chemistry subjects. A significant difference between the mean values of achievement scores were observed from the experimental group, which was made clear from the findings. Additionally, the control and the experimental groups individually identified and implemented the constructive feedback, which would improve students performance concering grade IX. Furthermore, the study's findings also indicated that low performance scores in the chemistry subject of grade IX significantlyimproved when they received constructive feedback related to their work.

Future Implications

This study provides the depth of an experimental research environment to promote beneficial feedback on the engagement and performance of Bio-science students of grade IX in Chemistry. By routinely applying positive feedback methods in the classroom, teachers empower their students to take responsibility for their learning. Constructive feedback practices will provide insight not only to the high score achiever students but also low scores achiever students would also be able to answer *"Where am I going?"*, *"How am I going?"* and *"What do I have to do next?"*. This study will be beneficial for students and the teachers, headmistress, top-level executives, and policymakers because it will provide them with more knowledge about essential factors influencing the teaching-learning process. Secondary school teachers would be more aware of the importance of motivating students through constructive feedback. The findings may contribute to plans for teachers' ongoing professional development in terms of constructive feedback.

Recommendations

1. Majority of secondary school teachers practice traditional teaching methods to provide feedback to their students. However, it is significant to note that their knowledge and understanding about constructive feedback is limited. Therefore, it is advised to organize a number of seminars for in-service teachers to improve their knowledge and understanding of feedback, which would also improve their teaching methods.

2. For this purpose, school management can arrange capacity-building programs or training for teachers to familiarize them with the effective process of delivering constructive feedback, which would be helpful for better teaching methodologies. Moreover, school management can avail teacher training and development services offered by various Oxford University Press, British Council, and other educationists of Pakistan.
3. Additionally, school management may encourage their teachers to provide constructive feedback to their students. To make teachers provide valuable feedback incentives can be provided to the teachers who would provide constructive feedback to their students in their formative assessments.

Directions for Future Research

The current study targeted girls' schools for the intervention of constructive feedback. However, future research can focus on boys' schools, which may receive intervention and a comparison can be done to look into the impact ofgender intervention between girls and boys schools. Furthermore, other subjects and grade levels may be considered for the intervention. Moreover, the moderating effects of age on subjects may also be suggested for the future research. The current study was restricted to the chemistry subject only concering grade-IX of girls schools. In addition, the study was restricted only to the affects of constructive criticism on students' performance. Hence, it was suggested that future researcher should can conduct study on the concept of exploring cause effect relationship betwwen constructive criticism and students' 21st-century skills.

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