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Constructive Feedback, Learning Motivation and Academic Achievement in Chemistry Subject: Qualitative Experiences from Classroom Intervention

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Abstract: *The study aimed to explore headmistress, teachers, and students' perceptions about constructive feedback before and after the intervention. A true experimental research design was used for the intervention to measure the effects of constructive feedback. One headmistress and three Chemistry subject teachers were interviewed, and Focus Group Discussion (FGD) was conducted with five experimental group students before and after the intervention. A semi-structured interview schedule and FGD guidelines were used to collect the data. Data were collected twice to find out the differences in opinions/perceptions before and after the intervention. Results support that constructive feedback practices increase students' performance and motivation towards Chemistry. Students' self-efficacy and self-regulation skills also developed among students after the intervention. Constructive feedback was also found effective for the low-score achievers to increase their performance in Chemistry. It is recommended that constructive feedback should be incorporated in daily formative assessment practices in the classroom setting.*

Key Words: Academic Achievement, Chemistry, Constructive Feedback, Motivation, Self-Efficacy, Self-Regulation

Introduction

Chemistry is one of the fundamental disciplines of pharmaceutical and health science; it is considered as a backbone of manufacturing industries; therefore, it is important to assess the standard of teaching and learning of Chemistry subject at the lower secondary level, i.e., Grade IX, where it is taught first time as a separate subject in Pakistan (Bhutto et al., 2018). Furthermore, Pakistani Students are found less motivated towards Chemistry and have a fear of it and considered it as a difficult subject (Akram et al., 2017); therefore, they struggle a lot to complete annual test papers (Bhatti & Qazi, 2017), resulting, poor performance in science exams (Chishti & Rana, 2021; Din & Saeed, 2018).

Though across Pakistan, every day in the classroom, science subject teachers establish such an environment for the students to exhibit their understanding and apply their knowledge, still less motivation in students is observed, and the performance graph of students is also decreasing day by day (Aslam & Khan, 2020; Javed, 2017). Students' need accurate information in the form of constructive feedback about their progress from their teachers to reach a mastery level and to increase motivation (Aslam & Khan, 2020; Javed, 2017). According to Hattie and Timperley (2007), "feedback is information such as knowledge, skills or attitudes provided by the teachers, peers, books, parents, self or gain through experiences regarding one's performance," mainly, feedback is "a Consequences of a performance."

Students' performance and quality of education in Pakistan at the secondary level are

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insufficient and unsatisfactory (Ahmed et al., 2020; Din & Saeed, 2018). Generally, the quality term refers to "individual students' performance, the outputs of an educational program, the student learning experience or the teaching provided" (Fry et al., 2008, p. 34). Students' motivation, academic performance, and attaining learning outcomes depend not only on the teachers' teaching methodologies but also on the quality of the feedback provided after the assessment (Ahmed et al., 2020; Din & Saeed, 2018). The standard-based education system of any country cannot be developed without the alignment of assessment with educational standards (Gulzar & Mahmood, 2019).

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 (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 (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 (NPSTP, 2009) sets standards for teachers, where providing feedback to students is one of the core components of their fifth standard.

However, Pakistan's school system is primarily based on summative assessment, taken at the end of the session. It 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 are a need to implement successful teaching (as feedback) techniques (Batool, 2020) that can 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 plays a vital role in determining students' achievements and influences students' self-efficacy and self-regulation (Petre, 2017). The issue related to students' 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. Therefore, to increase students' motivation in terms of learning goal orientation, it is also necessary to investigate both teachers' and students' roles for providing and receiving feedback in the natural setting of the classroom (Javed, 2017).

In a natural classroom setting, Hattie and Timperley (2007), Hattie (2009), Hattie and Zierer (2019), and Wisniewski et al. (2020) conducted a meta-analysis on the effects of feedback on student achievement (which is also referred to as Visible Learning research). It indicates a high effect of feedback (in between .70 to .79) on students' achievement. In 2007, Hattie and Timperley also proposed a feedback model in their famous study "Power of feedback" (Over 13,000 citations on Google Scholar), which can be used to understand why particular kinds of feedback, i.e., constructive feedback, promote learning effectively. A 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 the 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). Therefore, there is a need to investigate the effect of constructive feedback through Hattie and Timperley's model of 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 3rd 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 subjects. To fulfil the Chemistry curriculum requirements and move towards a student-centred 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 students' 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.

Objective of the Study

1. To explore the differences in opinions/perceptions of the headmistress, participant teachers, and participant students about constructive feedback before and after the intervention.

Research Methodology

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 school in Lyari town Karachi was selected by using the purposive sampling technique. The sample size of this study was all of the students 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. Ninety-seven students of grade IX of the public secondary school took part in this study. Forty-eight 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. A self-developed structured interview schedule for teachers and headmistress and FGD guidelines for students were used to collect qualitative data. The

interview schedule and FGD guideline was designed in the participant's local language, i.e., Urdu, and it comprised fifteen questions. Before administering, piloting the FGD guideline and interview schedule were done, and the instrument's trustworthiness was ensured by satisfying the criteria of credibility, transferability, dependability, and conformability. The validity of the tool was ensured by the experts. In-depth interviews were conducted before and after the intervention to explore the perception of participant teachers and school heads about constructive feedback. For this study, one FGD was also done with the experimental group participant before the intervention and one FGD after the intervention. Five participants of the experimental group were involved in FGD.

Analysis of Data

In-depth interviews with participant teachers and school's head and FGD with participant students were conducted to compare and contrast the perceptions of the headmistress, participant teachers, and participant students about constructive feedback before and after an intervention. Data were analyzed thematically; thirty-four codes were generated, which were categorized under five categories. The brief description is shown in figure 1.

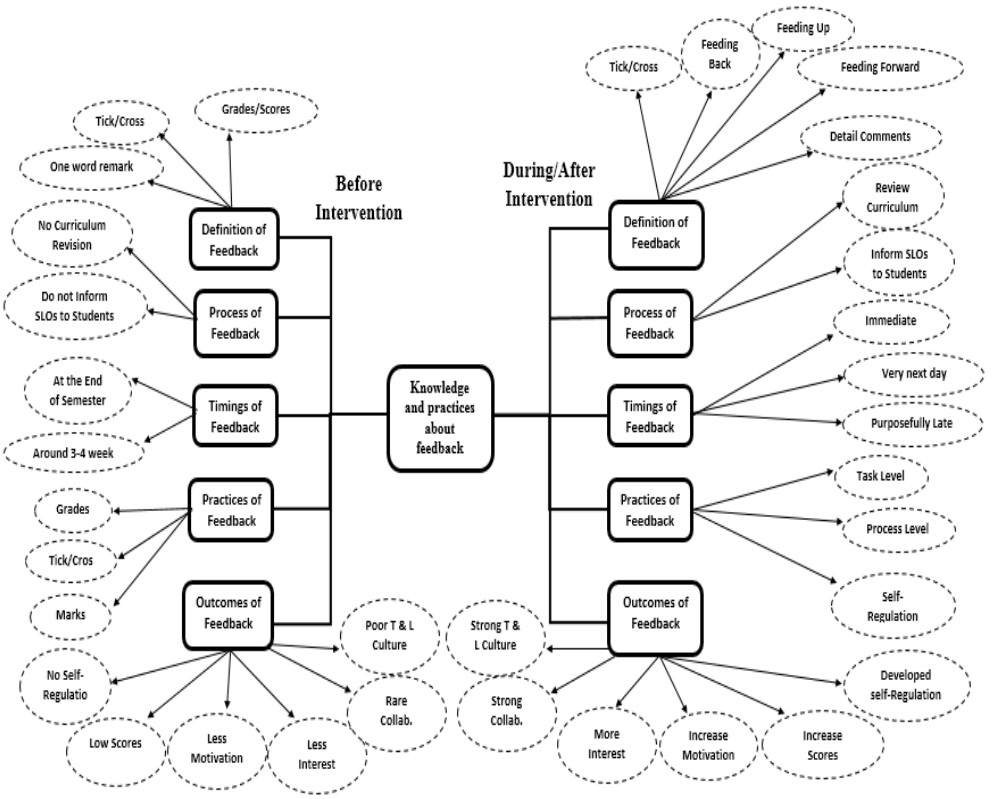

Figure 1: Summary of Theme, Categories, and Codes

Theme: Knowledge and Practices about Feedback

Category one: Definition of Feedback

Table 1 illustrates the description of category one, i.e., the definition of feedback, which contains seven codes; before the intervention, three codes were generated from the interviews. After the intervention, one code was retained, two were eliminated, and four new codes were generated.

Table 1. Description of Category one

Codes	Category 1: Definition of Feedback	
	Before Intervention	**After Intervention**
1	Tick and Cross	Tick and Cross
2	Grades/Scores	~~Grades/Scores~~
3	One word remark	~~One word remark~~
4		Feeding up
5		Feeding back
6		Feeding forward
7		Detailed comments

Inclusively, teachers, students, and the headmistress acknowledged that the constructive feedback intervention had changed their way of thinking about feedback; their perceptions of feedback moved to a student-centred approach from a teacher-directed process. In constructive feedback, students are given more importance. Teachers, school headmistress, and students reported considerable modification in teachers' feedback practices. Their responses indicated that feedback is perceived as only tick and cross on students' work before the constructive feedback intervention. Sometimes, the short word of appreciation, like good or excellent, was considered enough for feedback. For example, one student noted that "*teacher only provide tick on our homework, and sometimes, when we are assessed, then teacher put a tick on our right answer and put a cross on the answers that we wrote wrong.*" Continued with the same point headmistress stated that, "*Those students whose work is correct, got the remarks of "good" or "excellent" on their work, and if the student work is wrong, the teacher wrote "poor" on their task, which I think enough for the students to get the idea about their performance.*"

Category two: Process of Feedback

Table 2 illustrates the description of category two, i.e., the process of feedback, which contains four codes; before the intervention, two codes were generated from the interviews, and after the intervention, both the codes were eliminated, and two new codes were generated.

Table 2. Description of Category Two

Codes	Category 2: Process of Feedback	
	Before Intervention	**During/ After Intervention**
1	No curriculum revision	~~No curriculum revision~~
2	Do not inform students about SLOs	~~Do not inform students about SLOs~~
3		Curriculum revision
4		Inform students about SLOs

At the beginning of the experiment, teachers showed a lack of confidence in knowing the expectations of the topic or the interpretation of the success criteria. Teachers worked during the experiment to develop shared understandings of performance expectations from the students. Reviewing the curriculum before teaching each topic provides new direction to the teachers about the fundamental areas that must be considered before teaching and providing feedback to the students. One teacher described the effectiveness of developing collective ideas for the accomplishment of set standards. It makes a turning point for them during the intervention: "*when we all three teachers sit together and discuss the topic which we are going to teach and provide comments to students, it is a difficult task, but we all together share their understanding and finally conclude to the comment which we will provide to our students if they do not meet the set standard of learning outcome.*"

Category Three: Timings of Feedback

Table 3 illustrates the description of category three, i.e., timings of feedback, which contains five codes;

Table 3. Description of Category Three

Codes	Category 3: Timings of Feedback	
	Before Intervention	During/After Intervention
1	After 3-4 weeks	~~After 3-4 weeks~~
2	At the end of the semester	~~At the end of the semester~~
3		Immediately
4		Very next day
5		Purposefully late

Before the intervention, teachers usually take 3-4 weeks for corrections, or some of the teachers even checked only exams copies and provided feedback to students in the form of tick/cross and marks. As one of the teachers confirmed that "*we do take the assessment, but it takes around three to 4 weeks to assess and return to the students*". One student in FGD mumbled, "I don't recall when did my teachers provide me feedback on my test paper. It is usually in the mid or final exam when the teachers assess my paper and provide *me feedback in the form of marks*".

Category Four: Practices of Feedback

Category four was generated from the data received from teachers' voice recorders, recorded during teaching, and from the students' formative assessment documents. Teacher one voice recorder comprised 44,610 words (about 13 hours of recording), teacher two voice recorder comprised 36,215 words (about 13 hours of audio), and teacher three-voice recorder comprised 52,142 words (about 13 hours of audio). Data was transcribed into Microsoft word. Table 4 illustrates the description of the fourth category. Before the intervention, three codes were generated from the interviews, and after the intervention, one code was retained, two were eliminated, and three new codes were generated.

Table 4. Description of Category Four

Codes	Category 4: Practices of Feedback	
	Before Intervention	During/After Intervention
1	Tick and Cross	Tick and Cross
2	Grades	~~Grades~~
3	Marks	~~Marks~~
4		Task Level
5		Process Level
6		Self-Regulation Level

The model which was used for intervention was divided into two stages: feedback type and feedback level. Feedback type analyses the purpose of the feedback, and it is comprised of three types; 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?"*. Feedback level considers the level to which feedback is expected. According to Hattie and Timperley (2007), there are four feedback levels; task-level, process level, self-regulation level, and self-level. In which self-level was not the part of the intervention, and therefore was not used by the

teachers, as it potentially has negative effects on learning.

During teaching, teachers used the "feeding up" type at the starting of their lecture, while the other two types, feeding back and feeding forward, were used in formative assessment. Each unit was started with novice "Task-level," proceed to proficient "Process level," and then finally ends up with advanced "Self-regulatory level." Feeding back and feeding forward of self-regulatory level were purposefully delayed to enhance self-regulatory skills among learners, whereas the rest were given on time, immediately in case of verbal formative assessment practice, and on the very next day, in case of written formative assessment practice.

The task-level feeding up was primarily directed at the entire class and included items explicitly targeted to the learning purpose. For example: *"Today, we are learning the discovery of electron, proton, and neutron*." On a smaller scale, feeding up at the task level also included the items related to the task's success criteria. For example: *"that's what I am looking for to measure pH of solutions by using litmus paper and pH paper*." The use of prompts and questions highlighted feeding up at the process stage, which was targeted more towards individual students of the experimental group. For example, by showing students the structure of Nobel gases, "*Whose structure is this? So today, what are we going to learn?*" The use of goals was common in the few circumstances of feeding up at the self-regulatory stage.

Unlike feeding up, feeding back was used on students' responses, given on formative assessment. Feeding back at the task level was the most common feedback level. It included confirmatory feedback. For example, if the student's answer is correct, then *"Yes, that's right because compound who received electron pair is acid according to Lewis theory*." If the answer is wrong, then *"Your answer is wrong because the number of protons in an atom is used to calculate the atomic number, not with the number of the neutron*." Feeding back at the process level was mainly focused on explicit skills of the task, and it used prompts and questions from the teacher. For example, *"Your understanding of the concept of stomach acidity within this task is up to the mark*." Feeding back at the self-regulatory level was given through questions by the teachers, and it may only require verification feedback. For example, *"How do you know that atomic radius increases down the group?*"

Similar to feeding back, feeding forward was also used on students' responses, given on formative assessment. Feeding forward of task-level was very descriptive, and it also mentioned the students' next move directly. For example, *"Your calculation is wrong because you were given molecule, not atom. So, first calculate molecular mass then find the value of mole*". Feeding forward of process level was prompts and cues, and a challenge was given by the teacher to the student. For example, *"You described covalent bond correctly, but couldn't show covalent bond correctly in between two nonmetallic elements. Why don't you keep a number of electrons in mind and try it again*". Feeding forward of self-regulatory level reduced teacher reliance: *"You have learnt to calculate the number of moles, but how will you calculate Avogadro number from mole?.....How do you know that this is the correct way to calculate?*".

Category Five: Outcomes of Feedback

Table 5 illustrates the description of category five, i.e., outcomes of feedback, which contains twelve codes; before the intervention, six codes were generated from the interviews, and after the intervention, all were eliminated, and six new codes were generated.

Table 5. Description of Category Five

Codes	Category 5: Outcomes of Feedback	
	Before Intervention	**After Intervention**
1	Poor teaching and learning culture	~~Poor teaching and learning culture~~
2		Strong teaching and learning culture
3	Rare collaboration with counterpart teachers	~~Rare collaboration with counterpart teachers~~
4		Daily collaboration with counterpart teachers

Codes	Category 5: Outcomes of Feedback	
	Before Intervention	After Intervention
5	Less interest of students	~~Less interest of students~~
6		More interest of students
7	Less motivation in students	~~Less motivation in students~~
8		Increase motivation in students
9	Low scores	~~Low scores~~
10		Increase scores
11	No self-regulation in students	~~No self-regulation in students~~
12		Develop self-regulation in students

Overall, the experiment showed considerable improvements in the teaching and learning culture of the classroom. Succeeding to the constructive feedback intervention, providing feedback to students becomes more fluid and embedded with ongoing interactions of two-way feedback between teachers and students. A number of basic aspects and factors of the intervention have been identified, which positively contributed to the growth of a learning society. Like in reasoning questions, one of the teachers proclaimed that learning society and autonomy are developed in learners; before feedback practices, they (students) glance at the assessed answers sheet and put it in the bag without knowing why the answer is wrong. Now, before assessing the answer sheet, they are just come to me and said, "*Teacher, please check my work and provide me feedback that I have written right or not, and is there any other point which I need to add in the reason to make my answer better*." Society will prosper in which teachers give students insight into achieving their goals, and students also know that they could improve. Furthermore, sharing students' work as a sample to the whole class increased confidence in the students, and feedback was encouraged and pursued. As one of the students from FGD put it,

When asked about the effectiveness of the constructive feedback intervention as a whole, the school headmistress and teachers consistently stated that they thought it was successful. According to both teachers and school headmistress, the collaborative approach of the intervention was a fundamental part of its success. For instance, one teacher stated, "*I think constructive feedback practices was successful because it has not only provided us to use professional knowledge as a remark on students' work, but it also develops collaboration among teachers*." All 'three teachers stated that they rarely had an opportunity to meet with a counterpart teacher as a team and discuss students' progress. Therefore, they appreciated that the constructive feedback intervention was integrated into their teaching and that collaborative time was provided during daily teaching hours. Teachers noted that collaboration also required teachers to be more active. The school headmistress declared that creating a learning culture between teachers is another important factor of this constructive feedback intervention. The collaborative approach led the teachers, *"Teachers comfortably shared their comments with each other, and it makes them more competent*." All the teachers and headmistress perceive the effective use of constructive feedback as a foundation for creating a learning society. And this learning society not only developed among students in the classroom and the teachers in the staffroom. They all gather on one platform, as claimed by the headmistress.

Teachers and school headmistress also saw significant improvements in their students' understanding of achievement, which led significantly to the efficacy of feedback activities. These improvements included both current practices and the implementation of innovative techniques. Essentially, teachers have changed their methods to clarify their performance during the whole learning process. The way model was used by the teachers to explain the progress of a student was a significant shift in pedagogy. There was no concept of feedback model before the intervention, and feedback was referred to as "*checking the test copies."* Teachers' adopted the model through this intervention and used it at a variety of levels of achievement, thereby extending their relevance to students across all levels of achievement from the beginning of the lecture. This feedback approach helped students to become more proficient gradually and get

command over the content. Teachers also noted the visible change in students' behavior; they become more energetic and participate actively in solving worksheets, as they know "if they do *wrong, they will be corrected."*

Constructive feedback intervention caused teachers to change their feedback practices. Teachers perceived that formative assessment practices in the classroom have become more purposeful to identify students' strengths and weaknesses. The school headmistress noted that students' responses to the formative assessment provide feedback to the teachers about the students' progress, reflecting what would be the next. Particularly, the process of reflection on formative assessment helped teachers to provide feedback and plan accordingly.

Similar to the performance clarification, students' improvements were made to current techniques and usage of innovative strategies in the teaching pedagogy. Teachers were expected to use pre-assessments during the intervention to decide, *"Exactly where the students are standing…"*. This pre-assessment served three purposes: (1) to provide information to teachers about students' current learning status, (2) to decide instructional planning, and (3) to support self-regulation in students. Teachers observed that feedback practices had shifted students' perceptions, telling them how they are doing. Clarifying achievement provided the basis for self-regulation in the student so that they can review the progress of their own towards the goals. Students used constructive feedback to determine their progress.

Teachers saw significant improvements in the ways feedback encouraging development, which was consistent with clarifying performance and checking on results. Before the intervention, teachers indicated that much of their feedback focused on tick or cross on students' work. On the other hand, the intervention caused teachers to teach students what to do and follow active feed-forward strategies to make students see ways to change by self-review. As a result, the emphasis of teachers' feedback changed from correcting work to developing the learner. Students' knowledge of where they were going and how they were going was crucial to their autonomy in determining the progress—self-regulation developed in students due to the intervention, which shifted feed-forward responsibilities from teacher to students. Students steadily improved their ability to decide about their next steps as a result of provided feedback. Teachers and school headmistress reported that feed-forward process in which students are self-regulated and actively engaged bring noticeable progress in students' learning outcome. To encourage successful outcomes of constructive feedback, it was clear that the teacher's guidance to facilitate students was needed at first.

Students also observed positive changes in their behaviour after the intervention; they become motivated and taking more interest in Chemistry. As one student said, "*I choose science field just because of Biology, I don't like Chemistry subject, and my performance is worst in this subject nonetheless, I never knew where I am making mistakes and how can I overcome these mistakes, but then my teacher start giving me remarks on my mistakes, and not identified my mistakes but also encourage me to overcome with the solution. Now I like Chemistry subject a lot and take more interest in doing Chemistry assignments"*. The student also reported that they are somehow self-regulated in Chemistry subjects as now the teacher lets them think about the improvement in their work and the mistakes they made in certain assignments.

Constructive feedback practices play a vital role in Teachers, and the headmistress noted a significant change in students' performance. Significant differences were observed in their scores. The school's headmistress shared her point of view as *"It can be seen that students who couldn't score good marks in chemistry are getting better marks due to constructive feedback…they even perform better in their weekly test*". The teacher also seconded this point of view and added, *"Constructive feedback clear students' concept, when the concept is clear automatically performance will be better*." Participant student also confirmed the statement of the headmistress and teachers about their performance.

Students' positive feedback experiences were viewed as crucial to student self-regulation. This constructive feedback focused on developing students' self-regulation skills which required students' deeper engagement in receiving and understanding feedback. As in the focus group discussion, one of the students stated, "Teacher is providing me feedback in a new technique, and I learn a lot from this new technique, now I know what my mistake is and how I can *overcome it*."

Teachers reported that using constructive feedback methods boosted students' self-efficacy, with feedback focusing on "*improvement for all, not just any*." Additionally, teachers, headmistress, and students' responses revealed that these constructive feedback practices are more sustainable than the traditional feedback approach. Further, this approach brings ownership to the student of their learning. For instance, one student claimed that "*When I know my mistakes, and the way to overcome it, I can feel more confident….and I feel that yes! I can do*".

Conclusion and Discussion

Findings of the qualitative data collected before and after the intervention from the teachers,

headmistress, and students through interviews and focus group discussion reported that the constructive feedback intervention plays a significant role in increasing students' performance and motivation. Findings align with Fatima et al. (2021), who argued the same point 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). Wisniewski et al. (2020) and Hattie's (2009) meta-analysis also confirmed that feedback is essential due to its cognitive influences in any teaching-learning process. Feedback is helpful when it comes to helping students to respond to new techniques or understand how to enhance their learning and academic success during the learning process; it helps students to change their learning effectively and productively and succeed academically (Forsythe and Johnson, 2017). The viewpoint is consistent with Brown et al. (2012), who indicate that the students appreciate their feedback as they realize that it helps them pursue the educational process. Previous experimental researches by Ahmed et al. (2013); Fatima and Akbar (2020); Ghani and Ahmed (2016); Núñez-Peña et al. (2015); and Orsmond and Merry (2011) also support the impact of feedback on students' academic performance.

The finding of the study also suggests that the feedback that is delivered effectively has the power to increase effort, motivation, and engagement. These findings are 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 students' motivational behavior towards their homework, resulting in better academic performance (Núñez et al., 2015). Teachers' positive feedback is the strongest predictor of students' intrinsic motivation (Koka & Hein, 2005). Students' self-efficacy and motivation through feedback play a vital role in increasing students' performance in science subjects (De-Silva et al., 2018). Feedback intervention not only affects students but also affects pre-service teachers' motivation, which enhances their reflective thinking power (Çimen &Çakmak, 2020). 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 essential criterion for improving students' 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 increase students' performance in Chemistry subjects at grade IX.

Future Implications and Recommendations

This study will also provide the existing practices of feedback in the different subjects at the secondary level. It will also 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 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 be part of the assessment policy. The majority of secondary school teachers are practising traditional methods for providing feedback. They also have a low level of knowledge about constructive feedback, so it is 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 classes, and then the effects of age and subjects on intervention may be investigated.

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