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Impact of Formative Feedback on Students' Problem-Solving Performance in Mathematics: A Study in Secondary Level Students in Dolakha District, Nepal

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Abstract: *This study intends to study the relationship of teacher given formative feedback and problem solving performance of the students in mathematics at secondary level in Dolakha District, Nepal. A quantitative cross-sectional survey design was adopted and data was collected from 228 students (Grade ten) who were selected from five secondary schools (three public and two private), a rural - semi-urban district context. A structured questionnaire measuring three constructs Formative Feedback Practices (FFP), Problem Solving Performance (PSP) and Perception of Feedback (POF) using a five point Likert scale was used. Descriptive statistics showed quite high mean scores of FFP ($M = 3.98$, $SD = 0.66$), PSP ($M = 4.10$, $SD = 0.55$) and POF ($M = 3.91$, $SD = 0.84$) with acceptable internal consistency (Cronbach's alpha being in the range of .69 to .75). Pearson product-moment correlation analysis indicated that there were strong and positive relationships between FFP and PSP ($r=.80$, $p<.001$), FFP and POF ($r=.72$, $p=.001$) and POF and PSP ($r=.71$, $p=.001$).The results indicate that as well as having positive perceptions of feedback, students who indicated more frequent, clear and constructive formative feedback also indicated greater engagement in mathematical problem-solving activities. Although the allocation of causal relationships is impossible to infer from the results, they are suggestive of the potential importance of formative feedback in supporting reflections and strategy-oriented problem solving in secondary mathematics classrooms. The research recommends the need for strengthening of structured feedback practices and continuous teacher professional development for better formative assessment practices in the studied context.*

Keywords: *formative feedback, problem-solving, mathematics education, mathematical proficiency,*

Introduction

Mathematical proficiency involves a core element of mathematics problem-solving, which is a life skill that forms the basis of academic, professional, and real-life success (Hattie & Timperley, 2007).

Problem-solving, other than just being able to compute, is a practice that uses reasoning, creativity and persistence abilities that are essential in innovation, decision-making and being a mature citizen. Scholastic achievement, which is indicated by the ability to interpret, plan, and assess mathematical problems, predicts not only the readiness to work in STEM areas, but also to solve practical problems in everyday life. Nevertheless, enduring difficulties with conceptual knowledge, flexible reasoning and knowledge transfer among the students have attracted the focus on how the instructional feedback can facilitate more profound learning and independence (Black& Wiliam, 1998; Wiliam, 2011).

One of the most beneficial techniques to improve the learning outcomes has been defined as formative feedback information offered to assist learners to close the gap between their actual and desired performance (Hattie & Timperley, 2007; Wisniewski et al., 2020). Clarity, promptness and actuality of feedback improve not only academic achievements, but also self- regulation and motivation. High-quality feedback in the classroom is useful in mathematics to assist students in detecting mistakes, developing strategies, and enhancing metacognitive awareness (Shute, 2008; Nicol & Macfarlane-Dick, 2006; Butler & Winne, 1995). Good feedback is more of a learning dialogue that gives guidance and explanations that allow the learners to derive meaning of their performance and strategize on what to undertake. On the other hand, unclear or slow feedback may serve to support myths or demotivate (Lipnevich & Smith, 2009).

Recent research from high school mathematics classrooms suggests students too often receive feedback in the form of summative judgments in the form of grades rather than formative judgments that provides support and improvements during the learning process This restricts the learning potential of feedback because only those students who seek clarification actively use feedback dialogues and the others become passive recipients. The study further points out that the teacher's manner and classroom feedback culture has a significant influence on student's motivation, effort and willingness to act upon feedback, which emphasize the importance of dialogic and learner-centered feedback practices (Sandal & Sperle, 2024).

Feedback is not always useful. Its effects are determined by its valence (positive or remedial), specificity, concentration (task, process or self-level) and timing (immediate or delayed). The studies indicate that task and process-specific feedback have been found to produce higher learning outcomes in comparison to general compliments and self-focused remarks (Hattie & Timperley, 2007; Van der Kleij et al., 2015). Feedback cycles that facilitate using strategies, diagnosing errors, and reflecting are used in mathematics to enhance problem-solving proficiency in students (Schoenfeld, 1985; Polya, 1945/2014). Besides, feedback literacy of learners should determine the success of feedback their opportunities to interpreting and using feedback constructively (Carless & Boud, 2018). Rakoczy et al. (2019) also demonstrated that the motivational mechanisms between feedback and achievement are indirect when it comes to self-efficacy and learning behaviors among students, which suggests the motivational mechanisms of formative feedback on performance.

Despite continued national concern about the performance of students in mathematics in Nepal, secondary-level classroom instruction still remains heavily influenced by what is needed to pass the examinations and what is covered in textbooks. Assessment in schools is largely summative in its nature with feedback normally being limited to marks or identification of error rather than formative dialogue to support reflection and revision and strategic learning. Consequently, students get little chances to learn with feedback as an interactive learning process or develop self-regulation in mathematical problem solving.

Although national curriculum frameworks and teacher professional development initiatives in Nepal provide formal evidence of the importance of formative assessment, there is still little empirical evidence at the classroom levels about how use of formative feedback is actually implemented in secondary mathematics classrooms, and how students perceive and utilize such feedback for learning. Existing Nepal-based studies and reports have tended to focus on the achievement outcomes, curriculum reform, or examination performance, rather than look at the day-to-day feedback practices and their relationship with problem-solving performance and motivational engagement of the students. This mismatch between policy intentions and practices in social context in the classroom reveals a clear gap in research in the context of mathematics education in Nepal.

Statement of the Problem

In Nepal, students at the secondary level are still facing problems in solving non-routine mathematical problems that require multi-step reasoning, conceptual understanding and application to unfamiliar contexts. Although formative feedback is internationally acknowledged to be a powerful mechanism for enhancing learning, classroom assessment practices in Nepal are still largely examinations-oriented and summative in nature and feedback is often limited in the form of marks and identification of errors rather than being diagnostic in nature, that is, guiding children on how to improve. Studies on the performance of the school assessment system and implementation of curriculum in Nepal over the years have highlighted the dominance of high-stakes examinations and content coverage with no room for reflective feedback, revision and learner engagement during the teaching-learning process.

While various research studies across the world have shown the impact of formative feedback in terms of enhancing problem-solving skills, boosting motivation and self-efficacy (Hattie & Timperley, 2007; Shute, 2008; Rakoczi et al., 2019; Carless & Boud, 2018), formative feedback practices and their impact on learner achievements have not yet been studied in Nepal's secondary mathematics classrooms on a daily basis. Consequently, there is not so much information on what happens with students' perception of feedback, how often formative feedback is practiced and how these practices are related to problem-solving performance and motivational engagement.

To improve this gap the current study empirically examines the relationship between Formative Feedback Practices (FFP), Perception of Feedback (POF) and Problem Solving Performance (PSP) among the Grade ten students of Dolakha District. By focussing on classroom level experiences of students, the study adds context-specific evidence to inform the practice of teaching, teacher professional development and ongoing works to improve the implementation of formative assessment in the context of the Nepal secondary education system.

Objectives of the Study

The objectives of this study were mentioned below:

- To assess the prevalence and quality of formative feedback practices in secondary mathematics classrooms (as perceived by students).
- To measure students' self-reported problem-solving performance in mathematics.
- To examine the relationship between formative feedback practices and problem-solving performance.
- To explore students' overall perception of feedback and its association with problem-solving performance.

Research Hypotheses

Following Hypothesis were used in this study:

- H1: Formative Feedback Practices (FFP) are positively correlated with Mathematics Problem-Solving Performance (PSP).
- H2: Perception of Feedback (POF) is positively correlated with Mathematics Problem-Solving Performance (PSP).
- H3: Formative Feedback Practices (FFP) are positively correlated with Perception of Feedback (POF).

Review of Related Literature

Feedback has been recognized generally as one of the most powerful influences on student learning and performance across all disciplines. However, the effectiveness of it is highly depending on the quality, focus and time of information provided to the learners. Research has shown that both specific, timely and improvement-related feedback can lead to large gains in cognition and academic performance (Hattie & Timperley, 2007; Wisniewski et al., 2020). The most important function of formative feedback is to help close up the disconnect between actual and desired performance by answering three questions: Where am I going? Where am I going and how do I get there? (Hattie & Timperley, 2007). Through this process, feedback helps in both cognitive development and motivation by clarifying what the goals are, helps in tracking their progress and keeps them going to improve.

The impact of feedback on learning varies according to its focus task, process or self-regulation (Shute, 2008; Butler & Winne, 1995). Task-level feedback gives corrective information whereas process-level feedback directs reasoning and strategizing of the learners. The autonomy and metacognition are facilitated by self-regulatory feedback. Recent experimental evidence using data-driven instructional designs has shown that self-regulation level feedback is superior to task level feedback in improving the mathematics word problem solving performance of students. Feedback that encourages learners to plan, monitor and reflect on their problem solving strategies encourages them to engage more deeply in the problem solving processes and helps them develop self-regulated learning skills. These findings support the case for using feedback that can be most effective as focusing on cognitive and metacognitive regulation of learners rather than on the correction of errors in specific tasks. Conversely, ego-level feedback (e.g. praise/criticism) tends to have weak or negative effects (Kluger & DeNisi, 1996). Mathematically, reasoning and strategy-focused feedback is more productive than evaluative comments because it builds the ability to think flexibly and transfer learning (Shute, 2008; Nicol & Macfarlane-Dick, 2006).

These differences could be supported by empirical studies. Brookhart (2008) demonstrated that grades with no explanatory comment mean little but specific written feedback is encouraging to students. Similarly, directive, improvement oriented feedback is also found to be more effective than generic praise (Lipnevich & Smith, 2009). Meta-analytic evidence also shows that adaptive hints and worked examples lead to stronger learning outcomes than feedback which is only evaluative (Van der Kleij et al., 2015).

Feedback in the process of solving mathematical problems helps the representation - planning - execution - evaluation cycle (Polya, 1945/2014; Schoenfeld, 1985). It helps students uncover false assumptions and ineffective solution strategies, which helps to increase the level of self-regulation (Nicol & Macfarlane-Dick, 2006). Empirical evidence additionally indicates that on-task and process-level feedback that are timely promote persistence and transfer of learning to new problem situations (Harks et al., 2014). In addition, feedback has been shown to improve self-efficacy and learning behaviors, allowing students to maintain effort when engaged in challenging math tasks (Rakoczi et al, 2019).

It is also important how and when feedback occurs. Procedural learning is favored by immediate feedback and deeper reflection is favored by delayed feedback (Shute, 2008). Dialogic feedback by questioning and discussing promotes active interpretation and application of information by the learners (Andrade & Brookhart, 2020). Carless and Boud (2018) support the use of feedback literacy, which focuses on the fact that students should be able to take action on feedback.

Recent research is placing an emphasis on the fact that effectiveness of feedback is also dependent on feedback literacy - that is, the ability of learners to interpret feedback, evaluate it and use it to improve learning. For example, evidence from high school students have shown that feedback literacy is associated with unique reflective learning profiles and academic outcomes that suggest that students ability to "take action" on feedback is an important condition for feedback to translate into improved learning behaviors and achievement (Gong et al., 2025).

The central role played by feedback in the field of mathematics education has stood the test of meta-analyses. Wisniewski et al. (2020) found an average effect size of 0.48, which is a substantial positive impact on learning outcomes from feedback. These findings continue to show that feedback is most effective when it is goal-focused, dialogic and action-oriented.

A recent systematic review using a synthesis of formative assessment research in mathematics education of studies published between 2015 and 2023 shows mixed but generally positive effects of formative assessment on both cognitive and non-cognitive learning outcomes .In a conclusion the authors note that formative assessment is most effective if carried out regularly over long periods of time, is linked with clear learning intentions and is supported by content-specific measurement tools. Notably, the review points to computer-based and interactive formative assessment environments as promising with a specific focus on supporting lower and medium performing students and educational equity (Maskos et al., 2025).

Although the usefulness of formative feedback has been established with a plethora of international researches, the literature on the assessment system in Nepal has revealed that the schooling in general and, in particular, the secondary education is dominated by the examinations and the learning outcomes are heavily influenced by the high-stake examinations. National curriculum and assessment frameworks have a concentration on summative forms of assessment and particularly the form of standardized examinations which can priorities syllabus coverage and test performance over formative practice in the classroom. As a result, formative feedback in the mathematics classroom is often restricted to a more limited scope with less opportunities for dialogue, revision and strategy focused feedback.

Existing Nepal-based studies and reports have focused mainly on student achievement trends, curriculum implementation, and examination performance and have not explored the nature of enactment of formative feedback in day-to-day classroom interactions or the perceptions of students and enactment of formative feedback during mathematical problem solving. Consequently, there is a dearth of empirical evidence of the correlation between formative feedback practices, student perceptions about feedback and performance in problem-solving within the Nepali secondary mathematics context. Addressing this gap, the present study contributes to the evidence by providing context specific evidence on the experiences of students on formative feedback and its relation to problem-solving performance in secondary schools of Nepal.

Methodology

The study used a quantitative cross-sectional survey method to collect the data which helped to analyze the correlation between Formative Feedback Practices (FFP), Problem Solving Performance (PSP), and Perception of Feedback (POF) of secondary-level mathematics students of Dolakha District, Nepal. A total of 228 Grade ten students from five secondary level schools (three public and two private) took part in the research. The sample size was deemed appropriate for quantitative correlational analysis because it is larger than commonly accepted minimum values that can be used to study relationships between variables using Pearson correlation analysis and to make stable estimates of descriptive and inferential statistics. Data were gathered in school time during regular classes under normal supervision to make the data consistent between schools. Data were collected with the consent and cooperation of the school principal and the relevant subject teacher.

Data were collected by using a structured five point Likert scale questionnaire measured on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was composed of four sections: Section A (Demographics), Section B (Formative Feedback Practices, 10 items related to timeliness, clarity and opportunity for revision), Section C (Problem-Solving Performance, 10 items related to problem interpretation, planning and evaluation strategies) and Section D (Perception of Feedback, 5 items related to usefulness, motivation and collaboration). The questionnaire was formulated from known models of feedback and mathematical problem solving (Hattie & Timperley, 2007; Shute, 2008; Nicol & Macfarlane-Dick, 2006; Schoenfeld, 1985; Polya, 1945/2014).

Content validity was ensured by expert review of two mathematics teachers (one was from university level and another was from secondary level) and one assessment expert. A pilot test on 32 students established clarity and internal consistency of the instrument. Cronbach's alpha coefficients for the main study were 0.75 for FFP, 0.70 for PSP, and 0.69 for POF, which were acceptable levels of reliability. Ethical considerations were strictly followed: permission was sought from the selected schools and written informed consent from students and their guardians. Participation was voluntary and guarantees of anonymity, confidentiality and the right to withdraw at any stage were provided. Data were analyzed by using IBM Statistical Package System (SPSS) Statistics version 27. Descriptive statistics (mean, standard deviation, minimum, and maximum) and Pearson product-moment correlation were applied to study relations among the variables of the study, after verifying the requisites of statistical assumptions.

Results and Discussion

This section contains analysis, interpretation, and discussion of the data that was gathered among 228 students of secondary level in Dolakha District, Nepal. This part is to present the empirical results which were obtained based on the survey questionnaire and refer to the objectives and hypotheses of the study. The analysis of the respondents will start with the demographic profiles of the respondents, then the descriptive statistics, the reliability statistics, and the correlation outcomes of the three dominant constructs Formative Feedback Practices (FFP), Problem-Solving Performance (PSP), and Perception of Feedback (POF). The last aspect is the discussion of the findings in connection with the current literature on formative assessment and mathematics learning, which indicates the implication on classroom practice and teacher professional growth.

Demographic Profile of Respondents

This study was carried out on a sample of 228 students. The sample respondents were taken from the public and the private schools located in Dolakha District. This sampling guaranteed that different institutional settings such as government managed and community-based schools were represented thus enhanced external validity and generalizability of the results.

The demographic information was gathered to characterize the sample of the participants with regards to gender, school type, and age. These features give a general picture of the target population and guarantee that the sample has sufficient characteristics to reveal the demographic profile of the population of students of the second level of education which is characteristic of Nepalese schools.

Table 1

Demographic Characteristics of the Study

Variable	Category	Frequency	Percent (%)
Gender	Male	123	53.95
	Female	105	46.05
Type of School	Private	120	52.63
	Public	108	47.37
Age (years)	Mean = 10.95	SD = 5.53	Range = 5–17 *

Note. Several age entries (e.g., “5”) appear inconsistent with the expected Grade 10 age range (≈ 14–16 years). The mean and SD were computed as recorded. When erroneous “5” values are excluded, the corrected range is approximately 15–17 years and mean ≈ 15.8 (SD ≈ 0.8).

The demographic findings show that the sample is almost gender balanced with 53.95 percent males and 46.05 percent females. This equal representation makes it possible that gender bias is reduced in the feedback and problem solving results analysis. Moreover, the sample of private (52.63) and public (47.37) schools is quite balanced, which makes the comparison between the types of institutions quite fair. This balance will improve the generalizability of the results to the general population of secondary school in Dolakha District.

Even though the initial dataset also had some age inconsistencies, probably because of the errors in the data entry, the fixed distribution matches the assumed age range of 15-17 years in Grade 10 students in Nepal. This implies that the respondents represent the target level of education. All in all, the demographic representation is believable, ecologically relevant, and demographically diverse, which enhances the legitimacy of the further analysis concerning formative feedback practices and mathematics performance in solving problems.

Descriptive Statistics for Major Constructs

The three major constructs - Formative Feedback Practices (FFP), Problem-Solving Performance (PSP), and Perception of Feedback (POF) - are the self-reported perceptions of students about the formative feedback provided by teachers and self-reported experiences of problem solving by students in the mathematics classrooms. All constructs were calculated as mean scores of their respective Likert Scale items (1 = Strongly Disagree to 5 = Strongly Agree).

Table 2

Scale-level Descriptive Statistics and Reliability (N = 228)

Construct	Items	Mean	SD	Min	Max	Cronbach’s α
Formative Feedback Practices (FFP)	10	3.98	0.66	2.20	4.80	.75
Problem-Solving Performance (PSP)	10	4.10	0.55	2.00	5.00	.70
Perception of Feedback (POF)	5	3.91	0.84	1.80	4.80	.69

The descriptive results indicated students mean scores in relatively high range for all the three constructs. Formative Feedback Practices had a mean score of 3.98 (SD = 0.66), which shows that students had often the experiences of teacher feedback is timely, clear and constructive. Similarly, the average score for Problem-Solving Performance was 4.10 (SD = 0.55) which was considered to be quite high self-reported level of confidence by the students in interpretation, planning and evaluation of mathematical problems. Perception of Feedback We also found relatively high mean value (M = 3.91, SD = 0.84) which show that student perceived teacher feedback relatively as useful and supportive in learning.

The values of the internal consistency for all the three constructs were within acceptable limits for educational research (0.69-0.75). These results show that the measurement scales were sufficiently reliable to capture student's perception about the teacher feedback, problem solving performance and feedback usefulness as per the classroom scenario.

Item-Level Descriptive Statistics

The item-level analysis offers a more specific view of how students experience the certain facets of the formative feedback in the mathematics classrooms. It points out the dimensions of feedback e.g. timeliness, clarity, motivation, or opportunity to revise that most and least frequently come into play in real-life teaching practice.

Table 3
Descriptive Statistics – Formative Feedback Practices (FFP)

Item Code	Statement	Mean	SD	Min	Max
FFP1	My teacher gives feedback soon after I submit math work.	3.84	1.45	1	5
FFP2	Feedback explains what I did right and what to improve.	3.83	1.11	1	5
FFP3	The teacher discusses how to improve my solutions after assessment.	3.90	1.39	1	5
FFP4	Feedback is given immediately after assignments or tests.	3.93	1.26	1	5
FFP5	I receive written comments that explain why my answer is right or wrong.	**4.33**	0.73	3	5
FFP6	Feedback encourages me to try alternative methods to solve problems.	3.81	1.16	1	5
FFP7	The teacher gives opportunities to correct errors after receiving feedback.	3.89	1.07	1	5
FFP8	I discuss feedback with my teacher to clarify doubts.	3.86	1.09	1	5
FFP9	I feel motivated when my teacher provides constructive comments.	3.91	1.05	1	5
FFP10	Feedback from my teacher improves my confidence in solving math problems.	**4.33**	0.73	3	5

The item level descriptive statistics paint a picture of the different experiences reported by the students in terms of the formative feedback provided by their teacher in mathematics classrooms. Of the feedback practices, the highest mean scores were for those items relating to written explanatory comments (FFP5, M = 4.33, SD = 0.73) and improving confidence with feedback (FFP10, M = 4.33, SD = 0.73). These values show that the student indicated more frequently that receiving feedback in terms of correctness and confidence was more frequently reported than other aspects of feedback.

Items about improvement strategies (FFP3, M = 3.90) and opportunity for revision (FFP7, M = 3.89) were also relatively higher mean values and may reflect that such practices were common for students. In contrast to this, items related to encouragement to use alternative ways of solving the problem (FFP6, M = 3.81), and timeliness of feedback (FFP1, M = 3.84) showed a lower mean score and indicative of less frequency of the practice of these strategies being present.

These findings are descriptive in nature and are meant to give a sense of distribution and relative prominence of different formative feedback practices as viewed by students. No statistical inference about effectiveness or impact of individual feedback practices is made at the item level of analysis as the basis of analysis is based on a non-random sample and no item level significance testing.

Table 4
Descriptive Statistics – Problem-Solving Performance (PSP)

Item Code	Statement	Mean	SD	Min	Max
PSP1	I can identify what is being asked in a mathematics problem.	4.08	0.95	1	5
PSP2	I can plan steps to solve mathematical problems logically.	4.02	0.90	1	5
PSP3	I can apply suitable formulas or methods to solve problems.	4.05	0.87	1	5
PSP4	I can check and verify my answers after solving.	3.98	0.94	1	5
PSP5	I can solve new problems based on what I learned previously.	4.03	0.91	1	5
PSP6	I can explain my solution process clearly to others.	4.00	0.93	1	5
PSP7	I can find different ways to reach the same answer.	3.97	0.98	1	5
PSP8	I can use real-life examples to understand mathematical problems.	3.92	0.95	1	5
PSP9	I can manage time effectively while solving problems.	3.85	1.01	1	5
PSP10	I feel confident when solving challenging mathematics problems.	3.86	1.00	1	5

The item level descriptive statistics for Problem-Solving Performance (PSP) group the self-reported problem solving behaviors and self-reported problem solving confidence in mathematics of the students. Relatively higher mean scores were recorded for problem identification (PSP1, M = 4.08), application of formulas or methods (PSP3, M = 4.05), and planning solution steps (PSP2, M = 4.02) which were more often endorsed by students.

Items related to time management in problem solving (PSP9, M = 3.85) and confidence in solving challenging problems (PSP10, M = 3.86) received relatively low mean values, indicating that they were less often reported than other aspects of problem solving. The remaining items showed mean scores near the midpoint of the scale indicating moderate means of agreement among different dimensions of problem-solving performance.

These results are descriptive in nature and are meant to show the distribution and relative importance of various self-reported problem-solving behaviors by the students. No statistical inference is made about the actual competence of students or causal explanations are not made at the item level, since the analysis is based on a non-random sample, and no item level significance testing is conducted.

Table 5
Descriptive Statistics – Perception of Feedback (POF)

Item Code	Statement	Mean	SD	Min	Max
POF1	Formative feedback helps me understand mathematical concepts better.	3.90	1.05	1	5
POF2	Feedback encourages me to learn from my mistakes.	3.95	1.00	1	5
POF3	I prefer classes where the teacher provides frequent feedback.	3.88	1.08	1	5
POF4	I share feedback with my classmates for collaborative learning.	3.83	1.09	1	5
POF5	Effective feedback improves my overall performance in mathematics.	**4.01**	1.03	1	5

The findings indicate that most of the students view the feedback as either instructive or motivational with all of the items scoring near or over 3.9 on the scale out of 5. The statement with the highest rating, POF5 (M = 4.01) highlights the opinion of the students that the positive feedback has a direct impact on their overall performance in mathematics. Likewise, the question POF2 has the highest agreement (M = 3.95) and the meaning of the score is that learners consider feedback as an opportunity to learn through mistakes a major characteristic of formative learning.

The moderate scores of POF3 and POF4 indicate that students are fond of frequent and collaborative feedback but less often do they share feedback with their peers than with their teachers. These trends are consistent with Andrade and Brookhart (2020) and Harks et al. (2014) who note that the perception of feedback usefulness by students plays a mediating role in influencing learning motivation and achievement.

On the whole, the results show that pupils within Nepali secondary school do not just respond to the provided feedback positively, but also perceive its transformational nature in enhancing their conceptual knowledge, interest, and achievement in mathematics.

Correlation Analysis

To test the correlation between the three major variables, Formative Feedback Practices (FFP), Problem-Solving Performance (PSP), and Perception of Feedback (POF), Pearson correlation analysis was used. In this analysis, the strength and direction of the associations between the constructs is identified and thus the hypotheses of the study were tested.

Table 6

Pearson Correlation Matrix (N = 228)

Variable	FFP	PSP	POF
FFP	1.000	.802	.715
PSP	.802	1.000	.711
POF	.715	.711	1.000

Note: All correlations significant at p < .001.

The correlation coefficients show that all three variables are strongly and positively related to each other and are significant at the 0.001 level. Formative Feedback Practices and Problem-Solving Performance (r =.802, p <.001) have the highest level of correlation, indicating that students who receive more frequent, specific, and constructive feedback are more likely to display better skills in solving mathematical problems.

On the same note, Perception of Feedback (POF) is positively related with FFP (r =.715) and PSP (r =.711) being that students who appreciate and internalize feedback also do well in school and have a more positive attitude towards the practice of feedback by their teachers.

Empirically, these results augment all three hypotheses (H1 -H3) and are consistent with the global data that highlights the strong impact of feedback on learning outcomes (Wisniewski, Zierer, and Hattie, 2020; Rakoczy et al., 2019). Primarily, properly designed formative feedback does not only reinforce problem-solving abilities but it also improves the motivation, engagement, and feedback literacy of student's essential contributors to long-term academic development.

Discussion

The results of the current study indicate a strong correlation between the practices of formative feedback and the performance of students in problem-solving as a robust source of international research that underlines feedback as one of the greatest influences in enhancing learning (Hattie &Timperley, 2007; Wisniewski et al., 2020).

Nepalese secondary classroom students also indicated that they receive constructive, motivating, and frequent feedback, which seems to have led to a greater sense of self-efficacy, confidence, and increased metacognitive regulation. This is a pattern that is consistent with the three feedback questions model by Hattie and Timperley (2007) Where am I going? How am I going? Where to next?- the transparency and goal focus in feedback enable the learners to plan and track their thinking processes in mathematics. The high positive correlation between Formative Feedback Practices (FFP) and Problem-Solving Performance (PSP) (r =.802, p <.001) is yet another confirmation that the right feedback at the right time triggers the ability of students to diagnose mistakes, optimize strategies, and persevere in the face of cognitive difficulties (Shute, 2008; Nicol & Macfarlane-Dick, 2006).

What is equally interesting is emotional and motivational feedback. Encouragement and written explanations were ranked highest (FFP5 and FFP10) and this is in respect to the fact that confidence-building feedback that does not only correct mistakes but also confirms progress is important. This twofold cognitive-affective aspect of feedback hypothesized by Butler and Winne (1995) and Lipnevich and Smith (2009), exudes the fact that effective feedback promotes the intellect and the frame of mind of learners where persistence and resiliency in problem solving are developed.

These findings are in line with evidence indicating the potential for self-regulation - level feedback (feedback that supports the planning, monitoring and reflecting process) to produce higher levels of gains in mathematics word problem-solving performance compared to feedback focused solely on task correctness, particularly in environments of data-driven or structured feedback (Huang et al., 2024).

The high correlation observed between FFP, POF, and PSP (r =.71 to.80, all p=.001) suggests that the students who held an opinion that feedback is useful and motivating are more likely to perform better. This implies that the capacity of feedback literacy students to read and take action on feedback is becoming an important mediating variable, which aligns with the publications by Andrade and Brookhart (2020) and Carless and Boud (2018). The fact that students have got positive perception about feedback is an indication that they have become aware of its intent and use in learning process and not just as a way of measuring performance.

Besides, the research identified that the problem-solving competence is highly developed (M = 4.10), but such aspects as time management and confidence under pressure are less developed. These results align with the theory of mathematical problem-solving proposed by Schoenfeld (1985) that emphasizes that the affective regulation and perseverance is frequently underdeveloped in comparison with the procedural and conceptual abilities. The association between the process-based feedback and the outcomes of problem-solving serves as the confirmation that strategic thinking and emotional regulation can be strengthened with the help of structured and iterative feedback cycles.

To conclude, the theoretical and practical significance of formative feedback in mathematics education are supported by empirical evidence in this study. The findings confirm the hypothesis that effective feedback is an effective cognitive support and motivational engine that improves learners, strategy use, and performance. These excellent, stable correlations are resembled to global meta-analyses (Van der Kleij et al., 2015; Wisniewski et al., 2020) and prove the fact that in case feedback is dialogic, action, and implemented in learning cycles, it gives long-term improvements to student achievement and confidence in solving mathematical problems.

Conclusion

The research presents interesting classroom-level findings on Dolakha District, Nepal, which indicates that formative feedback practices are relevant in improving the performance of mathematical problems solving by students. The high and positive correlations of Formative Feedback Practices (FFP), Problem-Solving Performance (PSP), and Perception of Feedback (POF) prove that timely, specific and actionable feedback have a significant and positive impact on cognitive engagement, confidence and metacognitive regulation of students. These results resonate with those of Hattie and Timperley (2007), Shute (2008) and Wisniewski et al. (2020) and confirm the power of feedback as one of the most effective learning enhancers.

In this research study, students saw feedback as a way to grow not as an evaluative commentary but as a conversation a way to find mistakes and perfect their strategies and encourage them to work harder. The incorporation of formative feedback in classroom activities, therefore, seems to be a major contributor to the formation of independent, reflective students who have the ability to achieve long-term problem-solving effectiveness.

Practical Recommendations

Where possible, schools could adopt structured or technology supported approaches to feedback which includes timely, individualized feedback, including prompts in support of self-regulation (e.g. planning, monitoring and reflection). Such feedback can be used to motivate students to revise strategies and build up performance in solving mathematics problems (Huang et al., 2024).

Feedback literacy and engagement through students can also be improved through encouraging dialogic forms of feedback (teacher sunny conferencing and peer discussion around feedback). In addition, the timing of the feedback should be appropriate to the complexity of the task - feedback can be more immediate for routine or procedural tasks, while delayed feedback could be more helpful to promote deeper reflection for complex problem-solving tasks. Finally, continued professional development for teachers on the concrete practices of fair, clear and goal-oriented feedback is essential to continue effective formative assessment practices in mathematics classrooms.

Limitations and Future Research

Even though the research provides valuable results, it uses self-report information that is prone to perception bias. Follow-up research needs to integrate survey with classroom observation and performance based tests to have a better understanding of feedback effectiveness. Also, the sample was purposively selected in a single district, which would benefit generalizability, as future studies could use a varied mix of geographic and institutional settings rural and community schools, among others. Causal effects and time-sustained feedback impacts might also be investigated with the help of longitudinal or quasi-experimental designs. Lastly, researching on possible moderators like the prior performance of students, classroom environment and teacher feedback approach would inform more on how a constructive feedback system of formative feedback promotes meaningful learning in diverse learning environments.

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Conflict of Interest
The authors declare that there is no conflict of interest.

Data Availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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