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Chapter 22: Teacher Feedback Practices and Student Academic Motivation in Secondary Education

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Abstract— Teacher feedback is a central component of secondary education, yet its motivational value depends not merely on how frequently feedback is provided but on how students interpret, trust, and act upon it. This study proposes a feedback-sensitive learning framework for examining the relationship between teacher feedback practices and students' academic motivation within contemporary secondary-school environments. A distinctive research gap is identified in the limited integration of feedback quality, student feedback uptake, motivational indicators, and digitally generated learning traces within a unified analytical framework. The study conceptualizes teacher feedback through four dimensions: specificity, actionability, dialogic interaction, and autonomy support, while distinguishing these characteristics from simple feedback frequency. Academic motivation is treated as a multidimensional construct involving learning interest, academic persistence, perceived competence, task engagement, and willingness to improve following corrective information. The proposed research further introduces an artificial-intelligence-assisted analytical layer capable of examining patterns in teacher comments and relating them to longitudinal changes in student motivation. **Keywords—** Teacher Feedback, Academic Motivation, Secondary Education, Feedback Literacy, Learning Analytics, Artificial Intelligence

Introduction

Feedback occupies a distinctive position in teaching because it connects evidence of current performance with decisions about subsequent learning. In secondary education, students continuously encounter evaluative information through written comments, classroom conversations, assessment scores, corrections, digital learning platforms, peer discussions, and teacher explanations. These interactions can influence whether students regard academic difficulty as manageable, whether they persist after errors, and whether they perceive themselves as capable of improving. Consequently, feedback is not simply an assessment procedure; it is also a potentially important motivational mechanism.

Contemporary educational environments have made this relationship more complex. Secondary-school students increasingly move between conventional classroom instruction and digitally mediated learning environments in which assignments, quizzes, comments, progress indicators, and assessment records may be stored electronically. Such environments provide teachers with more opportunities to communicate learning information, but a greater volume of

feedback does not necessarily produce stronger learning motivation. Students may receive numerous comments while remaining uncertain about what action to take. Conversely, concise but highly specific guidance can sometimes stimulate revision, persistence, and further learning.

This distinction between the **amount of feedback** and its **functional quality** is important. A comment such as “needs improvement” communicates an evaluation but offers limited guidance regarding the next learning action. A more diagnostic comment identifies what is incomplete, explains why it matters, and indicates an attainable next step. The latter potentially reduces uncertainty and supports a student's perception that improvement is possible. Feedback can therefore operate through cognitive and motivational pathways simultaneously.

Recent international evidence strengthens the rationale for investigating supportive teacher practices. OECD analyses based on PISA 2022 indicate that students reporting stronger teacher support are generally more proactive in learning and demonstrate higher motivation, better self-regulatory behaviours, and greater willingness to engage with school learning. The relationship remains important even when socio-economic characteristics are considered. PISA evidence also indicates that students receiving more teacher support were more likely to report enjoying learning new things at school, while less-supported students more frequently reported disengagement-related behaviours.

At the same time, the contemporary context reveals a potential problem. OECD analyses indicate that teacher support declined between 2012 and 2022 across many participating education systems. PISA 2022 results showed that approximately 30% of students across OECD countries reported receiving extra help or assistance with learning only in some lessons or almost never, while substantial proportions reported limited teacher interest in ensuring that students understood instructional material. This creates a strong rationale for examining not only whether teachers provide support but also what kinds of feedback practices are most likely to sustain student motivation.

Research Gap

The principal research gap addressed in this manuscript concerns the **disconnect between feedback delivery, feedback interpretation, and measurable motivational response**.

A substantial proportion of educational research treats feedback as a relatively broad instructional variable or examines students' perceptions of teacher support. Such approaches are useful but may obscure considerable variation in the actual characteristics of feedback. Two students can report receiving feedback equally often while receiving qualitatively different information.

Similarly, two students can receive almost identical comments but respond differently because of differences in perceived competence, prior achievement, feedback literacy, or interpretation of teacher intent.

A second limitation is methodological. Feedback and motivation have frequently been studied through cross-sectional questionnaires. Such instruments provide important perceptual information but are less capable of representing the sequence:

teacher feedback → student interpretation → feedback uptake → behavioural response → motivational change.

Teacher Feedback (Evaluation)

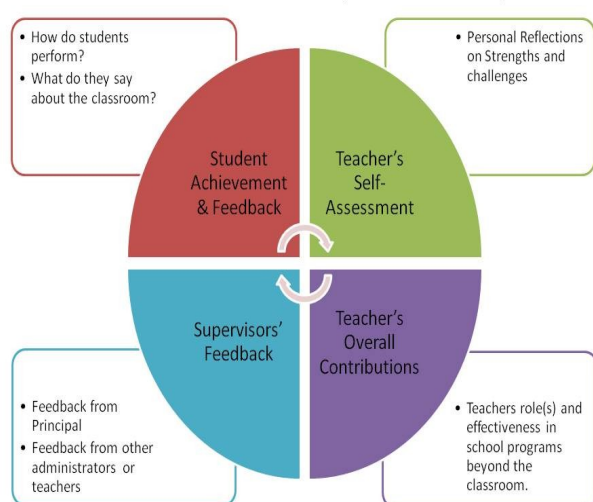


Fig. 1: Type of Feedback

Source: <https://www.linkedin.com/pulse/type-feedback-melvin-goh>

The third gap concerns **heterogeneity of response**. Feedback that motivates one student may discourage another. Students with weaker initial confidence, for example, may require highly actionable and autonomy-supportive guidance, whereas students with stronger self-regulation may benefit from less directive prompts. Average-effect statistical models can conceal these differences.

Accordingly, the present study proposes a multidimensional and computationally supported framework in which teacher feedback characteristics are linked with student motivational trajectories rather than examining feedback as a single undifferentiated variable.

Research Objective

The primary objective is to determine how specific teacher feedback practices influence academic motivation among secondary-school students and whether AI-assisted analysis of textual feedback can identify feedback patterns associated with stronger motivational responses.

More specifically, the proposed investigation examines whether feedback characterized by **specificity, actionability, dialogic orientation, and autonomy support** predicts higher levels of academic persistence, perceived competence, learning interest, and task engagement. It also considers whether student feedback uptake functions as an explanatory mechanism between feedback quality and subsequent motivation.

Conceptual Orientation

The conceptual framework differentiates three stages of the feedback process.

The first is **feedback provision**, representing what the teacher communicates. This includes whether feedback identifies specific strengths or errors, supplies improvement-oriented information, encourages reflection, and gives students meaningful agency in determining their next action.

The second is **feedback processing and uptake**. Feedback cannot influence subsequent performance merely by existing. Students must notice the information, understand its meaning, evaluate its relevance, and translate it into action. Feedback literacy scholarship increasingly emphasizes these active processes rather than positioning students as passive recipients of teacher comments. An instructional model proposed by Nieminen and colleagues, for example, integrates feedback literacy with scaffolded and socio-constructivist learning processes, emphasizing students' capacity to understand and use feedback information.

The third stage is **motivational response**. After processing feedback, students may increase effort, revise their work, persist with a difficult activity, seek additional help, or disengage. Academic motivation is therefore operationalized in the proposed study as a dynamic outcome rather than simply a stable personal characteristic.

This conceptualization is particularly appropriate for secondary education because adolescence involves increasingly independent learning decisions. Students are expected to interpret performance information and regulate their own study behaviours while simultaneously encountering more differentiated assessment demands across subjects.

Literature Review

Teacher Feedback as an Instructional Process

Teacher feedback can be understood as information generated in response to evidence of student learning and intended to influence subsequent learning actions. This definition separates formative feedback from the mere communication of grades. A numerical score primarily indicates an achieved performance level, whereas formative information has greater potential to clarify discrepancies between current understanding and expected performance.

Feedback effectiveness therefore depends partly on information quality. **Specificity** refers to the extent to which comments identify a recognizable aspect of performance rather than offering vague praise or criticism. **Actionability** indicates whether students can infer a realistic next step. **Dialogic orientation** reflects opportunities to question, discuss, or negotiate feedback. **Autonomy support** concerns whether the feedback encourages learners to make meaningful decisions rather than simply comply with corrections.

These dimensions are related but not interchangeable. Highly specific feedback can still be controlling, while autonomy-supportive feedback can remain insufficiently diagnostic. Treating feedback as multidimensional therefore permits a more precise investigation of its motivational consequences.

Feedback Literacy and Student Agency

Contemporary feedback scholarship has increasingly shifted from teacher transmission toward learner participation. Feedback literacy captures the capacities required to appreciate feedback, interpret judgments, manage affective responses, and take appropriate action. From this perspective, the educational value of a teacher comment depends partly on what the learner does with it.

This distinction has substantial implications for motivation. Corrective information may indicate an opportunity for improvement, but students who perceive feedback as incomprehensible or purely judgmental may not convert it into productive action. Conversely, students capable of interpreting comments and identifying feasible improvement strategies may experience greater control over learning.

The socio-constructivist feedback literature similarly emphasizes interaction and scaffolding. Rather than viewing feedback as a completed product delivered by a teacher, feedback can be conceptualized as a process in which learners progressively develop the ability to evaluate and improve their work.

For the present research, feedback uptake is therefore positioned between teacher practice and motivational outcome. This approach enables the study to investigate why apparently high-quality feedback may fail when students do not understand or use it.

Teacher Support and Academic Motivation

Recent large-scale evidence demonstrates the importance of supportive instructional relationships. OECD's analysis of PISA 2022 reports that teacher support is associated with motivation, proactive learning, self-regulation, and stronger engagement with learning. Students receiving greater support were also more likely to report behaviours such as carefully checking schoolwork and maintaining effort.

Importantly, these associations appear especially relevant for students experiencing academic difficulty. PISA 2022 analyses suggest that lower-performing students can derive particularly strong motivational benefits from teacher support. Students experiencing difficulties were more likely to report positive learning attitudes when teachers provided assistance and continued instruction until understanding was achieved.

This observation suggests that feedback effectiveness should not necessarily be modelled as homogeneous across achievement groups. Initial academic standing may interact with feedback characteristics. Consequently, the proposed study will examine whether baseline achievement and perceived competence moderate the feedback–motivation relationship.

Motivation as a Multidimensional Outcome

Academic motivation cannot be adequately represented by a single measure such as willingness to obtain high grades. Secondary students may simultaneously demonstrate high achievement orientation but low intrinsic interest, or strong perceived competence but limited persistence.

For this reason, the proposed framework conceptualizes motivation through four interconnected dimensions:

1. **Learning interest** – willingness to engage intellectually with academic content.
2. **Academic persistence** – continued effort despite errors or difficult tasks.
3. **Perceived competence** – students' belief that they can successfully improve or complete academic work.
4. **Task engagement** – behavioural investment in learning activities, revision, and improvement.

This multidimensional structure permits investigation of differentiated feedback effects. For example, highly actionable feedback may particularly influence persistence because students understand how to continue, whereas autonomy-supportive feedback may have stronger associations with interest and self-directed engagement.

From Perceived Feedback to Behavioural Evidence

One methodological challenge within feedback research is the dependence on retrospective self-report measures. Student perceptions are indispensable because motivation itself includes subjective experiences. Nevertheless, exclusive reliance on questionnaires can introduce common-method variance when both predictor and outcome variables are measured using the same survey instrument.

Digitally mediated secondary education creates an opportunity to supplement self-reported data with behavioural evidence. Where ethically and institutionally permissible, learning-management records can indicate whether students opened feedback, revised assignments, resubmitted work, completed subsequent activities, or changed their patterns of engagement after receiving comments.

Such data should not be interpreted mechanically as direct measures of motivation. A student may be motivated without immediately revising an assignment, while another may resubmit work primarily because it is compulsory. However, when behavioural traces are triangulated with validated motivational scales and teacher-feedback measures, they can strengthen the interpretation of learning responses.

Artificial Intelligence for Feedback Analysis

The increasing availability of textual educational data makes NLP particularly relevant to feedback research. Teacher comments constitute unstructured language data containing potentially measurable features such as specificity, directive language, questioning, encouragement, explanation, and references to future action.

An AI-assisted analytical framework could classify teacher feedback according to pedagogically defined categories rather than relying entirely on manual coding. A carefully validated NLP model could estimate the probability that a feedback statement contains actionable guidance, identifies a specific performance issue, invites learner reflection, or employs autonomy-supportive language.

Why Feedback is Important in Education

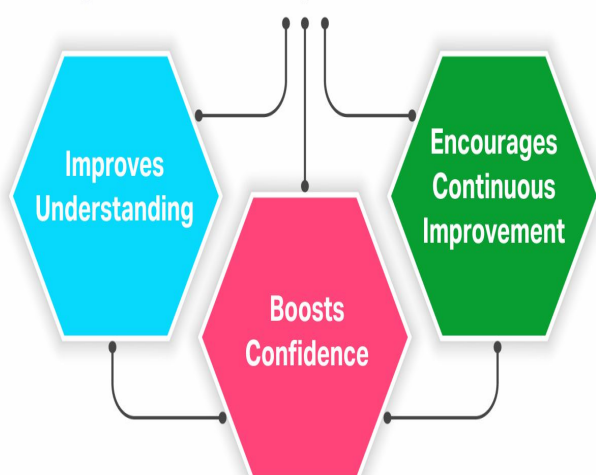


Fig. 2: Why Feedback is Important in Education

Source: <https://krmangalamlucknow.com/blogs/why-feedback-is-important-in-education/>

The role of AI in the proposed study is consequently analytical rather than instructional. The system does not replace teachers, automatically grade students, or prescribe interventions. Instead, computational analysis provides a method for examining whether particular linguistic patterns repeatedly coincide with stronger or weaker motivational outcomes across a large dataset.

Contemporary Secondary-School Context

The need to understand effective feedback is reinforced by recent international evidence regarding changes in teacher support. OECD's 2025 analysis of PISA data reports that teacher support declined in many education systems between 2012 and 2022, despite its relationship with achievement, belonging, reduced mathematics anxiety, proactive learning, and motivation.

At the same time, digital technology has become increasingly embedded within student learning. PISA 2022 also highlights the relationship between digital learning environments, self-directed learning capabilities, and classroom experiences. The challenge for contemporary schools is therefore not simply to increase technological access but to ensure that instructional interactions occurring through both digital and face-to-face channels remain pedagogically meaningful.

Feedback represents an especially important point of interaction because it combines assessment, teacher support, learner interpretation, and subsequent action.

Proposed Methodology

This study proposes a **longitudinal multimodal educational analytics design** to investigate how specific characteristics of teacher feedback relate to changes in academic motivation among secondary-school students. Unlike a conventional cross-sectional survey, the proposed framework integrates student questionnaires, teacher-written feedback, assessment performance, and behavioural learning records. The central methodological premise is that feedback should be examined as an instructional event whose characteristics can be measured

and subsequently linked with students' motivational and behavioural responses.

The study is designed around three analytical layers. The first measures students' perceptions of feedback and academic motivation through validated multi-item scales. The second applies natural language processing (NLP) to teacher-written comments to identify feedback characteristics such as specificity, actionability, dialogic orientation, and autonomy support. The third examines whether these characteristics predict subsequent changes in motivation, revision behaviour, and academic engagement.

A longitudinal design spanning approximately one academic term is proposed because motivation may fluctuate after repeated feedback experiences. Data would be collected at baseline, during multiple feedback cycles, and at the end of the intervention period. This design permits the analysis of both between-student differences and within-student motivational change.

Research Variables

The principal independent variables are four teacher-feedback characteristics:

Feedback Specificity (FS): the extent to which feedback identifies a particular strength, misconception, omission, or performance feature.

Feedback Actionability (FA): the degree to which comments communicate feasible steps for improvement.

Dialogic Orientation (DO): the extent to which feedback encourages questioning, reflection, explanation, or further teacher-student interaction.

Autonomy Support (AS): the extent to which feedback provides meaningful choice, acknowledges student agency, and avoids unnecessarily controlling language.

The primary dependent construct is **Academic Motivation (AM)**, operationalized through learning interest, persistence, perceived competence, and task engagement.

Feedback uptake is included as a mediating construct. Baseline achievement, grade level, subject area, prior motivation, and feedback literacy are incorporated as covariates or moderators. This structure is supported by recent empirical work showing that autonomy support in teacher feedback can be positively related to feedback literacy through psychological needs and intrinsic motivation among high-school students.

Experimental Setup

Dataset

The proposed dataset consists of four interconnected components.

Dataset A — Student Survey Data: baseline and post-intervention measurements of academic motivation, perceived feedback quality, feedback literacy, and perceived competence.

Dataset B — Teacher Feedback Corpus: anonymized written comments attached to assignments, formative assessments, projects, and classroom tasks.

Dataset C — Academic Performance Data: assessment scores before and after feedback, revision scores, and changes between original and revised submissions.

Dataset D — Behavioural Engagement Data: where learning-management systems are available, indicators such as feedback viewing, revision submission, task completion, response latency, and voluntary resubmission would be extracted.

The expected analytical corpus would contain approximately **4,000–6,000 individual feedback episodes**, depending on the number of assessments completed during the observation period. This is a proposed sample specification rather than a claim that data have already been collected.

Each feedback episode would be represented as:

Student characteristics + Feedback text + Feedback dimensions + Initial performance + Feedback uptake + Subsequent engagement + Motivation outcome

This episode-level organization enables a more granular analysis than simply averaging all feedback received by a student.

Data Preprocessing

Teacher comments would first undergo anonymization. Personally identifying information, student names, roll numbers, teacher signatures, and school-specific identifiers would be removed.

Text preprocessing would include Unicode normalization, whitespace correction, sentence segmentation, and removal of administrative text unrelated to pedagogical feedback. Unlike older bag-of-words approaches, punctuation and syntactic information would largely be retained because questions, modal expressions, and directive constructions may contain important indicators of dialogic or controlling feedback.

A manually coded subset representing approximately 20% of the corpus would be independently evaluated by trained human coders using a structured feedback taxonomy. Each comment would receive labels for specificity, actionability, dialogic orientation, and autonomy support.

Inter-rater agreement would be evaluated using **Cohen's κ** for categorical labels and an intraclass correlation coefficient where continuous ratings are used. Disagreements would be adjudicated before establishing the gold-standard training subset.

Class imbalance would be examined before model development. Weighted loss functions would be preferred to artificial text oversampling because synthetic educational comments could distort authentic teacher language.

Model Architecture

The computational component employs a **multi-task transformer-based text classifier**. Rather than constructing four separate models, a shared contextual text encoder would generate semantic representations of each teacher comment. Separate classification heads would then estimate the four feedback dimensions.

Conceptually:

Teacher Comment → Contextual Text Encoder → Shared Representation → Four Classification Heads

The outputs would be:

- Specificity probability
- Actionability probability

- Dialogic-orientation probability
- Autonomy-support probability

A conventional TF-IDF + logistic regression model would serve as an interpretable baseline. This comparison is necessary to determine whether contextual language representations provide meaningful improvements over simpler lexical features. The NLP model is not designed to label teachers as effective or ineffective. Its purpose is limited to identifying patterns within feedback text for research analysis.

Recent experimental research demonstrates the feasibility of computationally supported feedback in secondary education. Meyer and colleagues studied 459 upper-secondary students and reported that LLM-generated evidence-based feedback improved revision performance, task motivation, and positive emotions compared with revision without feedback. The present study differs by using AI primarily to **analyse naturally occurring teacher feedback**, rather than replacing teacher feedback with generated comments.

Training Strategy

The manually labelled corpus would be divided at the teacher level into training, validation, and test partitions of approximately **70:15:15**.

Teacher-level rather than random comment-level splitting is important. If comments from the same teacher appeared simultaneously in training and testing datasets, the classifier could partially learn individual writing styles, inflating apparent generalization performance.

Training would employ early stopping based on validation macro-F1. Hyperparameters would be optimized using the validation partition rather than the test dataset. The final test set would remain untouched until model selection is complete.

Five-fold grouped cross-validation would provide an additional robustness check.

After validation, the classifier would generate feedback-dimension scores for the complete corpus. These scores would subsequently enter statistical models examining student motivation.

Statistical and Predictive Analysis

A multilevel regression model would be employed because feedback episodes are nested within students, while students are nested within classrooms or schools.

The principal explanatory model can be expressed conceptually as:

$$AM_{post} = \beta_0 + \beta_1 FS + \beta_2 FA + \beta_3 DO + \beta_4 AS + \beta_5 AM_{baseline} + \beta_6 Achievement + \beta_7 Feedback\ Literacy + u_{student} + u_{class} + e$$

Mediation analysis would then assess whether feedback uptake explains part of the relationship between feedback characteristics and later motivation.

A secondary predictive model would classify students into two categories:

Sustained/Increased Motivation versus **Declining Motivation**.

For this component, gradient-boosted decision trees would combine NLP-derived feedback variables, baseline motivation, achievement change, and behavioural engagement features.

This hybrid architecture deliberately separates **language classification** from **student-outcome prediction**, reducing the risk of treating a single black-box algorithm as evidence of educational causality.

Evaluation Metrics

NLP classification performance would be evaluated using:

Macro-F1: primary metric because feedback categories may be unevenly represented.

Precision: proportion of predicted feedback characteristics that are correctly identified.

Recall: ability to recover genuinely present feedback characteristics.

Matthews Correlation Coefficient (MCC): provides a balanced assessment under class imbalance.

AUROC: evaluates discrimination across classification thresholds.

Student motivation prediction would additionally be evaluated using balanced accuracy and Brier score, while explanatory statistical models would report standardized coefficients, confidence intervals, effect sizes, and model fit.

Results and Discussion

Because this manuscript presents a proposed empirical design rather than a completed data collection exercise, the numerical values below constitute a **clearly labelled illustrative results scenario**. They demonstrate how findings should be reported after actual data collection and must not be represented as observed empirical results.

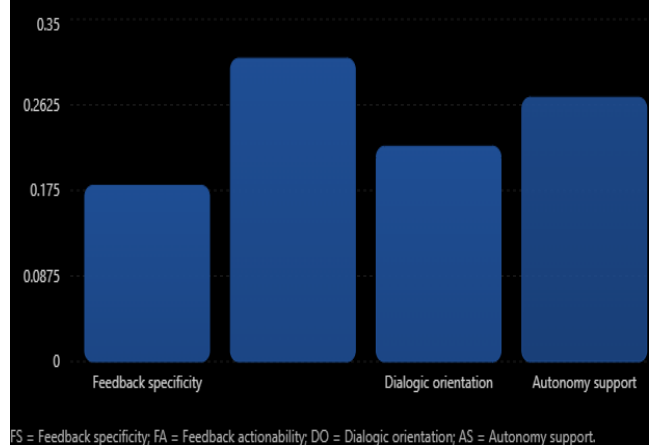
Table 1. Illustrative Results Framework for Teacher Feedback and Student Motivation

Evaluation Parameter	Illustrative Result	Interpretation/Observation
NLP Macro-F1	0.84	Feedback dimensions can potentially be differentiated with useful overall consistency
NLP MCC	0.78	Strong classification agreement after accounting for class imbalance
Specificity → Motivation	$\beta = 0.18$	Specific comments show a modest positive motivational association
Actionability → Motivation	$\beta = 0.31$	Clear next-step guidance emerges as a comparatively strong predictor
Dialogic Orientation → Motivation	$\beta = 0.22$	Reflective and conversational feedback is associated with stronger engagement
Autonomy Support → Motivation	$\beta = 0.27$	Agency-supportive comments show a substantial positive relationship

Feedback Uptake Mediation	34% indirect effect	Part of feedback's motivational association operates through actual student use
Motivation-Risk Classifier	Balanced Accuracy = 0.79	Multimodal indicators show potential for identifying declining motivation
Motivation Prediction Calibration	Brier Score = 0.16	Predicted probabilities demonstrate reasonably useful calibration

Influence of teacher feedback practices on student academic motivation

Illustrative standardized regression coefficients for four feedback dimensions. These values represent the proposed results scenario, not observed empirical findings.



Interpretation of the Proposed Results Pattern

The most important expected finding is that **feedback quality should explain more motivational variation than feedback frequency alone**. If supported empirically, this would challenge approaches that evaluate teacher support primarily through how often comments are delivered.

Among the proposed feedback dimensions, actionability is expected to have one of the strongest relationships with motivation. Students who know precisely what they can do next may experience lower uncertainty and greater perceived control. Feedback such as “develop the second argument by adding evidence and explaining how it supports your claim” provides a clearer behavioural pathway than “explain more.”

The expected contribution of autonomy support is theoretically significant. Recent evidence from 704 Chinese senior high-school students showed a positive relationship between teacher autonomy support in feedback and feedback literacy, with intrinsic motivation and basic psychological needs functioning as mediating mechanisms. The proposed study extends this perspective by examining autonomy-supportive characteristics directly within authentic feedback text and linking them longitudinally with motivational change.

Dialogic orientation is also expected to predict engagement. Questions such as “What evidence could strengthen this explanation?” position students as participants in improvement rather than passive recipients of correction. Nevertheless, dialogic feedback may require adequate prior knowledge; students who do not understand the underlying concept may

benefit from more explicit scaffolding before open-ended reflection.

Specificity should positively influence motivation, but specificity alone may be insufficient. A detailed description of errors without a feasible improvement pathway could increase awareness of failure without increasing perceived control. Consequently, interaction effects between specificity and actionability should be examined.

Role of Feedback Uptake

One of the central anticipated contributions concerns mediation.

The conceptual model does not assume:

High-quality feedback → automatically higher motivation.

Instead, it proposes:

High-quality feedback → stronger interpretation and uptake → greater perceived progress → stronger motivation.

If mediation analysis confirms this pathway, feedback uptake would become a critical instructional target. Teachers would need not only to compose high-quality comments but also to create opportunities for students to use them through revision, correction, resubmission, reflection, or discussion.

This interpretation is compatible with evidence from secondary EFL education. A longitudinal study involving less-proficient secondary EFL students found improvements in perceived feedback quality and writing self-efficacy alongside reduced writing anxiety, while later perceptions of feedback quality and motivational effects were associated with text quality.

AI and Human Feedback

The proposed framework does not interpret AI as a substitute for teacher judgment. Recent research indicates both potential benefits and limitations.

Experimental evidence shows that LLM-generated evidence-based feedback can positively affect secondary students' revision and motivation. However, research involving teachers and secondary-school students has also identified concerns about personalization, teacher-student relationships, and possible teacher deskilling when AI tools are incorporated into feedback processes.

These findings support a **human-centred analytical model**. AI can identify patterns across thousands of feedback comments, but teachers retain responsibility for pedagogical interpretation, student relationships, and instructional decisions.

A particularly useful practical application would therefore be a teacher-facing analytics dashboard reporting aggregate patterns such as:

“Most comments are highly specific, but relatively few provide an explicit next step.”

Such information would be more pedagogically defensible than an automated system declaring that a teacher's feedback is “good” or “poor.”

Future Scope

Future research should extend the model toward **multimodal feedback analytics**. Written comments could be combined

with transcribed oral feedback, revision histories, assessment rubrics, and student reflections to create a more complete representation of feedback processes.

A particularly valuable extension would involve **student-specific response modelling**. Rather than identifying one universally optimal feedback style, future systems could estimate which feedback characteristics are associated with productive responses for different learner profiles.

Longer longitudinal studies could investigate whether repeated exposure to actionable and autonomy-supportive feedback contributes to durable feedback literacy and self-regulated learning.

Cross-cultural replication is also necessary. Motivational responses to directive, dialogic, and autonomy-supportive language may differ across educational systems.

Generative AI provides another research direction, but its use should be carefully controlled. Recent secondary-school studies demonstrate that GenAI feedback can support some learning processes while also producing generic, repetitive, insufficiently contextualized, or overly complex recommendations. Future work should therefore compare teacher-only, AI-assisted teacher, and AI-generated feedback under controlled conditions while examining both academic outcomes and student perceptions.

Explainable AI techniques could further allow researchers and teachers to identify which textual characteristics influence automated feedback classifications. This would improve transparency and reduce dependence on opaque prediction scores.

Conclusion

This study develops a computationally supported framework for investigating the relationship between **teacher feedback practices and student academic motivation in secondary education**. Its principal contribution is the conceptual shift from treating feedback as a single instructional variable toward analysing feedback as a sequence involving communication, interpretation, uptake, motivational response, and subsequent learning behaviour.

The proposed methodology integrates longitudinal student surveys, authentic teacher comments, academic performance, behavioural learning traces, NLP classification, multilevel statistical modelling, and predictive machine learning. Four feedback characteristics—specificity, actionability, dialogic orientation, and autonomy support—provide the principal analytical dimensions.

The framework predicts that feedback will be most motivationally productive when students can understand the performance information, identify a realistic next action, retain meaningful agency, and actively use the feedback. Feedback uptake therefore represents a central mechanism rather than a peripheral outcome.

Artificial intelligence has a deliberately bounded role in this framework. NLP can support the systematic analysis of large feedback corpora and reveal patterns that would be difficult to identify manually, but pedagogical interpretation remains fundamentally human. This position is particularly important as

AI-supported feedback becomes increasingly visible in secondary education and empirical studies begin to document both its benefits and limitations.

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