



Formative Assessment and Feedback Literacy in Higher Education: Investigating Their Effects on Metacognitive Awareness, Learning Motivation, and Academic Performance

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Abstract

Formative assessment is most effective when students can interpret, evaluate, and act on feedback rather than receive comments passively. This structured integrative review examined thirty peer-reviewed studies published from 2021 to 2024 on feedback literacy, formative assessment, metacognition, motivation, and academic performance in higher education. Sources were coded for conceptual focus, assessment design, learner processes, and reported educational outcomes. The evidence showed rapid expansion of feedback-literacy measurement, growing emphasis on self-assessment and dialogic feedback, and repeated links between feedback use and self-regulatory processes. Metacognitive activity appeared most consistently when students compared standards, judged their own work, planned revisions, and traced how feedback changed later performance. Motivation was strengthened when feedback was timely, actionable, and autonomy-supportive, while grades or one-directional comments alone produced weaker learning processes. Academic gains were most plausible when feedback cycles required uptake through revision, peer dialogue, or subsequent task application. The synthesis positions feedback literacy as the mechanism connecting formative assessment design with metacognitive regulation, motivation, and performance.

Keywords: Academic performance, Feedback literacy, Formative assessment, Metacognition, Motivation.



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INTRODUCTION

Feedback occupies a central position in higher education assessment, yet the provision of comments does not necessarily ensure that students understand, interpret, or incorporate them into subsequent learning activities. Contemporary scholarship has increasingly challenged the conventional transmission-oriented conception of feedback, which positions instructors as information providers and students as relatively passive recipients of evaluative judgments. Instead, feedback is understood as an interactive educational process requiring learners to interpret information, evaluate its relevance, manage emotional responses, and translate evaluative input into observable improvements in academic work. The concept of feedback literacy provides a theoretical foundation for explaining these processes by emphasizing the capabilities students need to recognize feedback opportunities and use information productively within different learning environments (Nieminen & Carless, 2022). Differences in students' capacity to engage with feedback may consequently explain why similar assessment practices produce varying levels of participation, self-regulation, and academic development. This perspective indicates that the educational effectiveness of feedback should be examined not exclusively through the quality of instructor comments but also through the cognitive, motivational, and behavioral processes that determine whether feedback becomes meaningful learning information (Gravett & Carless, 2024).

Formative assessment is closely associated with feedback literacy because its educational contribution depends on how assessment information informs decisions and shapes subsequent learning activities. Assessment becomes formative when learners use evidence about their current performance to identify discrepancies between existing competencies and expected standards, determine appropriate responses, and evaluate the consequences of their actions. However, these processes cannot be assumed to occur automatically because students may lack sufficient familiarity with assessment criteria,

disciplinary expectations, or strategies for translating feedback into practical improvements. Discipline-specific feedback literacy therefore emphasizes the importance of contextualizing evaluative practices within the epistemological conventions, communication patterns, and quality standards characterizing particular academic disciplines (Winstone et al., 2022). The integration of explicit assessment criteria, representative examples, structured comparison activities, and opportunities for revision may create conditions that support students' capacity to recognize and act upon performance-related information. Such considerations suggest that formative assessment should be conceptualized as a deliberately organized sequence of learning interactions rather than an isolated instructional procedure occurring after the completion of academic tasks (Yan & Carless, 2022).

Recent developments in educational measurement have contributed to a more differentiated understanding of feedback literacy by examining the beliefs, competencies, attitudes, and behavioral practices associated with students' engagement with evaluative information. Earlier approaches frequently emphasized students' perceptions of feedback usefulness or their willingness to receive comments, whereas contemporary instruments increasingly distinguish these perceptions from the actions learners undertake after encountering feedback. Zhan (2022) developed and validated a student feedback literacy scale that contributes to the systematic examination of students' engagement with feedback processes, while Song (2022) investigated the multidimensional psychological structure underlying learner feedback literacy. Behavioral measurement has subsequently extended this perspective by examining how students seek, interpret, and act on feedback rather than relying exclusively on self-reported attitudes toward assessment (Dawson et al., 2024). These developments are methodologically important because favorable perceptions of feedback may coexist with limited revision, inadequate evaluative judgment, or difficulties transferring recommendations into subsequent academic assignments. Consequently, the assessment of feedback literacy requires attention to both students' reported understanding and the observable learning behaviors through which evaluative information is transformed into academic action.

Metacognitive awareness represents an important explanatory dimension in the relationship between formative assessment and learning outcomes because feedback utilization requires students to monitor their understanding, evaluate performance, and regulate subsequent learning strategies. These processes involve more than recognizing mistakes, since students must determine the significance of identified discrepancies, select appropriate corrective actions, and evaluate whether their revised approaches improve task performance. Research concerning computer-supported collaborative learning demonstrates that differences in regulation profiles are associated with variations in students' performance, motivation, and learning-related self-efficacy (De Backer et al., 2022). Related research indicates that group metacognition and motivational regulation contribute to learner autonomy, particularly in collaborative environments that require students to coordinate learning responsibilities and sustain engagement (Uslu & Durak, 2022). Within formative assessment, these findings suggest that feedback literacy may facilitate the transition from external performance information to internally regulated learning decisions. Nevertheless, the relationship between feedback practices and metacognitive development requires careful examination because improved awareness does not necessarily produce behavioral change unless learners receive meaningful opportunities to apply their evaluations within subsequent tasks.

Learning motivation constitutes another important dimension because students' willingness to process feedback depends partly on their perceptions of competence, autonomy, task relevance, and opportunities for academic improvement. Feedback may support motivation when evaluative information communicates attainable learning goals, provides understandable recommendations, and enables students to recognize progress through subsequent action. Conversely, feedback dominated by grades, ambiguous comments, or delayed explanations may constrain students' capacity to identify useful learning strategies and reduce their willingness to engage with corrective information. Research on instructional environments incorporating chatbot-supported learning and peer feedback demonstrates the relevance of interactive feedback arrangements for academic performance and intrinsic motivation (Fidan & Gencel, 2022). Broader research on learner engagement also emphasizes that meaningful participation depends on instructional practices that support active involvement rather than merely providing educational resources or opportunities for interaction (Martin & Borup, 2022). These perspectives indicate that motivational processes should be examined alongside metacognitive

regulation because feedback engagement requires both the capacity to interpret assessment information and the willingness to invest effort in responding to it.

Despite the expansion of scholarship on formative assessment and feedback literacy, the relationships among metacognitive awareness, learning motivation, and academic performance remain insufficiently integrated within a coherent explanatory framework. Existing studies frequently examine individual aspects of feedback literacy, validate measurement instruments, investigate particular educational technologies, or evaluate learning outcomes without systematically connecting these dimensions through the processes of feedback interpretation and uptake. Furthermore, variation in disciplinary settings, instructional arrangements, assessment practices, and outcome indicators complicates the development of general explanations concerning how feedback contributes to learning improvement. Relational and ecological perspectives suggest that feedback effectiveness emerges through interactions among individual capabilities, institutional arrangements, assessment expectations, and opportunities for subsequent learning (Chong, 2022; Gravett & Carless, 2024). Responding to this conceptual fragmentation, the present study conducts a structured integrative review of thirty peer-reviewed studies published between 2021 and 2024 to synthesize evidence concerning feedback literacy, formative assessment, metacognitive regulation, motivation, and academic performance. Specifically, the review aims to identify the mechanisms connecting formative assessment with learner outcomes, examine recurring characteristics of effective feedback practices, and distinguish relatively consistent evidence from relationships that remain conditional or insufficiently established.

RESEARCH METHODS

A structured integrative review was conducted using a fixed corpus of thirty peer-reviewed studies published between 2021 and 2024. The corpus was assembled around five concept families: feedback literacy, formative or peer assessment, metacognition and self-regulation, motivation and engagement, and academic performance. Priority was given to studies with DOI identifiers and publication in established international journals, including *Assessment & Evaluation in Higher Education*, *Higher Education*, *Computers & Education*, *Journal of Computer Assisted Learning*, *Teaching in Higher Education*, *Nurse Education Today*, and related outlets. Each source was coded for research design, educational setting, focal construct, feedback process, learner activity, and reported outcome. Review papers and measurement studies were retained because the objective was mechanism synthesis rather than pooled intervention effect estimation (Mohd Noor et al., 2024). The analysis used framework synthesis. First, conceptual and measurement papers were coded to identify how feedback literacy was defined and operationalized. Second, empirical studies were coded for learner actions such as self-assessment, peer dialogue, revision, reflection, feedback seeking, and monitoring. Third, outcome claims were grouped under metacognition, motivation or engagement, and academic performance. A source could receive more than one thematic code, so theme frequencies are not mutually exclusive. Claims were treated as stronger when supported across multiple research designs and weaker when based mainly on conceptual argument or a single disciplinary setting. The review does not estimate a pooled effect size and should not be interpreted as a meta-analysis (Nieminen & Carless, 2022).

RESULTS AND DISCUSSION

Feedback Literacy as the Mechanism of Formative Assessment Uptake

The reviewed literature demonstrates that feedback literacy has developed beyond a narrow conception of students' willingness to receive, read, or acknowledge evaluative comments. Contemporary scholarship increasingly characterizes feedback literacy as a multidimensional capacity involving conceptual understanding, evaluative judgment, emotional regulation, interpersonal interaction, and purposeful engagement with learning information. Nieminen and Carless (2022) identify important conceptual developments within feedback literacy research while questioning approaches that locate responsibility for unsuccessful feedback exclusively within individual learners. This criticism is significant because students' opportunities to develop feedback literacy depend partly on institutional arrangements, curriculum organization, assessment expectations, and the accessibility of subsequent learning activities. Feedback literacy therefore should not be interpreted as a fixed personal attribute that independently determines educational outcomes, but as a capability that develops through participation in structured assessment experiences. From this perspective, the effectiveness of

formative assessment depends on the interaction between students' capacity to interpret evaluative information and the educational conditions enabling them to transform that information into meaningful academic decisions.

Discipline-specific interpretations of feedback literacy further demonstrate that students' engagement with assessment information depends on their understanding of how academic quality is defined and evaluated within particular fields. Feedback that appears understandable to instructors may remain difficult for students to interpret when disciplinary standards are implicit, technical terminology is unfamiliar, or expectations concerning acceptable performance are insufficiently explained. Winstone et al. (2022) emphasize the relevance of discipline-specific feedback literacies for curriculum design, indicating that evaluative practices must reflect the distinctive forms of knowledge and judgment associated with different academic contexts. Explicit criteria and representative examples can support students in recognizing the characteristics of successful work, while comparison activities may reveal discrepancies between current performance and established standards. These practices may also reduce dependence on instructor interpretation by providing students with opportunities to develop their own evaluative judgments concerning academic quality. Accordingly, feedback literacy development requires the integration of disciplinary expectations into assessment activities rather than the provision of generalized advice concerning how students should respond to comments.

Measurement-oriented investigations provide additional evidence that feedback literacy consists of distinguishable psychological and behavioral dimensions that cannot be adequately represented through a single indicator of feedback receptiveness. Zhan (2022) contributes to this development through the validation of a student feedback literacy scale, while Song (2022) employs bifactor modeling to investigate the structure of learner feedback literacy constructs. Together, these studies strengthen the conceptual argument that students' understanding of feedback, confidence in using evaluative information, and actual feedback-related practices may operate as related but distinguishable dimensions. A student may recognize the educational value of feedback while experiencing uncertainty about its interpretation, limited confidence in requesting clarification, or difficulty identifying appropriate revision strategies. Such discrepancies illustrate why positive attitudes toward assessment should not automatically be treated as evidence of effective feedback utilization or improved learning performance. The methodological implication is that investigations of formative assessment should employ sufficiently differentiated indicators to distinguish students' perceptions of feedback from the cognitive judgments and practical actions involved in responding to it.

Behavior-focused approaches extend the measurement of feedback literacy by examining what learners actually do when they encounter assessment information in educational settings. Dawson et al. (2024) developed the feedback literacy behaviour scale to examine practices associated with seeking, making sense of, and acting upon feedback, thereby directing greater attention toward observable aspects of learner engagement. This orientation addresses an important limitation of research designs that depend primarily on satisfaction surveys or general judgments concerning the perceived usefulness of instructor comments. Students may report favorable experiences with feedback without undertaking substantive revisions, seeking further clarification, or transferring evaluative information to subsequent learning tasks. Behavioral indicators therefore provide a more direct basis for investigating whether formative assessment generates the activities through which learning improvement may occur. Nevertheless, measuring feedback-related behavior remains distinct from establishing its consequences for academic performance, making it necessary to connect documented feedback actions with subsequent changes in students' work and learning outcomes.

The effectiveness of feedback literacy also depends on the consistency of assessment opportunities across the different learning environments students encounter during their academic programs. Malecka et al. (2022) examine how students navigate feedback practices across learning contexts, highlighting the challenges associated with differences in assessment expectations, instructional arrangements, and opportunities for feedback engagement. A student may develop productive feedback strategies within one course while encountering considerably different expectations in another, limiting the transferability of previously acquired practices. These inconsistencies may be particularly consequential when students receive feedback after completing the final assignment in a course or when subsequent tasks provide limited opportunities to demonstrate improvement. Institutional approaches that treat feedback as a recurring component of curriculum development may therefore offer stronger conditions for sustained feedback literacy than arrangements

relying on isolated assessment events. The literature consequently suggests that feedback utilization should be understood as a cumulative educational process requiring continuity among assessment information, learner responses, and subsequent opportunities for academic application.

The feedback ecology perspective broadens this interpretation by positioning feedback literacy within interconnected relationships among students, instructors, educational technologies, disciplinary expectations, and institutional practices. Chong (2022) argues for moving beyond feedback as information transmission toward an ecological understanding of how feedback opportunities are created, interpreted, and used within specific educational environments. This approach recognizes that access to information alone does not determine learning outcomes because students must also navigate the social and instructional conditions influencing whether feedback can be discussed and implemented. Digital platforms may facilitate the organization, retrieval, and comparison of feedback, but their educational value depends on how these functionalities support meaningful learner activity. Similarly, instructors' willingness to clarify expectations and provide opportunities for dialogue may influence whether students regard feedback as actionable information or as a final judgment on completed performance. An ecological interpretation therefore shifts attention from the quantity of comments provided to the broader configuration of educational conditions that supports or constrains productive feedback engagement.

Self-assessment occupies a prominent position within this configuration because it requires students to participate actively in the generation and interpretation of evaluative information. Yan and Carless (2022) describe the enabling relationship between feedback literacy and self-assessment, demonstrating the conceptual importance of students' ability to judge their own work against relevant standards. Through self-assessment, learners must identify characteristics of successful performance, evaluate the adequacy of their current responses, and determine which aspects require further development. These activities may strengthen evaluative judgment by encouraging students to articulate reasons for their assessments rather than depend exclusively on instructor-provided interpretations. Feedback literacy and self-assessment can consequently be understood as mutually reinforcing processes, with developing evaluative capabilities supporting more effective feedback use and repeated feedback engagement refining subsequent self-evaluation. The educational implication is that structured self-assessment should be incorporated into formative assessment arrangements as a developmental activity rather than treated solely as an additional instrument for assigning or predicting grades.

Academic writing provides a particularly relevant context for examining feedback uptake because students' revisions can reveal how evaluative information influences subsequent decisions about content, argumentation, organization, and expression. Yu and Liu (2021) propose an evidence-based framework for developing student feedback literacy in academic writing, emphasizing the interpretive and action-oriented processes involved in responding to feedback. Writing tasks commonly require students to evaluate multiple comments, distinguish substantive concerns from stylistic suggestions, and determine which changes are consistent with the intended meaning of their work. These decisions involve evaluative judgment because not every comment can be implemented mechanically without considering disciplinary conventions and the coherence of the overall argument. Opportunities for staged drafting, revision, and reflection may make feedback processes more visible by connecting instructor or peer observations with identifiable changes in academic products. Consequently, academic writing illustrates how formative assessment becomes educationally meaningful when feedback is incorporated into a continuing cycle of interpretation, selective revision, and evaluation rather than concluding with the delivery of comments.

The synthesis of this thematic group indicates that feedback literacy provides an important explanatory connection between formative assessment practices and students' capacity to undertake productive learning actions. Across conceptual, measurement, and educational research, the recurring emphasis concerns students' ability to understand evaluative standards, interpret relevant information, regulate their responses, and implement appropriate changes in subsequent work. Measurement developments further demonstrate that perceptions of feedback and observable engagement are related but conceptually distinguishable dimensions, making it necessary to examine both when evaluating assessment practices (Dawson et al., 2024). Ecological and discipline-specific interpretations additionally indicate that feedback literacy develops within educational arrangements that determine whether meaningful engagement is possible (Chong, 2022; Winstone et al., 2022). These findings support the design of formative assessment as a sequence of coordinated learner activities rather than a

process defined exclusively by instructor commentary or the availability of assessment information. Nevertheless, the evidence should be interpreted as supporting an explanatory framework rather than demonstrating that feedback literacy independently causes improved performance across all higher education settings (Woitt et al., 2024).

Table 1. Evidence Map of the Reviewed Corpus

Theme	Sources coded (n)	Interpretive emphasis
Feedback literacy conceptualization/measurement	15	Conceptual/measurement foundation
Formative/peer/e-assessment feedback design	8	Learning-process and outcome evidence
Metacognition/self-regulation	9	Learning-process and outcome evidence
Motivation/engagement	8	Learning-process and outcome evidence
Academic performance/achievement	10	Learning-process and outcome evidence

The evidence presented in Table 1 demonstrates the thematic composition of the thirty studies included in the integrative review, with feedback literacy conceptualization and measurement receiving the greatest attention across the corpus. The fifteen studies addressing this theme indicate a substantial emphasis on defining feedback literacy, developing measurement instruments, and distinguishing students' perceptions of feedback from their actual engagement with evaluative information. Academic performance represents another important dimension, appearing in ten studies, while metacognition and self-regulation are addressed in nine studies, reflecting scholarly interest in the learning processes through which assessment information may influence educational outcomes. Formative assessment design and motivation or engagement are each represented in eight studies, suggesting that instructional arrangements and motivational conditions constitute complementary dimensions of feedback-related learning. Because individual studies could contribute to multiple thematic categories, these frequencies should be interpreted as overlapping analytical classifications rather than mutually exclusive distributions. The thematic distribution consequently indicates that the literature provides a substantial conceptual and measurement foundation for feedback literacy, while the relationships connecting feedback practices, metacognitive regulation, motivation, and academic achievement require further integrated investigation.

Metacognitive Awareness and Motivational Regulation in Feedback Processes

Metacognitive awareness becomes particularly relevant to formative assessment when students are required to interpret performance information, compare their work with evaluative standards, and identify strategies for subsequent improvement. These activities involve monitoring and regulating learning rather than simply acknowledging assessment outcomes or recognizing that an error has occurred. Feedback literacy supports this process by providing the interpretive competencies necessary to distinguish useful evaluative information from comments that may be irrelevant or difficult to implement. Yan and Carless (2022) emphasize the relationship between feedback literacy and self-assessment, suggesting that students' capacity to evaluate their own work contributes to more purposeful engagement with subsequent feedback. The conceptual relationship indicates that metacognitive development may be strengthened when students participate in assessment practices that require explicit judgments, explanations, and revision decisions. However, the presence of reflective activities should not be assumed to produce metacognitive improvement unless students have opportunities to use their evaluations in subsequent learning situations and assess the consequences of their chosen strategies.

Evidence from computer-supported collaborative learning provides additional insights into how regulatory processes relate to learning performance, motivation, and perceptions of academic competence. De Backer et al. (2022) investigate regulation profiles in collaborative learning environments, demonstrating the importance of variation in learners' approaches to monitoring and managing educational activities. Within these settings, regulation involves coordinating individual understanding with shared objectives, interpreting information concerning group progress, and

adjusting strategies when existing approaches are inadequate. Such processes are relevant to formative assessment because feedback frequently requires students to reconcile external judgments with their own perceptions of performance and determine appropriate corrective actions. Students who engage more effectively in monitoring and strategic adjustment may be better positioned to transform assessment information into changes in learning behavior, although the reviewed findings do not establish that all regulatory differences originate from feedback practices. The contribution of this evidence is therefore explanatory, identifying learning processes through which formative information could influence achievement rather than providing direct proof of a universal causal relationship.

Research concerning learner autonomy further supports the importance of integrating metacognitive awareness with motivational regulation in educational activities involving collaborative responsibility. Uslu and Durak (2022) identify group metacognition and motivational regulation strategies as relevant predictors of learner autonomy within collaborative learning environments. This relationship suggests that students require both an understanding of how learning is progressing and the motivational resources necessary to sustain engagement when tasks become challenging. In formative assessment, metacognitive awareness may help students recognize gaps between current and desired performance, whereas motivational regulation may influence whether they persist in addressing those gaps. A reflective assignment that identifies weaknesses without providing opportunities for improvement may consequently generate awareness while leaving subsequent regulation insufficiently developed. Effective formative assessment design should therefore connect diagnostic information with achievable learning actions, enabling students to exercise strategic control while maintaining engagement with academic objectives.

The motivational consequences of feedback depend substantially on its perceived usefulness, timing, clarity, and relationship to students' capacity to influence their learning outcomes. Feedback that provides understandable explanations and identifies achievable next steps may support students' sense of competence by reducing uncertainty concerning performance expectations. Conversely, ambiguous or exclusively evaluative comments may direct attention toward judgments about ability without adequately explaining how improvement can be achieved. Fidan and Gencel (2022) examine the use of chatbot and peer feedback mechanisms within online instructional environments, providing evidence relevant to the relationship between interactive feedback arrangements, performance, and intrinsic motivation. The importance of these findings lies in the integration of feedback with continuing learning opportunities rather than in the assumption that technological mediation independently improves student motivation. Motivationally supportive feedback may therefore be characterized by its capacity to preserve learner agency, clarify improvement possibilities, and connect evaluative information with activities that students can realistically undertake.

The growing use of digital assessment systems introduces additional opportunities and challenges for developing feedback literacy and metacognitive regulation in higher education. Wongvorachan et al. (2022) propose a framework for improving students' feedback literacy in electronic assessment environments, emphasizing the need to consider how learners interact with digital evaluative information. Automated feedback and electronic assessment interfaces can provide information rapidly, potentially allowing students to identify errors and reconsider their responses without extensive delays. Nevertheless, the instructional value of these systems depends on whether the information provided is interpretable, appropriately contextualized, and connected to opportunities for further learning. Students may encounter detailed performance indicators without understanding their significance for disciplinary standards or knowing which strategies should be modified in response. Digital feedback should consequently be accompanied by instructional support that enables students to prioritize information, evaluate their performance, and determine how technological feedback can inform subsequent academic decisions.

Feedback analytics represents a related development because it offers possibilities for organizing assessment information across tasks and making patterns of learning engagement more visible. Jin et al. (2024) investigate the design of a feedback analytics tool with students, drawing attention to the importance of incorporating learner perspectives into technologies intended to support feedback literacy. Such systems can potentially assist students in identifying recurring recommendations, recording responses to feedback, and tracing whether previously identified concerns have been addressed in subsequent academic work. These functions are relevant to metacognitive monitoring because they may provide external records that support reflection on learning decisions and changes in

performance over time. However, the availability of analytics does not establish that students will interpret the information appropriately or undertake the actions necessary to improve their learning. Feedback analytics should therefore be evaluated through the quality of learner engagement and documented feedback uptake rather than solely through platform functionality or the quantity of assessment information displayed.

Affective processes also influence students' engagement with formative feedback because assessment comments may challenge existing perceptions of competence, academic identity, or the value of previously invested effort. Students who experience disappointment, uncertainty, or defensiveness may find it difficult to examine critical feedback constructively, even when the information contains relevant guidance for improvement. Gravett and Carless (2024) conceptualize feedback literacy through relational, spatial, and temporal dimensions, emphasizing that feedback encounters occur within social circumstances that influence how information is experienced and interpreted. This interpretation suggests that emotional responses should not be understood exclusively as individual psychological characteristics detached from interactions with instructors, peers, and educational institutions. Respectful communication, opportunities for clarification, and assessment arrangements that permit meaningful revision may help students approach critical information as part of academic development rather than as an irreversible judgment of their ability. The motivational implications of feedback therefore depend partly on whether educational relationships support trust, agency, and the expectation that improvement remains possible through subsequent learning activity.

The relationship between feedback literacy and educational regulation also requires attention to the consistency and transparency of instructors' assessment practices. Middleton et al. (2024) examine calibration processes and their influence on feedback literacy in higher education marking, highlighting the importance of shared understandings of standards and the practices through which assessment judgments are developed. When evaluation criteria are unclear or applied inconsistently, students may struggle to identify which aspects of performance require improvement or how different feedback comments should be reconciled. These difficulties can redirect metacognitive effort toward interpreting inconsistent judgments rather than evaluating substantive learning needs and developing appropriate strategies. Assessment calibration and transparent communication may provide more stable conditions for students to develop reliable expectations concerning academic quality and use feedback effectively. Consequently, the development of feedback literacy should involve attention to instructor practices and assessment structures alongside efforts to strengthen students' individual capacities for self-regulation.

Taken together, the reviewed evidence suggests that metacognitive awareness and motivational regulation operate as interconnected processes through which formative assessment information may influence learning engagement. Metacognitive monitoring enables students to recognize performance discrepancies and evaluate available strategies, while motivational regulation influences whether they sustain the effort required to implement appropriate improvements. Research on collaborative learning and learner autonomy supports the relevance of these regulatory processes, although their direct relationships with specific formative assessment interventions remain dependent on the contexts examined (De Backer et al., 2022; Uslu & Durak, 2022). Digital feedback systems and relational approaches additionally demonstrate that opportunities for regulation are shaped by instructional organization, technological affordances, and the quality of assessment interactions. The synthesis therefore favors assessment arrangements that integrate clarification of standards, active comparison, reflection, revision, and subsequent evaluation within repeated learning cycles. This interpretation is consistent with broader scholarship on learner engagement, which emphasizes the importance of supportive practices that enable students to participate meaningfully in learning rather than remain passive recipients of educational information (Martin & Borup, 2022).

Table 2. Formative Feedback Designs and Expected Learner Processes

Design feature	Metacognitive process	Motivational condition	Likely learning action
Exemplars and criteria	Comparison and judgment	Clarity and competence	Self-evaluation
Peer feedback	Perspective taking	Relatedness and agency	Dialogue and revision

Immediate digital feedback	Monitoring	Timeliness and control	Rapid correction
Revision requirement	Planning and evaluation	Goal commitment	Feedback uptake
Reflective log	Metacognitive awareness	Ownership	Strategy adjustment

The relationships presented in Table 2 illustrate how different formative feedback designs may support metacognitive processes, motivational conditions, and subsequent learning actions within higher education environments. Exemplars and explicit assessment criteria provide reference points for evaluating academic quality, enabling students to compare their performance against established expectations and develop more informed self-evaluation practices (Yan & Carless, 2022). Peer feedback introduces opportunities for perspective taking and collaborative dialogue, while immediate digital feedback may facilitate timely monitoring and corrective action when students can interpret the information provided (Fidan & Gencel, 2022). Revision requirements and reflective logs extend these processes by encouraging students to translate evaluative judgments into strategic adjustments and examine the consequences of their learning decisions. However, these relationships represent theoretically informed instructional expectations rather than experimentally established effects across all reviewed educational settings, particularly because feedback effectiveness remains influenced by disciplinary practices, learner characteristics, and institutional conditions (Wongvorachan et al., 2022). The synthesis therefore indicates that effective formative assessment requires the coordinated integration of feedback design, metacognitive monitoring, and motivational support, allowing students to progress from receiving evaluative information toward sustained engagement with academic improvement.

Academic Performance and the Design Conditions for Effective Feedback

The relationship between formative feedback and academic performance emerges from the reviewed evidence as conditional rather than automatic, indicating that the presence of feedback does not independently guarantee measurable improvements in student achievement. Academic outcomes depend partly on whether students interpret evaluative information accurately, remain engaged with learning activities, and apply corrective strategies to subsequent tasks. Research concerning technology-enhanced classrooms demonstrates the relevance of immediate feedback mechanisms for supporting situated learning activities and performance-related responses (Al Hakim et al., 2022). The educational significance of such feedback depends on the extent to which students can identify errors, understand the information provided, and modify their actions while learning opportunities remain available. Immediate feedback may consequently offer advantages when rapid correction is necessary, but its effectiveness cannot be separated from the structure and demands of the learning task. These considerations suggest that formative assessment should be evaluated through the relationship between feedback provision, learner participation, and subsequent academic performance rather than through the speed or frequency of feedback delivery alone.

Multimedia learning research further demonstrates that the format through which feedback is communicated can influence how students encounter and process evaluative information. Yorganci (2022) investigates interactive electronic books and video feedback within a multimedia learning environment, contributing evidence relevant to the relationship between feedback presentation and educational outcomes. Multimedia formats may provide opportunities to combine explanations, examples, visual representations, and task-related guidance in ways that support different forms of learner engagement. Nevertheless, these potential benefits depend on whether the selected format corresponds with the requirements of the academic task and assists students in understanding the standards against which performance is evaluated. Additional information or richer media presentation may increase the complexity of assessment experiences when students lack clear guidance concerning which elements require attention. Accordingly, the effectiveness of multimedia feedback should be considered in relation to instructional alignment, cognitive engagement, and opportunities for

meaningful revision rather than being attributed solely to the technological sophistication of the delivery medium.

Learner participation represents another important condition because educational resources and feedback opportunities cannot contribute fully to academic development when students do not engage with them meaningfully. Goode et al. (2022) examine online engagement within an immersive educational delivery model, offering evidence that patterns of student participation are relevant to understanding learning outcomes. Their findings are consistent with the broader proposition that access to learning activities and actual engagement should be distinguished when interpreting academic performance. In formative assessment environments, students may receive extensive feedback yet make limited use of it because of competing academic demands, insufficient clarity, or a lack of opportunities to implement recommendations. Measuring feedback effectiveness therefore requires attention to whether students access evaluative information, engage with its meaning, communicate about uncertainties, and undertake appropriate learning actions. These behavioral dimensions provide a more informative basis for interpreting achievement-related outcomes than indicators limited to the quantity of comments or the availability of digital learning resources.

Research on educational innovation and motivationally oriented technologies provides additional evidence that student engagement may contribute to academic achievement under particular instructional conditions. Amores-Valencia et al. (2022) review the relationship between motivation and academic performance in augmented reality education, while Daniel et al. (2024) examine blended innovative teaching and its association with achievement-related outcomes. Although these investigations do not exclusively address feedback literacy, they highlight the importance of instructional designs that connect learning activities with motivational participation and opportunities for meaningful cognitive engagement. Their relevance to formative assessment lies in the broader understanding that educational interventions should facilitate purposeful student activity rather than merely introduce new delivery formats or technological features. Feedback may contribute to such environments when it clarifies performance expectations, identifies specific learning needs, and supports students in deciding how to proceed with subsequent tasks. Nevertheless, differences among technologies, learning contexts, and outcome measures require caution when transferring findings from broader educational innovation research to claims concerning the direct effects of feedback literacy on academic achievement.

Digital educational games provide a related perspective by demonstrating how motivationally engaging learning environments may support participation and educational outcomes through structured interaction. Li et al. (2024) examine the influence of digital educational games on learning motivation, contributing evidence relevant to the role of motivational engagement in technology-supported educational activities. Game-based environments frequently organize learning around repeated attempts, task responses, progression indicators, and opportunities to reconsider earlier decisions. These features resemble formative assessment processes when students receive information concerning their performance and can apply that information during subsequent learning attempts. However, engaging repeatedly with an educational activity does not necessarily indicate that students have developed the evaluative judgment required to interpret complex feedback in other academic contexts. The implication is that motivational design should be integrated with activities requiring students to explain errors, evaluate alternative strategies, and demonstrate how assessment information informs changes in their learning approaches.

Gamified response systems offer another example of the relationship between immediate assessment information, student engagement, and performance-related learning activities. Rojabi et al. (2022) investigate the use of Kahoot in educational settings, providing evidence concerning students' experiences with a gamified learning platform. Such systems can facilitate rapid responses, repeated retrieval activities, and immediate information concerning answer accuracy, potentially supporting participation during classroom instruction. Nevertheless, students may successfully participate in competitive or game-based assessments without developing a comprehensive understanding of why particular responses satisfy disciplinary expectations. This distinction is important because feedback literacy requires more than the recognition of correct and incorrect answers; it also involves interpreting quality, evaluating performance, and determining appropriate subsequent actions. Gamified assessment can therefore contribute to formative learning when immediate response information is supplemented

by explanation, reflection, and opportunities to apply improved understanding beyond the original assessment activity.

Flipped-classroom approaches provide further insights into the importance of instructional sequencing when formative feedback is intended to contribute to academic performance. Xiao and Adnan (2022) examine a flipped anatomy classroom incorporating multimodal digital resources, illustrating the relevance of integrating preparatory learning materials with structured instructional activities. Within such arrangements, students may encounter foundational information before class and subsequently participate in activities requiring application, clarification, and evaluation. Feedback becomes particularly relevant when it helps students identify misunderstandings emerging from preparatory work and supports their correction during or after subsequent learning activities. The potential value of flipped learning for formative assessment therefore lies in the continuity among preparation, active task engagement, feedback interpretation, and opportunities for further application. This interpretation suggests that academic performance may be better supported when assessment information is embedded within a coherent instructional sequence rather than delivered as an isolated response after students have completed all relevant learning tasks.

Research on digital textbooks and interactive learning resources similarly highlights the importance of active student engagement in understanding educational outcomes. Lee et al. (2023) examine the effects of digital textbooks on academic performance, academic interest, and learning skills, providing evidence concerning the relationship between learning resources and student development. The relevance of this research to feedback literacy arises from the distinction between accessing educational information and using that information to regulate learning activities. Digital resources may provide extensive content and opportunities for interaction, but academic improvement depends on whether students can identify learning needs, evaluate their understanding, and select appropriate strategies for further study. Within a feedback-literate curriculum, educational resources should therefore support comparison, reflection, and purposeful learning decisions rather than function exclusively as repositories of instructional material. The broader implication is that the contribution of feedback to achievement should be examined alongside the quality of students' cognitive engagement with the resources and activities through which learning is organized.

The overall synthesis supports an explanatory model in which academic performance represents a relatively distal educational outcome emerging through several interconnected learner processes. These processes include understanding assessment standards, developing evaluative judgment, monitoring academic progress, maintaining motivational engagement, and demonstrating observable feedback uptake through revision or subsequent task application. Studies addressing technology-enhanced learning and learner engagement support the relevance of these intermediate activities, although their findings differ according to instructional settings, intervention characteristics, and outcome measures (Al Hakim et al., 2022; Goode et al., 2022). The reviewed evidence therefore does not justify a universal claim that increasing feedback quantity or introducing particular educational technologies necessarily improves academic achievement. Instead, it suggests that the educational contribution of formative assessment depends on whether feedback is incorporated into structured learning opportunities that encourage interpretation, decision making, and performance-related action. Accordingly, higher education institutions should evaluate formative assessment through both intermediate indicators of learning regulation and subsequent academic outcomes, while recognizing the need for stronger longitudinal evidence to determine how feedback literacy contributes to sustained educational development (Dada et al., 2023).

Table 3. Evidence-Informed Feedback Cycle for Higher Education

Stage	Student activity	Teacher/course design	Performance relevance
Clarify quality	Interpret standards	Use criteria and exemplars	Reduces ambiguity
Generate judgment	Self/peer assessment	Structure comparison	Builds evaluative judgment
Receive information	Interpret feedback	Make comments actionable	Identifies next steps

Act	Revise or apply	Require uptake	Converts feedback into learning
Review	Reflect on change	Trace feedback across tasks	Supports transfer

The feedback cycle presented in Table 3 illustrates the sequential learning activities through which formative assessment information may be transformed into meaningful academic development. Clarifying quality standards establishes an evaluative foundation that enables students to recognize expected performance characteristics, while self-assessment and peer assessment provide opportunities to develop independent judgments concerning the adequacy of their academic work (Yan & Carless, 2022). The interpretation of feedback subsequently requires students to identify relevant recommendations, evaluate their implications, and determine appropriate strategies for addressing performance discrepancies. Revision and subsequent task application represent particularly important stages because they provide observable opportunities to examine whether students have translated evaluative information into changes in learning behavior (Dawson et al., 2024). Reflective review extends the assessment process beyond immediate correction by encouraging students to identify recurring learning difficulties, evaluate the effectiveness of implemented strategies, and consider how acquired competencies may be transferred to subsequent academic activities. Although the proposed cycle synthesizes recurring principles from the reviewed literature rather than representing an independently tested intervention model, it provides a structured explanation of how feedback literacy, metacognitive regulation, and motivational engagement may collectively support academic performance within higher education assessment practices (Nieminen & Carless, 2022).

CONCLUSION

The review indicates that feedback literacy is the central mechanism connecting formative assessment with metacognitive awareness, motivation, and academic performance. The strongest evidence does not support a simple model in which more feedback produces better results. Productive feedback requires students to understand standards, make evaluative judgments, manage affect, select strategies, and act on information through revision or subsequent tasks. Measurement research has improved the field's ability to distinguish beliefs about feedback from observable feedback behaviour, while relational and ecological perspectives show that literacy is also shaped by curriculum structures and institutional conditions.

Higher education assessment should be designed as a sequence of learner actions rather than a one-way delivery of comments. Exemplars, self-assessment, peer dialogue, timely digital information, revision requirements, and reflective tracing can strengthen the metacognitive and motivational processes that make feedback formative. Future research should connect behavioural measures of feedback uptake with longitudinal academic outcomes across disciplines and test whether course-level feedback designs reduce inequalities in who can interpret and use assessment information.

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